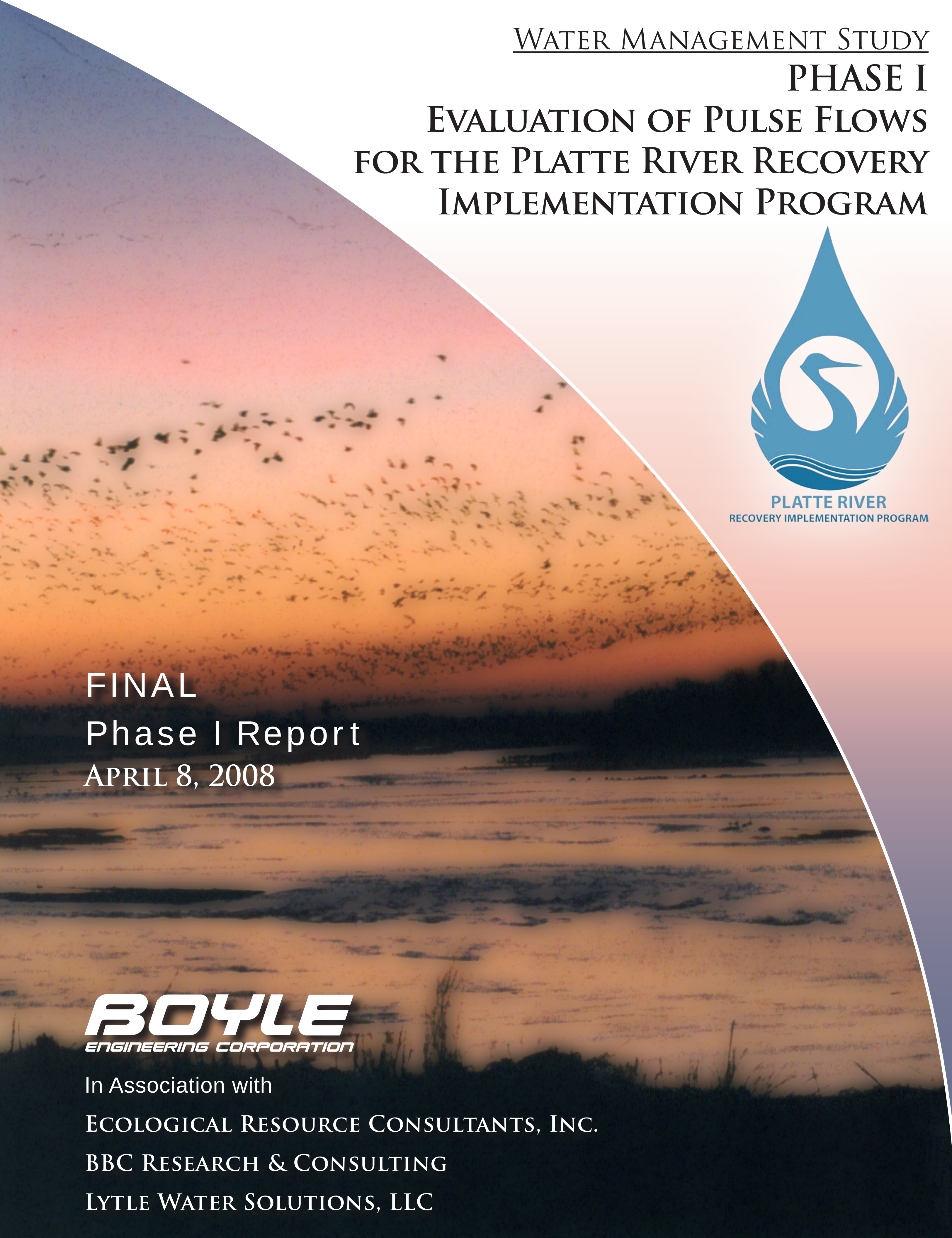

WATER MANAGEMENT STUDY

PHASE I

EVALUATION OF PULSE FLOWS FOR THE PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

FINAL

Phase I Report

APRIL 8, 2008

BOYLE
ENGINEERING CORPORATION

In Association with

ECOLOGICAL RESOURCE CONSULTANTS, INC.

BBC RESEARCH & CONSULTING

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1.0 INTRODUCTION AND PURPOSE

Phase I of the Water Management Study (WMS) for the Platte River Recovery Implementation Program (PRRIP or Program) evaluates the ability of the Program to achieve pulse flows of Program water during the low demand period on the Platte River in central Nebraska. Phase I also evaluates the potential to provide a maintenance flow to the same geographic area during the summer irrigation months. This report presents the results of this Phase I evaluation. The study will be used by the Governance Committee of the PRRIP to meet certain Program water supply objectives, including the determination of water delivery timing and quantities, and additional water supply and conservation project needs.

Figure 1-1 entitled, "Study Area and Locations" illustrates key locations on the Platte River in central Nebraska which are referenced in this report. Figure 1-1 is located at the end of the main report section.

The Phase I study objective, as defined in the Request for Proposals (RFP) included as Appendix 4, is to evaluate the feasibility of meeting the following water supply goals by December 31, 2011:

1. Provide 5,000 cubic feet per second (cfs) of Program water for three days to the Overton gage on the Platte River in central Nebraska for pulse flows when other demands that may be competing for river channel and irrigation system capacity are low (normally September 1 through May 31). Assuming this water-delivery availability, Program water may be used to supplement existing flows to achieve pulse flows in excess of 6,000 cfs two out of three years. If these flows are achieved by existing flows (without Program water), the deliveries of Program water would not be necessary.

2. Identify feasible measures and quantify the Program water necessary to ensure a yield of 800 cfs of Program water at the Overton gage during the irrigation season (May 1 through September 30). The USFWS indicated that the intent of the 800 cfs flow is augment flows from May 11 to September 15 as outlined in the

Instream Flow Recommendations Document (see FWS Meeting Notes in Appendix 1).

In addition to the objectives identified in the Problem Statement of the RFP presented above, the following objectives were also identified in the RFP and elaborated on during discussions with Program participants.

3. Evaluate how the 13 alternatives in the Program Final Environmental Impact Statement (FEIS) (USDOI, 2006) may contribute to the 5,000 and 800 cfs flows, as opposed to the average annual reduction determined in prior studies.

4. Provide initially required modeling tools and initial characterization of the projects to guide further assessments in Phase II of the study.

The 5,000 cfs pulse flow and 800 cfs irrigation season flow targets represent Program water only. These target flows are in addition to other flows that may be in the river including natural flows or other managed water. The evaluation of providing these targets of Program water was specifically stated in the RFP as the objective of the WMS and stated in the RFP.

As stated above, the location for evaluating the flow objectives in the WMS is the Overton, NE gage in contrast to the use of the Grand Island gage in evaluating target flows in other Program work. The Overton location is representative of the upstream end of the critical habitat and was identified in the FEIS as the basis for the pulse flow. The pulse flow recommendations were developed based on target flows at Overton that were anticipated to meet goals for channel restoration and improving habitat within the critical reach. In addition, evaluation at this location recognizes the proximity of the Overton gage just downstream of the J-2 Return which is a key delivery point evaluated in the pulse flow analysis.

The objective of Phase II is to evaluate additional potential alternatives and combinations of alternatives for meeting the target flows of 5,000 cfs and 800 cfs of Program water (6,000 cfs total flow in two of three years). The evaluation will include revisions to these alternatives if necessary and updated operational scenarios as identified in the Phase I participant interviews.

The development of the Program was authorized with the signing of the Cooperative Agreement on July 1, 1997. The Governance Committee's Alternative was selected as the Preferred Alternative for meeting the goals of the Program when the Record of Decision was signed on September 27, 2006 by the Secretary of the Interior. The Program Agreement was subsequently signed by the governors of Nebraska, Wyoming, and Colorado and the Secretary of the Interior.

The Program was initiated on January 1, 2007 between Nebraska, Wyoming, and Colorado and the Department of the Interior (DOI) (the parties) to address issues related to certain threatened and endangered species that have habitat in the Platte River Basin. The target species are the whooping crane, piping plover, interior least tern, and pallid sturgeon.

2.0 GUIDANCE OF PROGRAM PARTICIPANTS

The Program Document Water Plan defines the Program's water management process, describes the initial projects to be implemented to meet Program water supply objectives, and identifies additional projects to be considered in the Program's first increment. The focus of this study is to quantify how these projects are able to reduce shortages to the target flows at Overton and to assist the Governance Committee in the selection of projects capable of meeting the Program's water supply goals. The Program Document Water Plan (PRRIP, 2006) and the FEIS provided the basis for the analysis.

Boyle reviewed the Program Document Water Plan as well as additional documentation, including the Water Conservation/Supply Reconnaissance Study (Boyle, 1999) and the FEIS (USDOI 2006).

In addition to a review of the literature, meetings, or interviews, were held with representatives of several of the Program participants to discuss the intent of the WMS and to provide information on key aspects of the project. These Program representatives shared a wealth of knowledge on the Platte River system, the importance of the routing studies and how identified projects would work today and in the future. A total of 9 meetings were held with 8 agencies during the initial stages of the study. Table 2-1 entitled, "Interview Participants" presents a summary of these contributors and the highlighted topics of discussion.

Table 2-1
Interview Participants

Interview	Primary Topics
Mark Butler and Don Anderson U.S. Fish and Wildlife Service	Yield of water supply projects, Environmental Account Management, Ramping rates for water deliveries
Jeff Runge U.S. Fish and Wildlife Service	Associated costs related to Program water delivery, sensitivity of ramping rates
Don Kraus, Mike Drain, and Cory Steinke CNPPID	District's system, Environmental Account in Lake McConaughy, potential solutions, travel times and losses
Brian Barels NPPD	District's system, including physical constraints and potential liabilities
Jon Altenhofen Northern Colorado Water Conservation District	Tamarack Projects, South Platte River
Mike Purcell State of Wyoming	WMS Objectives, Pathfinder Modification Project, Wyoming Projects
John Lawson, Lyle Myler USBR	Pathfinder Modification Project, Wyoming deliveries
Ann Bleed Nebraska Department of Natural Resources	Conveyance losses, Nebraska water administration
Duane Woodward Central Platte Natural Resources District	Central Platte hydrology

A summary of the discussion was prepared following each interview. These summaries were provided to the participant for review and comment. These interviews and summaries acted as a basis for the development of the tools and analysis in Phase I and phase II of the WMS. These summaries are provided in Appendix 1.

The interviews were beneficial in helping to frame the main issues related to the Program's goal of providing the target flows to the critical habitat. These main points include:

- The primary objective of the WMS is to characterize to what extent releases from Lake McConaughy or other supplies will reach the critical habitat and the total volume necessary. This goal focuses much of the analysis on moving water through the Platte River system, NPPD's system, and CNPPID's system given many physical and administrative constraints. In addition to applying these limitations and constraints to the routing of flows, this study provides a basis for a critical analysis of which of these constraints is limiting, and to what extent modifications or relaxations are possible.

- Another issue related to the framework of the tools developed as a part of this study is how Program water will be administered by the State of Nebraska. Program water is administered separate from natural flows, similar to other storage releases. This water is charged a pro-rata amount for river losses, but in the case of a gain in the river, it does not accrue gains. Program water run through the NPPD and CNPPID (the Districts) systems is administered the same losses as if it were to remain in the river. Similar to this administration, the travel times are assumed to be equivalent to travel times in the river.
- Since the development of the Water Conservation/Supply Reconnaissance Study, the Reconnaissance Water Action Plan, and the FEIS, the Platte River has seen significant changes in hydrology and flows. The recent dry years coupled with the spread of phragmites has changed the regime of the river. These changes reemphasize the need to consider how Program water can be used to benefit the critical habitat and target species.
- These meetings and future meetings with Program participants are valuable in framing the operations and benefits of the current alternatives identified in the Water Action Plan and additional alternatives to be considered in Phase II to aid in providing the target flows of 5,000 cfs and 800 cfs of Program water.

3.0 EVALUATION OF PROGRAM FLOW TARGETS

3.1 Program Water

A long-term objective of the Program is to reduce shortages to specified target flows by an average of 130,000-150,000 acre-feet (ac-ft) per year in the Platte River in central Nebraska (Platte River valley area from Lexington to Chapman, Nebraska). The following list describes three initial Program projects and a reference to the description of the respective projects that can be found in the Program Document Water Plan:

a. Nebraska's Environmental Account in Lake McConaughy (NEA) (Attachment 5, Section 5)

b. Wyoming's Pathfinder Modification Project (PMP) (Attachment 5, Section 4)

c. Colorado's Initial Water Project (Tamarack I) (Attachment 5, Section 3)

Table 3-1 entitled, "Average Yields", depicts estimated quantities of Program water that will be available in Average, Wet, and Dry years. The following yields are based on model runs used in the FEIS for the Program for the 1947 through 1994 hydrologic period. The yields of the NEA and PMP are achieved in Lake McConaughy. The Tamarack I contributions represent an average annual volume as presented in Attachment 5, Section 3 of the Program Document. The yields of Tamarack I are based on increased flows below the Western Canal in Nebraska.

Table 3-1
Average Yields
(ac-ft x 1,000)

	Avg. Annual		Avg. Annual and Max. Monthly
Project	**NEA**	**PMP**	**Tamarack I**
Wet year (25%)	74.8	29.5	12.3 Avg. Annual 1.9 Max. Mo.
Average year (50%)	56.9	22.7	
Dry Year (25%)	48.5	10.2	

The above three projects will be credited with producing an average of 80,000 ac-ft per year toward the objective of reducing average annual shortages to species and pulse flows by 130,000 to 150,000 ac-ft per year (USDOI, 2006). It is envisioned that the remaining 50,000-70,000 ac-ft of water per year, on average, will be obtained from an alternative(s) selected from those identified in the Program Document Water Plan (Attachment 5, Section 6).

3.2 River Channel, NPPD, and CNPPID System Capacity

The maximum channel capacities for the reaches of the North Platte, South Platte, and Platte Rivers used to convey Program water is based on discharge rates at flood stage determined by the National Weather Service, with one notable exception. The flood stage discharge of the North Platte River, north of the city of North Platte, Nebraska and approximately two miles upstream of the intersection of the North Platte River and Highway 83 will be assumed to be 3,000 cfs. Channel improvements currently under study are anticipated to increase the capacity to 3,000 cfs (currently the flood capacity is approximately 1,600 cfs). This location on the North Platte River is often referred to as the "Choke Point" and is done so in this report.

Action stage flood charts were obtained from the National Weather Service (NOAA, 2007) for the following forecast points in the North Platte Hydrologic Service Area:

- South Platte at Julesburg, CO
- South Platte at Roscoe, NE

- South Platte at North Platte, NE
- North Platte at Casper, WY
- North Platte at Glenrock, WY
- North Platte at Orin, WY
- North Platte at Henry, NE
- North Platte at Mitchell, NE
- North Platte near Minatare, NE
- North Platte at Bridgeport, NE
- North Platte at Lisco, NE
- North Platte at Lewellen, NE
- North Platte at North Platte, NE
- Platte River at Brady, NE
- Platte River near Cozad, NE
- Platte River near Overton, NE

The action stage is when a river is three quarters bank full. Calculated rating tables for specific river gage sites are used to determine flows for minor, moderate, and major flood stages. The flood stage value cited on the NWS charts correlated directly with a flow value for the majority of the gages. Flood flows corresponding to the NWS flood stages were not available as direct take-offs from the NWS charts for the Cozad, Lewellen, Brady and North Platte at North Platte gages. These gages required use of the rating table and flow equations defined by the Nebraska DNR to calculate the corresponding flow for flood stage. The rating tables were provided by the Nebraska Department of Natural Resources (DNR). The estimated flood flows are presented in Table 3-2 entitled, “Estimated Flow at NWS Flood Stage for Platte River Reaches”.

The Central Nebraska Public Power and Irrigation District (CNPPID) and Nebraska Public Power District (NPPD) divert available flows up to the diversion capacity throughout the year, including Program water. Program water may also be intentionally re-regulated within the Districts' systems and/or Program water may be intentionally bypassed to the river under specific conditions described in the Program Document Water Plan (Attachment 5, Section 1), and current and future agreement(s) with the Districts.

The following are the known limitations and capacities, as presented in the WMS Request for Proposals (RFP), within the Districts' systems and the North Platte River below Lake McConaughy that affect the delivery of Program water. These limitations and capacities were confirmed during discussions with NPPD and CNPPID staff. The capacities discussed below are also presented in Table 3-3 entitled, "Table of System Capacities", and annotated on Figure 1-1.

Table 3-2

Estimated Flow at NWS Flood Stage for Platte River Reaches

Location	Unit	Flow
North Platte River at Casper, WY	CFS	12,000
North Platte River at Glenrock WY	CFS	19,500
North Platte River at Orin, WY	CFS	8,630
North Platte River at Henry, NE	CFS	6,400
North Platte River near Mitchell, NE	CFS	4,620
North Platte River near Minatare, NE	CFS	3,530
North Platte River at Bridgeport, NE	CFS	15,200
North Platte River at Lisco, NE	CFS	5,500
North Platte River at Lewellen, NE*	CFS	4,795
North Platte River at North Platte, NE**	CFS	3,000
South Platte River at Julesburg, CO	CFS	8,240
South Platte River at Roscoe, NE	CFS	9,970
South Platte River at North Platte, NE	CFS	18,700
Platte River at Brady, NE*	CFS	15,846
Platte River at Cozad, NE*	CFS	5,845
Platte River at Overton, NE	CFS	7,430

* Flood flow calculated based on NWS Flood Stage and best available rating curve data.

** Capacity estimated based on anticipated channel improvements to North Platte “choke point”

3.2.1 North Platte River Channel Limitations and Capacities below Keystone Diversion Dam

- North Platte River Channel below Keystone Diversion Dam
  - The initial ramp-up rate will be 300 cfs/day with no ramp down-rate limits (all seasons).
  - Flows in the North Platte River at North Platte, Nebraska must not exceed flood stage as defined by the National Weather Service. Current flood stage is estimated to be approximately 1,600 cfs. However, it is assumed to be 3,000 cfs due to planned Program improvements to the channel in the area.

3.2.2 CNPPID System Limitations and Capacities

- Central Diversion Dam at North Platte
  - The maximum diversion is 2,250 cfs all year (barring icing conditions or hydro/system malfunctions).
  - There are presently no specified maximum ramp-up/down rates.
  - A full diversion is generally possible all year long and is likely to occur in wet years.
  - In average and dry years, the maximum diversion is being used for irrigation from July 1 to September 15.
  - Diversion of the District's water reduces the available capacity for Program water. Program water in excess of available capacity must flow down the river.
  - The capacity available for Program water in mid-March is reduced by 300 cfs, typically for Elwood Reservoir filling. This limitation is applied to the total diversion limit in the tools developed for the WMS.

- Jeffrey Return
  - The maximum return is 1,250 cfs.
  - Capacity for Program water is limited during the irrigation season when the return is being used for NPPD irrigation flows.
  - Use of the Jeffrey Return may be limited during the dry years from August through September due to CNPPID water conservation practices. This limitation is interpreted as a potential operating constraint and therefore not yet included in the tools developed for this study.
  - Use of this return diminishes the flow continuing to Johnson Reservoir and could therefore reduce the capacity for regulation of Program water in Johnson Reservoir and/or the amount of water that can be released through the J-2 return.
- J-2 Return
  - The maximum return is 2,000 cfs.
  - The capacity for return flows will decline from 2,000 cfs in mid April when irrigation deliveries begin. In dry years (when irrigation deliveries are reduced), available return flow capacity may be as high as approximately 800 cfs from July 1 to September 15. In some years, there may be no return flow capacity available.

3.2.3 NPPD System Limitations and Capacities

- Keystone Diversion
  - The maximum capacity of the diversion is 1,750 cfs all year barring icing conditions, summer weed growth, system maintenance and unplanned malfunctions.

- The ramp-up/down rate is 100 cfs/day all year, barring icing conditions and summer weed growth and system malfunctions. This ramp rate limitation is intended to avoid canal system damage that could result in a loss of the cooling water supply to Gerald Gentlemen power plant.
- The entire capacity is typically required for irrigation from July 1 to September 15.

- Korty Diversion
  - The maximum capacity of the diversion is 850 cfs all year, barring icing conditions, summer weed growth and system malfunctions.
- Total NPPD Diversion
  - The total diversion to NPPD can be no more than 1,900 cfs below the confluence of the Keystone and Korty Diversions all year, barring icing conditions, summer weed growth and system malfunctions.
- NPPD North Platte Hydro
  - The maximum capacity is 1,750 cfs. As the hydro discharge rate increases to the maximum, a reduction in the storage level in Lake Maloney is required due to the fact that the system has no by-pass potential at the North Platte Hydro. When the outlet canal is flowing at a high rate, additional space is necessary in Lake Maloney to allow for the storage of the additional flow. The maximum hydro discharge rate may also decrease as the storage level in Lake Maloney is reduced, assuming inadequate replacement inflows in the Sutherland Outlet Canal.
  - The ramp-up rate is 200 cfs per day and there is no maximum ramp-down rate, as long as adequate storage space exists in Sutherland and Maloney Reservoirs for flows in the canals.

3.2.4 Reregulation within the District's System

For the basis of this study, it is assumed there will be the opportunity to use a maximum of 4,000 ac-ft of the capacity in Johnson Lake within the CNPPID system as re-regulation space for Program water in February, March, and April. Re-regulation in the District's system is described in and subject to the EA Bypass Agreement of Attachment 5, Section 1 of the Program Document Water Plan.

3.2.5 Limitations in Capacities and Operational Flexibilities

System limitations and capacities will play a crucial role in the ability to move Program water downstream to the critical habitat and will also impact the required volume of water. Some of these limitations such as the channel capacities and diversion capacities are physical constraints. To modify these constraints would require design and construction activities similar to the modification of the North Platte "choke point". Other limitations such as ramping rates appear to be more institutional in nature, though founded on the basis of potential physical impacts and costs if violated. Examples of these limitations include the ramp up limitation on the North Platte River in order to limit damage to diversion structures and to limit debris mobilization, and the limit on ramping in the Sutherland Canal to avoid canal wall breaching, reservoir bank sloughing, and ultimately disruptions to deliveries for irrigation and power supplies. To the extent that these limitations can be adjusted or mitigated by the Program is a potential benefit to reducing the total volume of water required to achieve the flow targets considered in this WMS. The costs of making these adjustments will need to be compared to the cost to the Program in terms of water and other liabilities. The tools developed in this study have been designed to facilitate the evaluation of the sensitivity of achieving the target flows based on these capacities and limitations.

Table 3-3
Table of System Capacities

Location	Unit	Capacity
NPPD Keystone Diversion	CFS	1,750
NPPD Keystone Diversion ramp up/down	CFS/D	100
North Platte River at North Platte, NE below Keystone ramp up	CFS/D	300
North Platte River at North Platte, NE	CFS	3,000
NPPD Korty Diversion	CFS	850
NPPD Combined Diversion	CFS	1,900
NPPD North Platte Hydro return	CFS	1,750
NPPD North Platte Hydro ramp up	CFS/D	200
CNPPID Diversion	CFS	2,250
CNPPID Diversion, mid-March	CFS	1,950
CNPPID Jeffrey Return	CFS	1,250
CNPPID Johnson Lake Reregulation	AC-FT	4,000
CNPPID J-2 Return	CFS	2,000
CNPPID J-2 Return – Dry Year Irrigation Season	CFS	800

3.3 Hydrologic Data Analysis

Flow data was obtained for the analysis of remaining capacity and routing Program water through the Platte River system. Data was obtained for the Platte River (North, South, and Central) and major canals from the USGS, Nebraska Department of Natural Resources, USBR, Colorado Division of Water Resources, NPPD, CNPPID, and Northern Colorado Water Conservancy District. Daily and monthly data were obtained for the study period 1947 – 2006.

Classification of water years (October to September) for the WMS into Average, Wet, and Dry conditions is based on the average annual flow at the Overton, Nebraska gage. The classification of years is done to facilitate the presentation and interpretation of hydrologic conditions and resulting analysis. The WMS study period is water year 1947 through water year 2006. These years are classified as Wet (25% wettest years), Dry (25% driest years), and Average (remaining years). The 60 year period results in 30 Average, 15 Wet, and 15 Dry years. This methodology for classifying hydrologic conditions for use in the WMS was determined by the Program participants and outlined in the RFP. The hydrologic period of record for the Water Action Plan and the FEIS ended in 1994. Inclusion of the years 1995-2006 in the WMS add five of the seven lowest flow years in the 60-year study period. Figure 3-1 entitled "Classification of Water Years Based on Average Annual Flow at Overton (1947-2006)" presents the classification graphically for the average annual flows at the Overton gage. Table 3-4 entitled "Classification of Water Years Based on Average Annual Flow at Overton (1947-2006) details the classification and the associated average annual flow at Overton.

Figure 3-1
Classification of Water Years Based on
Average Annual Flow at Overton (1947-2006)

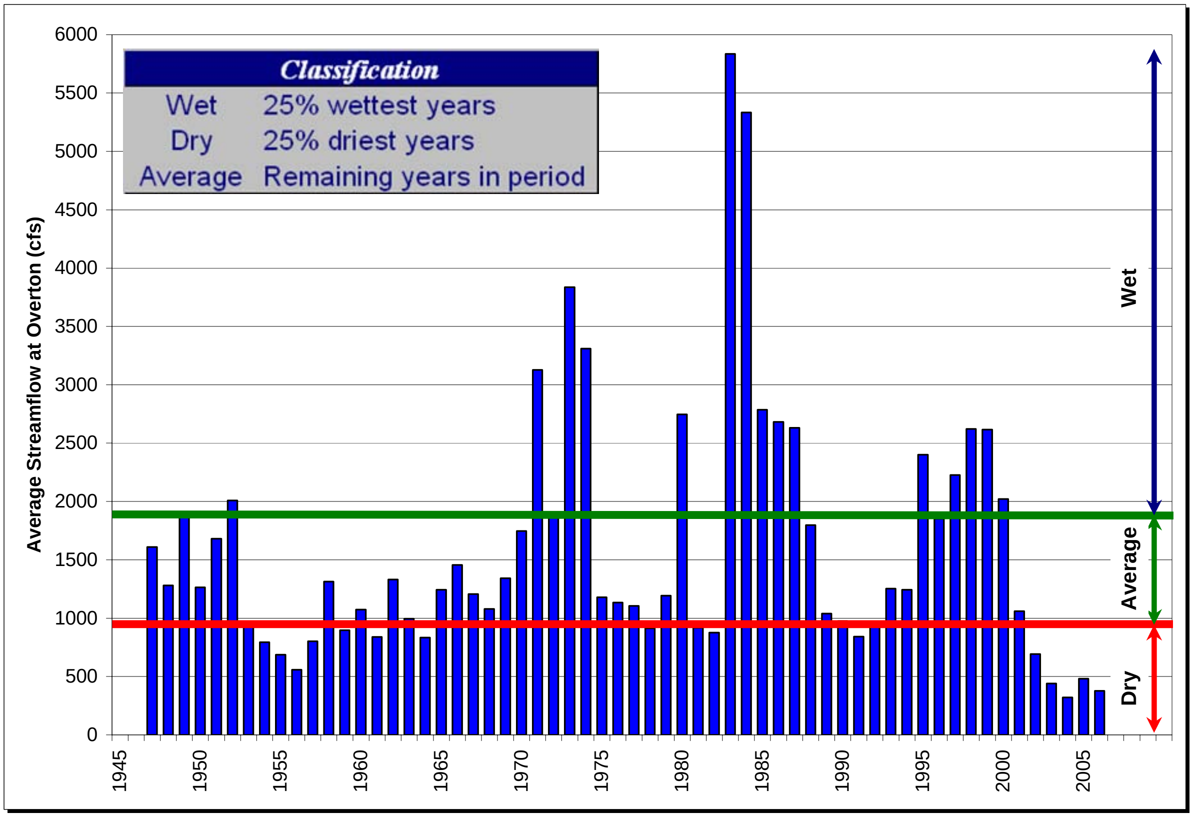


Table 3-4
Classification of Water Years Based on Average Annual Flow at Overton (1947-2006)

Water Year	Average Flow at Overton (CFS)	Classification		Water Year	Average Flow at Overton (CFS)	Classification
1947	1609	Average		1977	1104	Average
1948	1280	Average		1978	912	Dry
1949	1891	Average		1979	1193	Average
1950	1263	Average		1980	2746	Wet
1951	1680	Average		1981	918	Average
1952	2007	Wet		1982	876	Dry
1953	956	Average		1983	5835	Wet
1954	793	Dry		1984	5334	Wet
1955	687	Dry		1985	2787	Wet
1956	558	Dry		1986	2682	Wet
1957	802	Dry		1987	2631	Wet
1958	1313	Average		1988	1797	Average
1959	896	Dry		1989	1039	Average
1960	1074	Average		1990	975	Average
1961	838	Dry		1991	842	Dry
1962	1330	Average		1992	951	Average
1963	996	Average		1993	1253	Average
1964	832	Dry		1994	1243	Average
1965	1243	Average		1995	2400	Wet
1966	1456	Average		1996	1852	Average
1967	1206	Average		1997	2227	Wet
1968	1079	Average		1998	2622	Wet
1969	1342	Average		1999	2617	Wet
1970	1747	Average		2000	2020	Wet
1971	3127	Wet		2001	1059	Average
1972	1867	Average		2002	692	Dry
1973	3837	Wet		2003	440	Dry
1974	3310	Wet		2004	321	Dry
1975	1178	Average		2005	481	Dry
1976	1133	Average		2006	376	Dry

3.4 Update of WMC Loss Model Spreadsheet

The original Water Management Committee (WMC) water budget spreadsheet model (loss model) spanned 20 water years from 1975 through 1994. The loss model was expanded to include hydrology for water years 1995 through 2006 to provide a comprehensive analysis by including the driest drought years of 2002 through 2006. A technical memorandum is included in Appendix 2, providing a detailed explanation of modifications and assumptions made.

3.5 Travel Times and Daily Losses

The geographic separation of Lake McConaughy and Overton, Nebraska, the natural and constructed environment, and variability in hydrology all contribute to the complexity of estimating the timing and magnitude of a timed release of Program water necessary to meet target flows downstream at the Critical Habitat. These complexities are approximated with the use of travel times and loss factors incorporated into spreadsheet calculations. Empirical estimates for these variables were derived based on analysis of daily streamflow and diversion data for specific river reaches and information gathered from the participant interviews.

3.5.1 Estimation of Travel Times

Travel times were estimated for the river and canal systems from Lake McConaughy on the North Platte River and the Roscoe gage on the South Platte River, downstream to the Overton gage on the Platte River. Intermediate locations include North Platte, NE (the confluence) and the Brady gage. These intermediate locations were chosen based on the location of stream gages, and relative proximity to the Districts' diversions and returns. The confluence of the North and South Platte Rivers, the North Platte Hydro Return, and the CNPPID diversion are grouped together for purposes of estimating travel time. Travel times were rounded to daily increments due to the daily time step of the routing tool. Based on discussions with the Districts' staff, travel times for the canals are estimated to be the same as travel time in the coincident river reach.

Travel time from the Keystone gage to North Platte is estimated to be 2 days. This estimate is based on discussions with CNPPID and is supported by empirical evidence in the stream gage data. Similarly, the travel time from the Roscoe gage on the South Platte to the gage at North Platte is estimated to be 2 days based on stream gage data. Travel time from North Platte (the confluence) to Brady on the Platte River is estimated to be about 1 day. The actual travel time may be shorter than 1 day; however, the 1 day timestep and the proximity of the Jeffrey Return to Brady support this approximation. The next downstream reach terminates at the J-2 Return and the Overton gage. These two locations are also grouped based on their proximity to each other. The travel time for this reach is estimated to be 1 day. The total travel time from Lake McConaughy/Roscoe downstream to Overton is thus approximated to be 4 days. Table 3-5 entitled "Travel Times on the Platte River – Keystone to Overton", summarizes the travel times incorporated in this study.

Table 3-5
Travel Times on the Platte River – Keystone to Overton

Reach	Upstream Location	Downstream Location	Approx. River Miles	Travel Time
South Platte River – Roscoe to North Platte	Roscoe, Nebraska	North Platte, North Platte Hydro, and CNPPID Diversion	50	2 Days
North Platte River – Keystone to North Platte	Lake McConaughy	North Platte, North Platte Hydro, and CNPPID Diversion	60	2 Days
Platte River – Confluence to Brady	North Platte, North Platte Hydro, and CNPPID Diversion	Brady, Nebraska and Jeffrey Return	20	1 Day
Platte River – Brady to Overton	Brady, Nebraska and Jeffrey Return	J-2 Return and Overton, Nebraska	50	1 Day

3.5.2 Estimation of River Losses

Daily river losses were developed on a seasonal basis for each of the four river reaches included in the routing tool. The seasonal variation was limited to winter (October - April) and summer (May - September) periods. Loss factors were evaluated for both winter and summer values for each of the water year classifications. The analysis resulted in a single loss factor for winter months for each classification and three loss factors for the summer months corresponding to the year classification.

The term "loss" in the daily analysis is used as a general term to represent a combination of effects on river flows as they move downstream including attenuation, in-channel storage, bank storage, evaporation, or other losses (phreatophytes, irrigation diversions, pumping for irrigation and municipal uses, and unrecorded diversions).

Loss factors were developed based on an empirical analysis of historic daily flows at the upstream gage and naturalized flows at the downstream gage of each reach. The naturalized flows were estimated for the 60 year period utilizing the available daily data for the river gage, measured diversions, and measured returns to the river. Major diversions occurring in the reach were added back to the downstream gage and major returns were subtracted from the downstream gage to remove these influences from the gage. For reaches and periods that appeared to be gaining at the downstream gage, the baseflow portion of flow was subtracted from the gage. The baseflow was estimated for individual events using a straight line method. Baseflow estimates varied for each location, event, or season evaluated. The naturalization calculation is represented by the following equation:

Naturalized Flow = Downstream Gage + Diversions – Returns – Baseflow

Table 3-6 entitled, "Diversions and Returns Included in Daily Loss Estimates" lists the diversions and returns (inflows) included in the naturalized flow calculation for each river reach evaluated.

Table 3-6
Diversions and Returns Included in Daily Loss Estimates

Reach	Diversions	Returns
South Platte River – Roscoe to North Platte	Korty Diversion	N/A
North Platte River – Keystone to North Platte	Keith-Lincoln North Platte Paxton-Hershey Suburban Cody-Dillon	N/A
Platte River – Confluence to Brady	CNPPID	Birdwood Creek (est) (North Hydro Return included in estimate of flow at confluence)
Platte River – Brady to Overton	Thirty Mile Gothenburg Six Mile Cozad Orchard-Alfalfa Dawson County	Jeffrey Return J-2 Return

Using naturalized flows, a downstream flow was estimated based on the upstream flow. This estimated flow was compared graphically with the naturalized flow. This technique was applied to several isolated events in the hydrologic record where identifiable. Isolated events were utilized for two reasons: 1) by evaluating a single event, the influence of other unknown events or operations is minimized; 2) a single large event provides an estimate similar to that resulting from a pulse flow such as the intent of this study. Where isolated events on the order of days were not possible to identify, longer duration periods were evaluated in the same manner. Because no two events or hydrologic periods will result in the same loss estimate, empirical values were derived by inspection of the hydrographs and combined into a single representative value for each reach, year classification and season. Figures 3-2 through 3-5 illustrate example hydrographs used in the estimation of the loss factors for each of the four reaches, South Platte River from

Roscoe to North Platte, North Platte River from Keystone to North Platte, Platte River from the confluence to Brady, and Platte River from Brady to Overton. These graphs show the recorded upstream flow, recorded downstream flow, calculated naturalized flow at the downstream gage, and the estimated downstream flow. The estimated downstream flow is calculated by applying the loss factor for that event or period to the upstream recorded flow. The estimated loss factor for a given event, or period, is derived iteratively by inspection of how well the estimated flow hydrograph matches the naturalized flow hydrograph. This process was performed for several events over each reach and the resulting estimated factors combined to a representative factor.

The estimated loss factors for the summer months vary based on year classification. In the case of winter months, little variability was seen across year classification, and therefore a single winter loss factor is used. Table 3-7 entitled, “Daily Loss Factor Estimates” summarizes the loss terms by season and water year classification.

Figure 3-2
South Platte River Loss Estimate – Roscoe to North Platte

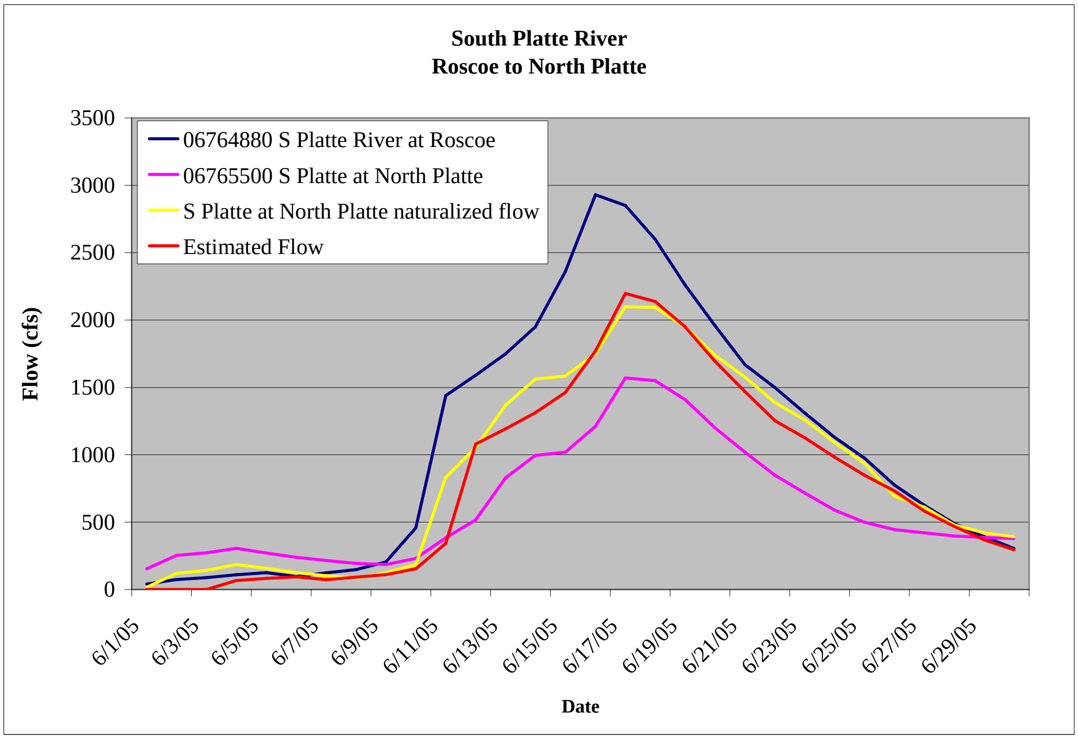


Figure 3-3
North Platte River Loss Estimate – Keystone to North Platte

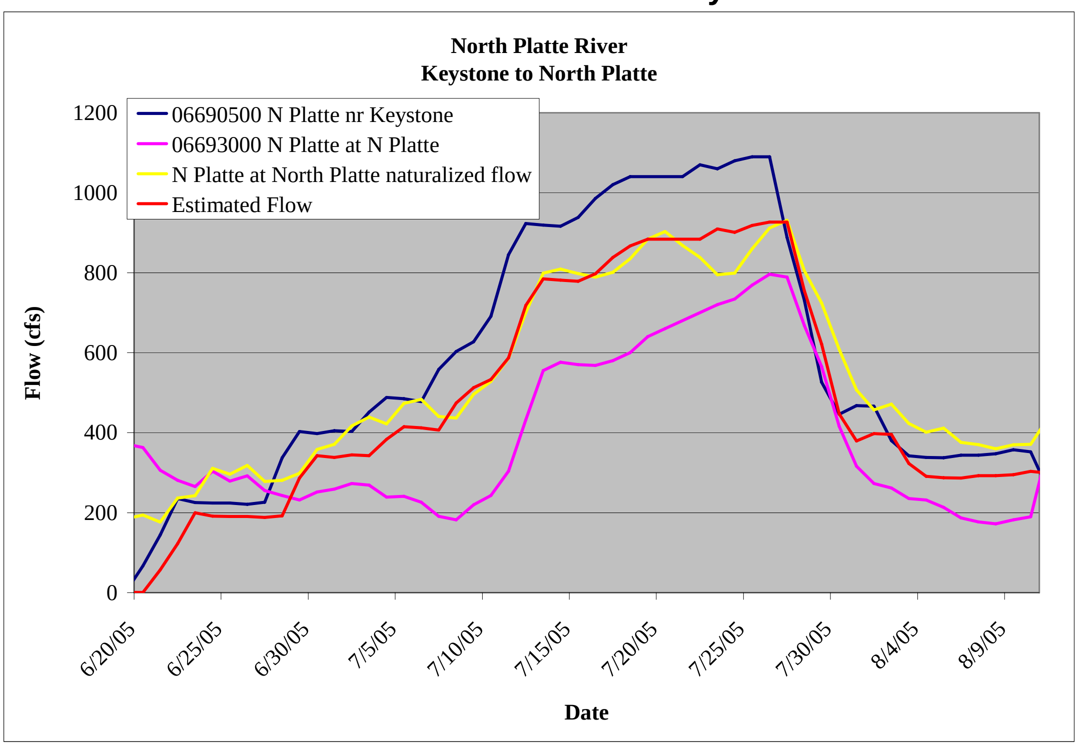


Figure 3-4
Platte River Loss Estimate – Confluence to Brady

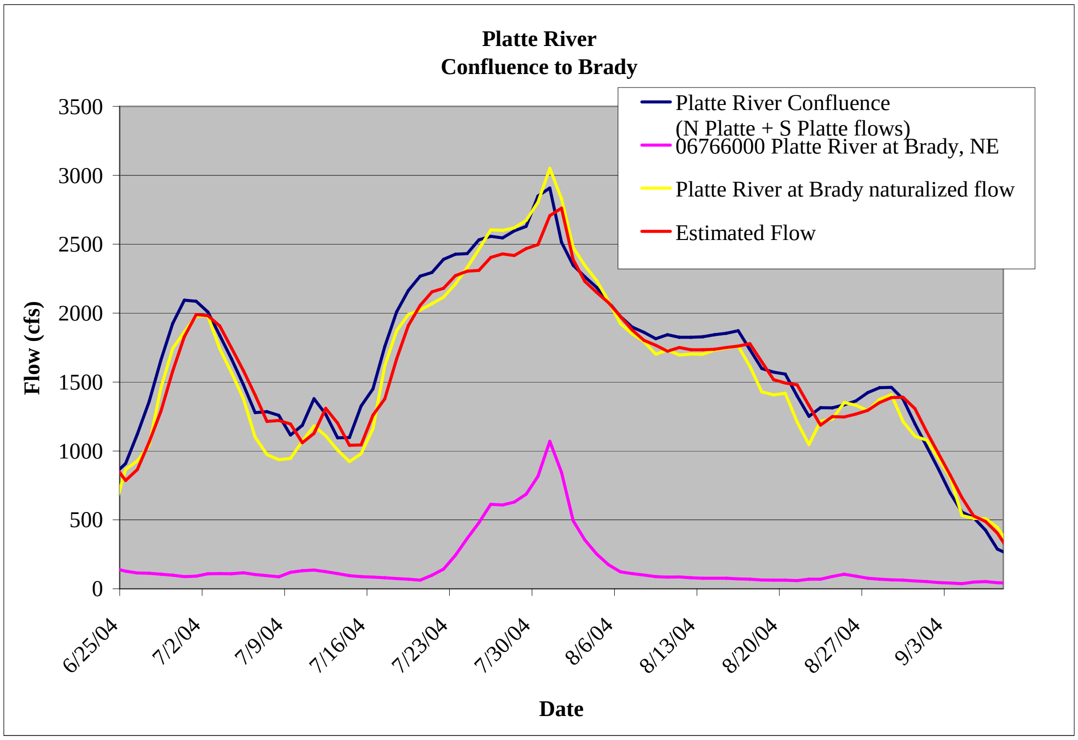


Figure 3-5
Platte River Loss Estimate – Brady to Overton

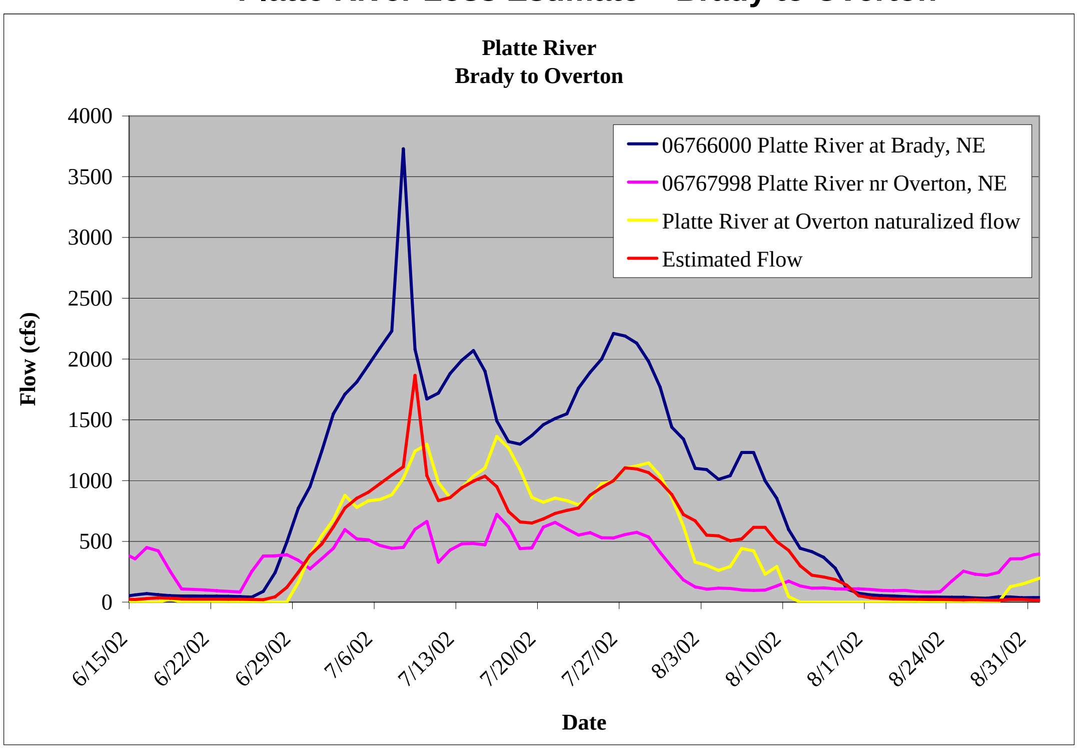


Table 3-7
Daily Loss Factor Estimates

Reach	Winter	Summer		
	All years	Avg. years	Wet years	Dry years
South Platte River – Roscoe to North Platte	5%	20%	10%	35%
North Platte River – Keystone to North Platte	5%	15%	15%	15%
Platte River – Confluence to Brady	5%	5%	5%	5%
Platte River – Brady to Overton	5%	13%	13%	50%

3.6 Available Capacities for Program Water

The available capacity at critical points within the Districts' systems and within the river channels for delivery of Program water was estimated for Average, Wet, and Dry year classifications. Limitations related to delivery of Program water were identified during the execution of the routing study as described in the following sections.

The amount of water that can be delivered to the critical habitat is subject to the capacities in the river and also the Districts' systems when the water is not bypassed. Information was compiled to estimate the capacity available at critical points in the river and within the Districts' systems for Program water. Capacities and constraining points along the Platte River were estimated with information provided by the National Weather Service, included in the WMS RFP, and provided by the Program participants during the interviews.

The available capacities in the river and systems were quantified for Average, Wet, and Dry year classifications for river reaches of interest. Available channel capacities for Program water were computed by comparing physical capacities in selected river reaches to streamflow records. Available river channel capacities were evaluated for the South Platte River at Roscoe, South Platte River at North Platte, North Platte

River at North Platte, Platte River at Brady, Platte River near Cozad, and Platte River near Overton gages. Capacities were computed on a daily basis using daily flow records, then summarized on a monthly basis and expressed as average flow rates for Average, Wet, and Dry years.

Canal capacities available for Program Water were based on historic diversions for the two systems. The constraint in any month was based on headgate diversion capacity at the Korty, Keystone, and CNPPID diversions and return capacities at the North Platte Hydro, Jeffrey, and J-2 Returns. As with the stream channels, available canal system capacities for Program water were summarized on a monthly basis and expressed as average flow rates for Average, Wet, and Dry years.

A spreadsheet tool organizing the system capacity and remaining capacity for Program water by reach was developed. This spreadsheet analysis supports the sensitivity analyses on particular constraining capacities in the systems and the limitations on delivering water to the critical reach. The average remaining capacity for Program water, based on the known capacities, is presented in Table 3-8 entitled, "Remaining Capacity for Program Water for Average, Wet, and Dry Years". The volumes of Program water necessary to achieve the recommended flows of 5,000 cfs and 800 cfs of Program water were quantified for two cases as part of the routing analysis discussed in the following sections.

3.7 Development of Routing Tool for Program Water

The routing of Program water is subject to the capacities, travel times, and losses described above. The routing tool is used to evaluate two target flow rates of Program water (5,000 cfs and 800 cfs) for two Cases (with diversion of Program water by the Districts and without diversion of Program water by the Districts). The routing tool evaluates the flow of Program water at Overton resulting from releases to the North Platte River from Lake McConaughy and Program water credited to the Tamarack I project on the South Platte River. The routing tool estimates a total required release from Lake McConaughy necessary to meet flow targets at Overton (supplemented by flows from Tamarack I). With this approach, the resulting peak flow at Overton is limited by the system capacities and not the available supply of EA water in Lake McConaughy. This approach focuses on conveyance constraints that are limiting, helps to limit the number of potential routing solutions for a particular study year, and answers the question, “How much water would need to be released from Lake McConaughy in an attempt to achieve the pulse flow target”.

Table 3-8

Remaining Capacities for Program Water for Average, Wet, and Dry Years

Location	Year Class	Average Monthly Remaining Capacity (CFS)											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
South Platte River at Roscoe	AVG	9,681	9,777	9,676	9,293	9,058	9,192	9,444	9,679	9,607	9,889	9,900	9,481
	WET	9,110	9,222	9,118	8,809	8,701	9,059	8,750	7,350	5,773	8,724	9,346	9,292
	DRY	9,897	9,906	9,864	9,822	9,768	9,841	9,843	9,895	9,613	9,906	9,963	9,934
NPPD Korty Diversion	AVG	651	577	528	458	368	367	483	591	443	633	714	684
	WET	546	469	475	379	308	354	419	414	448	680	743	691
	DRY	793	769	724	693	635	663	676	694	615	798	842	821
South Platte at North Platte	AVG	18,492	18,531	18,536	18,479	18,351	18,424	18,478	18,351	17,800	18,382	18,503	18,461
	WET	18,137	18,280	18,269	18,059	17,946	18,144	17,865	16,077	15,478	17,843	18,230	18,205
	DRY	18,569	18,572	18,567	18,565	18,546	18,547	18,546	18,394	18,311	18,549	18,579	18,576
Keystone Diversion on North Platte	AVG	1,040	1,005	1,002	1,096	1,193	1,151	1,134	1,041	795	429	459	734
	WET	986	754	655	824	823	664	589	730	492	176	146	435
	DRY	1,233	1,187	1,245	1,293	1,307	1,389	1,297	1,018	605	198	247	858
NPPD Com-bined Flow in Canal	AVG	1,018	895	851	867	867	822	980	994	531	353	462	742
	WET	854	529	444	510	424	298	334	401	227	156	210	449
	DRY	1,336	1,263	1,268	1,286	1,242	1,353	1,314	1,091	605	308	371	981
North Platte Hydro Return	AVG	1,098	1,056	956	929	950	874	961	1,040	894	471	416	859
	WET	807	627	544	585	489	408	412	497	374	231	190	540
	DRY	1,437	1,427	1,325	1,325	1,347	1,398	1,341	1,202	948	332	448	1,122
North Platte River at North Platte	AVG	2,467	2,523	2,625	2,649	2,593	2,546	2,544	2,447	2,423	1,755	1,969	2,460
	WET	2,168	2,347	2,362	2,437	2,288	2,040	2,016	1,889	1,613	1,179	1,485	1,878
	DRY	2,529	2,636	2,656	2,669	2,654	2,616	2,647	2,667	2,632	1,716	2,165	2,621

Table 3-8
Remaining Capacities for Program Water for Average, Wet, and Dry Years
(continued)

Location	Year Class	Average Monthly Remaining Capacity (CFS)											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
CNPPID Diversion at North Platte	AVG	897	906	898	928	782	677	754	733	587	281	266	723
	WET	504	524	618	589	336	312	290	259	215	168	137	399
	DRY	1,367	1,441	1,381	1,393	1,332	1,332	1,298	1,107	803	218	419	1,138
Platte River at Brady	AVG	15,682	15,687	15,671	15,590	15,494	15,513	15,605	15,498	15,006	14,821	15,135	15,599
	WET	14,976	15,117	15,043	14,841	14,703	14,520	14,008	11,896	10,586	13,285	14,004	14,397
	DRY	15,733	15,718	15,698	15,690	15,678	15,666	15,672	15,554	15,575	14,965	15,315	15,732
CNPPID Jeffrey Return	AVG	1,201	1,199	1,242	1,243	1,237	1,237	1,246	1,194	1,089	1,098	1,003	1,139
	WET	1,189	1,184	1,248	1,218	1,218	1,247	1,246	1,245	1,220	1,149	1,138	1,211
	DRY	1,208	1,248	1,249	1,249	1,249	1,245	1,247	1,158	1,036	955	903	1,147
Platte River nr Cozad	AVG	5,595	5,566	5,594	5,389	5,389	5,367	5,497	5,522	5,242	5,496	5,693	5,645
	WET	4,785	4,966	4,914	4,525	4,525	4,395	4,039	3,339	2,825	4,772	4,960	4,649
	DRY	5,708	5,656	5,626	5,604	5,604	5,558	5,592	5,586	5,709	5,770	5,769	5,768
J-2 Return	AVG	1,071	1,012	933	864	864	750	1,002	1,362	1,452	1,652	1,721	1,325
	WET	756	730	679	437	437	453	574	834	1,138	1,727	1,587	922
	DRY	1,535	1,446	1,371	1,284	1,284	1,321	1,556	1,754	1,753	1,927	1,924	1,746
Platte River nr Overton	AVG	6,185	6,080	6,011	5,707	5,707	5,489	5,916	6,300	6,097	6,528	6,878	6,475
	WET	4,966	5,082	4,958	4,296	4,296	4,209	4,028	3,512	3,141	5,776	5,942	4,961
	DRY	6,698	6,549	6,454	6,324	6,324	6,246	6,509	6,741	6,876	7,195	7,182	7,016

The routing tool was applied to evaluate two flow targets, the 5,000 cfs 3-day pulse during the low-demand period (September to May) and the 800 cfs steady flow during the irrigation season (May to September), for the 60 year period from 1947 through 2006. The results for each of the 60 years are summarized for the Average, Wet, and Dry year classifications. The routing studies for each target flow were completed for the following cases:

- Case I –Program water will first be diverted by the Districts when the Districts have the capacity within their system to divert it. When constrained by canal system capacity, available Program water not diverted by the Districts will be left in the river to flow down to the critical reach.
- Case II – Program water will bypass the Districts' system even if the Districts have the capacity to divert it. Program water will bypass the Districts and be subject to the operations of the river.

The tool developed for the routing of flows through the Platte system was developed as an Excel spreadsheet representation of the Platte River from the Roscoe gage on the South Platte River and Lake McConaughy on the North Platte River downstream to the Overton gage. The spreadsheet includes the Platte River reaches from upstream gage to downstream, the NPPD Korty and Keystone Diversions, the CNPPID Diversion, and the North Platte Hydro, Jeffrey, and J-2 Returns.

Canal capacities, ramping rates, and river capacities, are represented in the routing tool as described in Section 3.2. Specifically, the canal capacities incorporated in the routing tool are the Korty Diversion, Keystone Diversion, combined capacity of Sutherland Canal, North Platte Hydro Return, CNPPID Diversion, Jeffrey Return, and J-2 Return. These capacities are included as variables in the tool to facilitate sensitivity analyses of these constraints. Ramping rates are included for the North Platte River below Keystone, Keystone Diversion, and North Platte Hydro Return. These rates are incorporated as variables similar to the canal capacities to facilitate sensitivity analyses. River capacities, represented by flood stage capacities, are included in the routing tool for North Platte River at North Platte, Platte River at Brady, Cozad, and Overton. The North Platte "choke point" is incorporated in the calculation of releases of Program water from Lake McConaughy. The Brady, Cozad, and Overton gages are included for use in comparison to total flow. These locations are less constraining than the reaches and canal systems below McConaughy and therefore not explicitly included as constraints in the routing tool.

The routing tool utilizes a daily timestep to estimate the travel times and losses through the system. Travel times are estimated at 1 or 2 days depending on the location in the system. Historical travel times may vary or may be more or less than a multiple of a day, but the use of a daily increment necessitates this approximation. The estimated travel times for the key locations in the spreadsheet are summarized in Table 3-5 (Section 3.5).

River and canal losses as described in Section 3.5 and Table 3-7 are incorporated in the routing tool based on water year classification. The river reaches for which these losses were developed coincide with the reaches in the routing tool.

Program water is routed 'on top of' the historical hydrology, diversions, and return flows in the Platte River and the Districts' systems, constrained to the remaining available capacity. Historical daily data for the period of 1947 through 2006 was obtained from the USGS and Nebraska DNR to represent the historical hydrology and operations of the river system. The historical data contains some periods of missing data. It is not clear in the presentation of the data if a period of missing data represents a period of zero flow, or a period of non-recorded flow. A period of zero flow can represent times when a canal or return might be shut down for the season, for maintenance, or for inspections, such as occurs with FERC re-licensing (required every five years). Since the reason for the missing data is unclear, periods of missing data were filled with averages of recorded values based on year classification. The average daily flow from the respective calendar day for the Average, Wet, or Dry year classifications was substituted for missing data. See Section 3.3 for more explanation on how the Average, Wet, and Dry water year classifications were determined.

Sites that required filling included:

- Roscoe Gage – Missing water years 1947 through 1982
- Korty Diversion – Missing fall months for water years 1955 through 1977
- Keystone Diversion – Missing fall and spring months from water years 1955 through 1977
- North Platte Hydro Return – Missing winter months for water year 1956 and fall months for water years 1968, 1969 and 1977
- CNPPID Diversion at North Platte – Missing December 1989
- Jeffrey Return – Missing the fall through spring months with occasional summer days for water years 1955 through 1977; winter months for water years 1978 and 1992; fall months water year 1993
- J-2 Return – Missing December 1989; days in July and August 2000

The first Program water to be routed through the system is that available from the Tamarack I Project on the South Platte River, as measured below the Western Canal, and an estimate of the required release from Lake McConaughy. The estimated release from Lake McConaughy represents the volume of water that would be required from the EA and Pathfinder Modification Project (PMP) (and other potential sources) in Lake McConaughy combined.

The spreadsheet tracks Program water downstream to the Overton gage by incorporating an order of operations in conjunction with the capacities, travel times, and losses. These operations are similar for both the 5,000 cfs and the 800 cfs target flows. Operations for Case I and Case II are, by the nature of the scenarios, different. Routing of water through the river and Districts for Case I (Districts divert up to capacity) is done in the following order:

1. Program water available at Korty (Tamarack I) is diverted subject to remaining capacity in the Korty Diversion and Sutherland Canal. This Program water is always diverted subject to available capacity first and the remaining Program water is routed downstream to North Platte.

2. Program water released from Lake McConaughy is diverted at the Keystone Diversion subject to the remaining capacity at the diversion, ramping rates, and remaining capacity in the Sutherland Canal below the junction of the Keystone and Korty portions of the canal. The construct of this operation in the spreadsheet is such that the release is a function of these constraints, travel times, and losses.
3. Program water released from Lake McConaughy not diverted at the Keystone Diversion is routed downstream to North Platte subject to the capacity at the "choke point" and channel ramping rates. The construct of this operation in the spreadsheet is such that the release is a function of these constraints, travel times, and losses.
4. Program water in the Sutherland Canal is returned to the South Platte River at North Platte via the North Platte Hydro Return.
5. Program water in the North Platte and South Platte Rivers is added at the confluence for a total combined flow of Program water.
6. Program water available at the CNPPID Diversion is diverted subject to the remaining capacity. Remaining Program water in the river is routed downstream to the Overton gage.
7. If selected by the user, Program water is returned to the Platte River via the Jeffrey Return subject to remaining capacity for the Return. Program water is then routed downstream to the Overton gage.
8. If re-regulation at Johnson Lake is selected, Program water is bypassed, stored, or released to the J-2 Return. Program water is routed downstream to the Overton gage.
9. Program water reaching the Overton gage is the sum of Program water at Brady, Jeffrey Return, and J-2 Return subject to travel times and losses.

Routing of water through the river for Case II (Districts do not divert Program water) is performed in the following order:

1. Program water in the South Platte River (Tamarack I) is routed downstream to North Platte (confluence).
2. Program water is released from Lake McConaughy to the North Platte River subject to ramping rate limitations and remaining capacity at the North Platte "choke point".
3. Program water in the North Platte and South Platte Rivers is added at the confluence for a total combined flow of Program water.
4. Program water is routed downstream from North Platte to Overton subject to travel time and losses.

The routing tool is applied to each year of the study period for each the two target flows and two cases. The spreadsheet is set up to evaluate one target and case combination, resulting in four individual spreadsheets for each year of the study.

User input and evaluation is required to identify the operations and time period most likely to achieve the target flow. The user is required to flag days for releases from Lake McConaughy to meet the flow targets at Overton considering travel times, capacities, and estimated start dates to accommodate ramping rates. More input is required by the user in evaluating the 5,000 cfs target flow compared to the 800 cfs irrigation season target. This is because the operations for the 800 cfs are simply turned on and the 5,000 cfs requires identification of periods with capacity in the system and determination of necessary operations.

The target period for the 5,000 cfs, Case I scenario is generally February, March, or April to allow the use of the Johnson Lake reregulation storage. With this starting point, the available capacity in the North Platte River at the choke point and the remaining capacity in the J-2 Return typically determine the best target release period. The user must also determine when and if to store, bypass, or release flows at Johnson Lake. In addition, to supplement the peak flow from the J-2 Return, operation of the Jeffrey Return a day prior to the anticipated peak flow is set by a user variable. Exceptions to these considerations do occur as a result of the historical flow data used in the routing tool.

In the scenario of a 5,000 cfs target and Case II, the maximum deliveries are governed by the maximum remaining capacity at the North Platte River choke point. Periods identified for this scenario range from November to April. The month of May is typically avoided due to the higher loss factors applied during the irrigation season in the routing tool.

The 800 cfs target flow runs from May through September. The target period for the 800 cfs flow evaluated in this study is from May 1 to September 30. USFWS indicated that the 800 cfs flow is intended to augment flows from May 11 to September 15 as outlined in the *Instream Flow Recommendations Document* (see FWS Meeting Notes in Appendix 1). The difference in volume of the two durations is approximately 40,000 ac-ft at Overton. The release from McConaughy is capped based on an estimated required release determined by travel times and losses to Overton. The start date to meet the target flow on May 1 varies from year to year subject to remaining capacities and ramping rates for Case I. The Case II scenario relies solely on the capacity at the North Platte River choke point, and also varies the start date subject to ramping rates on the North Platte River.

Output for each scenario includes the following summary:

- Total annual release from Lake McConaughy (EA water)
- Total EA water reaching Overton (including Tamarack I water)
- Peak EA water flow at Overton
- Peak 3-day volume of EA water at Overton (5,000 cfs target scenarios)
- Total number of days of EA flows at Overton greater than 5,000 cfs (5,000 cfs target scenarios)
- Total number of days of total flows at Overton greater than 6,000 cfs (5,000 cfs target scenarios)
- Total number of days of EA flows at Overton greater than 800 cfs (800 cfs target scenarios)
- Total EA reaching Overton for May through September (800 cfs target scenarios)

Additional results regarding shortages to target flows and days of operations are included in the summary tables in Appendix 3.

3.8 Analysis of Routing Program Water to Overton

The routing tool was applied to both flow targets for Cases I and II for the entire 60 year study period. Table 3-9 entitled, “Resulting Peak Flows for Target 5,000 cfs Case I and Case II”, summarizes the results of targeting 5,000 cfs of Program water at Overton for Average, Wet, and Dry year classifications. These results are average values for each water year classification. Table 3-10 entitled, “Resulting Peak Flows for Target 800 cfs Case I and Case II”, summarizes the results of targeting 800 cfs of Program water at Overton for Average, Wet, and Dry year classifications. These results are average values for each year classification.

Table 3-9
Resulting Peak Flows for Target 5,000 cfs
Case I and Case II

Year Class	Scenario	Total McConaughy Release (ac-ft)	Total Program water at Overton* (ac-ft)	Peak Program water flow at Overton (cfs)	Peak 3-Day Total (ac-ft)	# Days > 5,000 cfs of Program water	# Days > 6,000 cfs Total Flow	Shortage from 5,000 on Peak Day (cfs)	Target Volume Short (ac-ft)	Typical Month of Operation	Typical reasons for shortage to target flow
Average	5000 Case I	81,300	78,300	4,700	22,200	-	2	300	7,600	Apr	Keystone Div, Sutherland Canal, North Platte Hydro, North Platte River
Average	5000 Case II	41,100	44,800	2,500	14,500	-	2	2,500	15,200	Dec, Jan, Feb, Apr	North Platte River choke point
Wet	5000 Case I	71,600	70,600	3,800	19,100	-	41	1,200	10,700	Apr, Feb	Keystone Div, Sutherland Canal, North Platte Hydro, North Platte River
Wet	5000 Case II	46,300	49,100	2,500	14,500	-	40	2,500	15,300	Dec, Jan, Feb, Apr	North Platte River choke point
Dry	5000 Case I	99,900	91,500	5,200	24,300	1	-	(200)	5,500	Apr	Keystone Div, Sutherland Canal, North Platte Hydro, North Platte River
Dry	5000 Case II	42,800	44,600	2,500	14,600	-	-	2,500	15,100	Apr	North Platte River choke point

* Total Program water reaching Overton for year, including Tamarack I

Table 3-10
Resulting Peak Flows for Target 800 cfs
Case I and Case II

Year Class	Scenario	Total McConaughy Release (ac-ft)	Total Program water at Overton* (ac-ft)	Peak Program water flow at Overton (cfs)	# Days > 800 cfs of Program water	Total Program water May-Sep (ac-ft)	Shortage on Peak Day (cfs)	Target Volume Short (ac-ft)	Typical Month of Operation	Typical reasons for shortage to target flow
Average	800 Case I	342,900	246,200	800	136	236,600	N/A	6,100	May-Sep	Keystone Div, North Platte Ramp, North Platte River
Average	800 Case II	342,800	247,000	800	142	236,500	N/A	6,200	May-Sep	North Platte River choke point
Wet	800 Case I	293,300	212,600	800	105	202,300	N/A	40,400	May-Sep	System generally at capacity
Wet	800 Case II	280,200	203,900	800	108	194,200	N/A	48,600	May-Sep	North Platte River choke point
Dry	800 Case I	582,400	243,100	800	120	232,400	N/A	10,400	May-Sep	Keystone Div, North Platte Ramp, North Platte River
Dry	800 Case II	580,900	243,100	800	124	231,600	N/A	11,100	May-Sep	North Platte River choke point

* Total Program water reaching Overton for year, including Tamarack I

The results for each individual year are presented in Appendix 3. Appendix 3 presents the total amount of Program water released from Lake McConaughy, the total Program water reaching the Overton gage, the peak Program water delivery, and the period of release to achieve the target flows.

The following results correspond to Table 3-9 and Appendix 3 for the target flow of 5,000 cfs of Program water for Cases I and II:

<u>5,000 cfs Program water - Case I (Districts divert Program water)</u>:

- Pulse flows of 5,000 cfs of Program water are achieved for 19 of the 60 years of the study period, about 1 in 3 years. However, peak flows in excess of 5,000 cfs occur for only one day. The three day duration is not achieved. Of these 19 years, 10 occur in Average years and 9 occur in Dry years; the 5,000 cfs target is not achieved in any of the Wet years of the study period.
- Average year classification- A peak flow of 5,000 cfs of Program water is achievable in some years, for a duration of 1 day only, but on average is not met. On average, the peak Program water flow at Overton is 4,700 cfs. The average volume for the 3 day pulse flow is 22,200 ac-ft, and is 7,600 ac-ft less than the target volume. This volume at Overton is achieved with a release from Lake McConaughy of 81,300 ac-ft (in addition to a small volume of Tamarack I water).
- Wet years - A peak flow of 5,000 cfs of Program water is never achieved due to the system being generally full. On average, the peak Program water flow at Overton is 3,800 cfs in these Wet years. The average volume for the 3 day pulse flow is 19,100 ac-ft, and is 10,700 ac-ft less than the target volume. This volume at Overton is achieved with a release from Lake McConaughy of 71,600 ac-ft (in addition to a small volume of Tamarack I water).
- Dry years - A peak flow of 5,000 cfs of Program water is achievable for 1 day in some years, but not all years. On average, the peak Program water flow at Overton is 5,200 cfs in these Dry years. The average volume for the 3 day pulse flow is 24,300 ac-ft, and is 5,500 ac-ft less than the target volume. This volume at Overton

is achieved with a release of 99,900 ac-ft of water from Lake McConaughy (in addition to a small volume of Tamarack I water).

- February and April are the typical months that the peak flow of Program water is possible as a result of system capacity and the potential for reregulation in Johnson Lake.

Shortages to the 5,000 cfs target flow occur for various reasons for Case I, including:

- North Platte River capacity at North Platte – The modeled capacity of 3,000 cfs at this location on the North Platte limits the release to the river from Lake McConaughy.
- Capacity and ramping rates of the Keystone Diversion, capacity in Sutherland Canal, and capacity and ramping rates at the North Platte Hydro Return – the flow diverted at the Keystone Diversion is influenced by the capacities and historical flows at all three of these locations. On occasion, one, two, or all three can limit the amount of Program water that can be returned to the South Platte River to circumvent the choke point on the North Platte River.
- Regulating capacity in Johnson Lake, both volume and time of year per the "Bypass Agreement" – Reregulation in Johnson Lake is limited to the months of February, March, and April. There are situations when reregulation in other months may better coincide with available historical system capacities. The limit of 4,000 ac-ft of reregulation provides peaking flow typically for one day. The use of the Johnson Lake reregulation to achieve the 5,000 cfs target is made when the remaining capacity in the J-2 Return is the highest, and therefore consumes the reregulation volume in about 1 day.

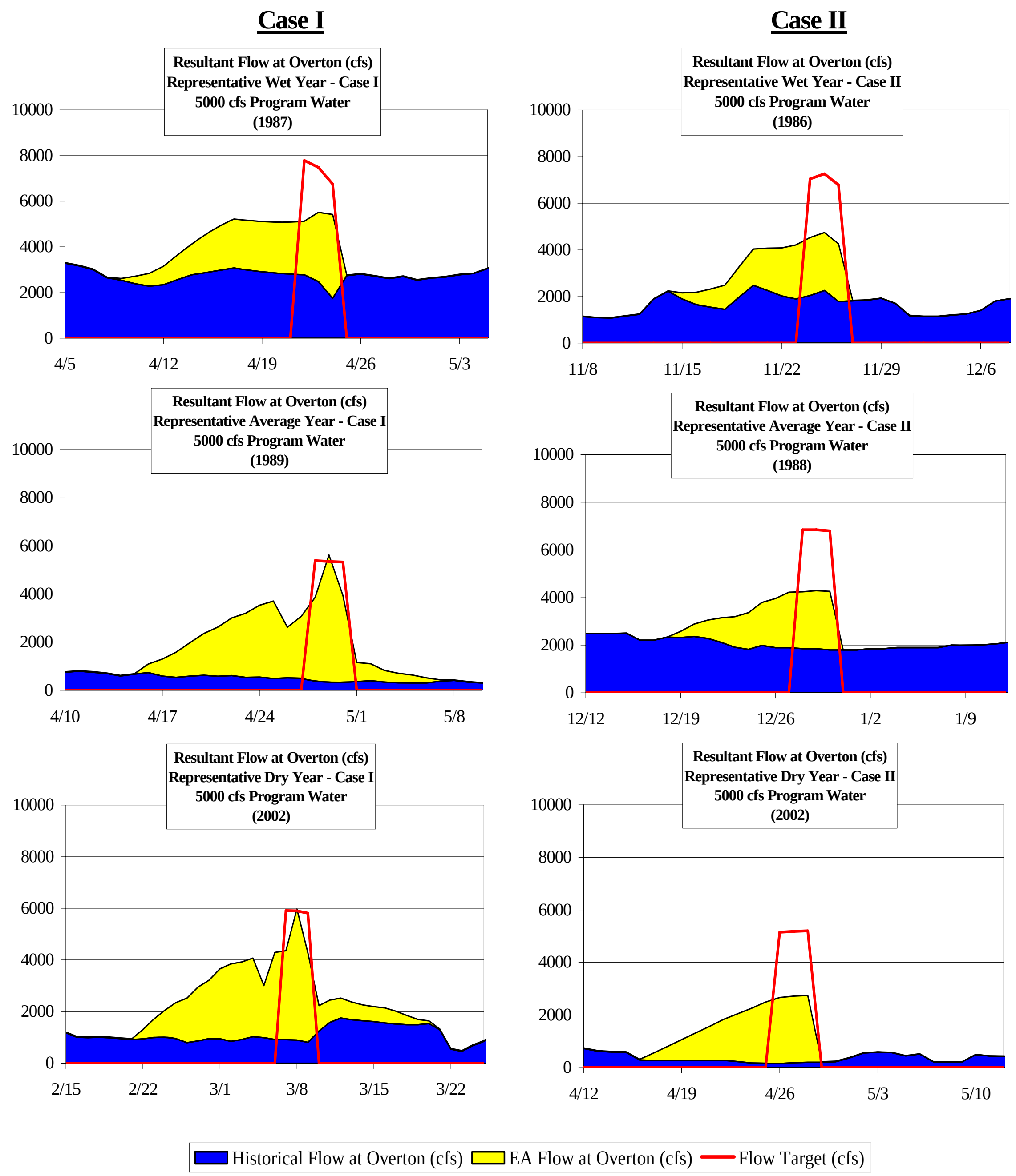
<u>5,000 cfs Program water - Case II (Districts Bypass)</u>:

- In all 3 types of year classifications, Average, Wet, and Dry, the average peak Program water reaching Overton is 2,500 cfs. The average volume for the 3 day pulse flow is approximately 14,500 ac-ft. The shortage to the target volume ranges from 15,100 ac-ft to 15,300 ac-ft on average for the target three-day period. These flows at Overton are achieved with a release from Lake McConaughy of ranging from 41,100 ac-ft for Average years to 46,300 ac-ft in Wet years (in addition to a small volume of Tamarack I water). The constraint to target flows in Case II is the chokepoint capacity on the North Platte River at North Platte.

Figure 3-6 entitled, "Hydrographs for 5,000 cfs Program Water Targets", illustrates the results of routing Program water from Lake McConaughy and Tamarack I for representative Average, Wet, and Dry year classifications for Cases I and II.

Figure 3-6

Hydrographs for 5,000 cfs Program Water Targets



Flows in excess of 6,000 cfs (total flow) for 3 days in 2 out of every 3 years were also analyzed for the 60 year period to quantify the number of occurrences of these flows and to evaluate the contribution of the modeled EA releases. The number of days the flow at Overton exceeds 6,000 cfs is summarized for each year in Appendix 3. The results of this analysis are:

- Flows in excess of 6,000 cfs occur for durations of 3 days or more for 18 years of the 60 year period (aggregating all year classifications). This is approximately equal to 1 year in 3, in contrast to the target of 2 years in 3.
- Flows in excess of 6,000 occur 6 times in Average years, 12 times in Wet years, and no times in Dry years.
- On occasion, EA water contributes to the flow in excess of 6,000 cfs. However, the flow is never entirely EA water.
- Most occurrences of these target flows are a result of historical flows. The 3 days or longer duration is always a result of historical events.

For the second flow objective, 800 cfs of Program water during the May through September irrigation season, the following results correspond to Table 3-10 and Appendix 3:

<u>800 cfs Program water - Cases I and II</u>:

The 800 cfs of Program water for May-September (153 days) is achievable on most days for each year type assuming there were to be adequate EA water in storage at the start of each year. Occasional shortages occur and vary in timing and magnitude among the six scenarios (three year classifications and Cases I and II). The 800 cfs flow target equates to a volume of Program water of about 243,000 ac-ft for the 153 day season from May 1 to September 30. (If based on the period of May 11 to September 15 as outlined in the *Instream Flow Recommendations*, the volume is about 200,000 ac-ft). (Releases from Lake McConaughy in an attempt to meet this target range from about 280,000 ac-ft in Wet years (Case II), to about 580,000 ac-ft in Dry years (Case II), when losses are highest. Part of the flow target is met by yields of the Tamarack I project on the South

Platte, but these are small compared to the required release from Lake McConaughy.

Shortages occur on individual days due to system capacity constraints. Shortages are typically a result of:

- North Platte River capacity at North Platte – The modeled capacity of 3,000 cfs at this location on the North Platte limits the release to the river from Lake McConaughy.
- North Platte River below Keystone ramping limitation – this ramping rate typically limits releases from Lake McConaughy when diversions at Keystone are changed based on downstream limits or historical operations.
- Capacity and ramping rates of the Keystone Diversion, capacity in Sutherland Canal, and capacity and ramping rates at the North Platte Hydro Return – the flow diverted at the Keystone Diversion is influenced by the capacities and historical flows at all three of these locations. On occasion, one, two, or all three can limit the amount of Program water able to return to the South Platte River, circumventing the choke point on the North Platte River.

These limitations to target flows vary from year to year and within the same year being analyzed.

There are instances during the irrigation season of some years when flows in the river exceed flood stage limits due to historical flows. The occurrence of these events near the downstream end of the system are difficult to incorporate into the release determination for achieving the 800 cfs target. These events are infrequent and do not appear to represent a significant impact on the volume of EA water released. Refinement of this capacity limitation will potentially be addressed in Phase II as part of routing tool refinements.

3.9 Recommendations for Further Evaluation of Capacities

It is recommended that a sensitivity analysis of certain limits and capacities included in the routing tool be evaluated further in Phase II. During the routing analysis, insights were developed regarding some of the more limiting constraints in achieving the target flow rates and volumes. Limits to achieving the target flows as described in Section 3.8 include physical capacities of the Districts' systems, the North Platte choke point and the reregulation capacity in Johnson Lake. Ramping rates, to some degree, impact the achievable peak flow. Current ramping rates greatly affect the required volume of Program water releases to achieve the pulse flow on both the rising and falling limbs of the hydrograph. The following are recommendations for additional evaluation as part of Phase II:

- North Platte choke point – The channel capacity at the North Platte choke point is currently set at 3,000 cfs in the routing tool. This capacity is in anticipation of channel improvements at this location. This capacity is a constraint to achieving a pulse flow of 5,000 cfs of Program water for both Cases I and II.
- Johnson Lake reregulation operations – An increase in the available capacity and relaxation of the timing of operations for the use of Johnson Lake reregulation should be evaluated. Reregulation is currently allowed by the Bypass Agreement to occur in the months of February, March, and April. In some years, there appears to be additional available capacities elsewhere in the system, outside of these months, that if combined with reregulation may achieve a higher pulse flow. The available capacity for reregulation in Johnson Lake is limited to 4,000 ac-ft in a year. This volume of water is able to contribute to the pulse flow for typically one day via the J-2 Return. Additional capacity would provide additional volume to extend the duration of the pulse flow.
- Ramping rates – An increase in the ramping rates are likely to reduce the required volume of Program water to achieve the pulse flow, and to a limited degree the steady summer flow targets. A sensitivity analysis of the ramping rates on the North Platte below Keystone, Keystone Diversion ramp up and down limit, and the North Platte Hydro Return is recommended.
- Canal capacities – If additional capacity in the NPPD system to circumvent the North Platte choke point, or additional capacity in the CNPPID system to fill Johnson Lake faster, were available, this might increase the ability to meet the

pulse flow targets. However, due to the physical nature of the structures, flexibility in these constraints is not anticipated. Further evaluation of the sensitivity to canal capacities, if performed, should be based in part on input from the Districts.

4.0 PROJECT ASSESSMENT

The Platte River Water Conservation/Supply Study (Boyle, 1999) and Reconnaissance-Level Water Action Plan (Boyle, 2000) provided supporting information for the Governance Committee to select a package of thirteen alternatives to reduce average annual shortages to target flows by more than 60,000 ac-ft. The selection of projects considered: 1) yield at the Critical Habitat; 2) up-front capital costs; 3) long-term operating costs; 4) legal and institutional issues (e.g. the need for new authorizing legislation, state water rights administration and water export constraints, maximum lease terms, NEPA compliance and site-specific environmental permit requirements); 5) third-party impacts; and 6) implementation schedule. Table VI-1 of the Water Action Plan presents “First Increment Unit Costs” (initial capital cost plus the present worth of first 13 years of operation) ranging from $580 - $1,070 per ac-ft of yield at the critical habitat (1999 price levels). Although the FEIS analysis arrived at estimates of water yield that, in some cases, differ from the earlier estimates, the FEIS credits this combination of thirteen “water elements” or projects with accomplishing the Program objectives based on the aggregate yield of all the Governance Committee Alternative actions (FEIS, page 3-29). Per the Governance Committee’s requirements for this study, this section: 1) reviews the 13 Water Action Plan projects; and 2) identifies those projects that would likely be the most cost-effective in reducing shortfalls to the Program water delivery objectives focusing on their individual and combined ability to accomplish the 5,000 cfs and the 800 cfs flow criteria under three hydrologic conditions (Average, Wet, and Dry years) and two water administration scenarios (Cases I and II, without, and with, respectively, irrigation district bypasses of Program water).

The following project descriptions are summarized from the Program Water Plan. Information from the interviews with Program participants will be used to revise project configurations and operational scenarios in Phase II. References to reach numbers correspond to those described in the Water Action Plan and the WMC Loss Model Update.

4.1 CNPPID Regulating Reservoir

Nebraska indicated they are willing to consider a re-regulating reservoir(s) capable of yielding an annual average of up to 8,000 ac-ft of target flow reductions at the critical habitat, of which 4,000 to 5,500 ac-ft would be made available to the Program (Cook, 2000). The remaining portion of the yield will be retained by Nebraska to potentially offset future depletions. Up to an average of 8,000 ac-ft/yr of target flow reductions could be attained through a single re-regulating reservoir or a combination of reservoirs. The six most promising re-regulating reservoir options evaluated in the *Depletion Mitigation Study Phase I* conducted by HDR include:

- Option 1: Jeffrey Canyon Reservoir. Located south of Brady in Lincoln County on the south side of the Central District Supply (Canal). Would be fed from Jeffrey Reservoir. Capacity is estimated at 10,390 ac-ft.

- Option 2: Smith Canyon Reservoir. Located southwest of Gothenburg in Dawson County on the south side of the Canal. Would be fed by water pumped from the Canal. Capacity is estimated at 12,895 ac-ft.

- Options 3 & 4: Midway Lakes Reservoirs No. 2 and No. 5. Located south of Willow Island in Dawson County on the south side of the Canal. Would be fed by water pumped from the Canal. Capacities are estimated at 6,433 ac-ft and 11,429 ac-ft, respectively.

- Option 5: North Plum Creek Reservoir. Located southeast of Cozad in Dawson County on the north side of the Canal. Would be fed by water from the Canal. Capacity is estimated at 2,320 ac-ft.

- Option 6: J-2 Forebay Reservoir. Located southeast of Lexington in Gosper County in the Plum Creek basin, south of the J-2 Forebay on the south side of the Canal. Would be gravity fed from the Canal. Capacity is estimated at 3,436 ac-ft.

Re-regulating reservoirs capture Platte River water beyond that required for irrigation deliveries and mainstem instream flows during periods of excess flow at the critical habitat. In general, water would be diverted from the Central District Supply Canal during periods of excess and released during periods of shortage at the critical habitat. In the case of the Jeffrey Canyon and the J-2 Forebay Reservoirs, water would be supplied from Jeffrey Reservoir and the J-2 Forebay, respectively, as opposed to the Canal. CNPPID would re-regulate the flows in their system, in which case diversions will not be increased or decreased, only return flows will change.

CNPPID has provided additional information on other potential storage sites that will be evaluated as part of Phase II.

4.2 Water Leasing in Nebraska

Nebraska has not yet identified specific irrigation districts or individual farmers that are willing to participate in a leasing program in conjunction with the Program. The willingness to participate is also unknown at this time. Due to these conditions, a leasing program was evaluated for Reaches 10 (Julesburg, CO gage to South Platte at North Platte, Nebraska gage) and 14 through 19 (Keystone Diversion gage to Grand Island, Nebraska gage). It was assumed that representative leasing projects are located at the mid-point of each reach because specific irrigation districts and lands willing to participate in the Program are not yet known. The reaches are defined as follows:

- Reach 10: Julesburg, CO gage to South Platte at North Platte, Nebraska gage
- Reach 14: Keystone Diversion gage to North Platte at North Platte, Nebraska gage
- Reach 15: North Platte at North Platte, Nebraska, gage to Brady, Nebraska gage
- Reach 16: Brady, Nebraska gage to Cozad, Nebraska gage
- Reach 17: Cozad, Nebraska gage to Overton, Nebraska gage
- Reach 18: Overton, Nebraska gage to Odessa, Nebraska gage
- Reach 19: Odessa, Nebraska gage to Grand Island, Nebraska gage

In general, water would be leased from an irrigation district or farmer with storage rights in Lake McConaughy. The reduction in consumptive use will likely be added to the EA when storage space is available and released during times of shortage at the critical habitat. The leasing program that has been analyzed considers leasing approximately 25,500 ac-ft annually, which corresponds to a reduction of approximately 17,000 ac-ft/yr delivered on farm and a reduction in consumptive use of about 8,400 ac-ft/yr.

4.3 Nebraska Water Management Incentives (Conservation Cropping, Deficit Irrigation, Fallowing, and On-Farm Irrigation Changes)

Irrigation districts or individual farmers have not been identified that are willing to participate in a water management program in conjunction with the Program. The following options have been analyzed.

- Option 1: Conservation cropping in Reaches 16 through 19.
- Option 2: Deficit irrigation in Reaches 16 through 19.
- Option 3: Land fallowing in Reaches 10, and 14 through 19.
- Option 4: On-farm changes in irrigation techniques in Reaches 17 through 19.

These programs ideally would be located downstream, close to the critical habitat to minimize difficulties associated with “protecting” the water. Because participating irrigation districts and farmers are not yet known, it was assumed that representative water management projects are located at the mid-point of each reach (same as the Water Leasing in Nebraska).

Water management alternatives consist of programs resulting in reductions in consumptive use, or in the case of on-farm changes in irrigation techniques, reductions in the return flows that do not return to the Platte River above the critical habitat. An irrigation district or farmer with storage rights in Lake McConaughy will be paid to reduce their diversions through conservation cropping, deficit irrigation, land fallowing, or changes in irrigation techniques. The reduction in consumptive use will likely be added to the EA when storage space is available and released during times of shortage at the critical habitat.

The yield has been limited to surface water irrigation; however, if additional water generated from these options is not protected, it may be institutionally easier to apply these programs close to the critical habitat. In order to achieve the proposed yields below Kearney, Nebraska these types of projects would also have to be applied to lands irrigated with groundwater because there is not a sufficient amount of surface water irrigation below Kearney to realize the proposed yield.

4.4 Groundwater Management in Nebraska

Potential groundwater management areas in Phelps and Kearney Counties are:

- 13,000-acre high groundwater table area bounded by the Phelps Canal to the south and east, the Township 6 line to the north, and the Funk Odessa Road to the west.
- 60 acre Reynold's and Robb Wetland, located in Section 10, Township 8 North, Range 21 West.
- 22,000 acres in Township 7 North, Ranges 18 and 19 West.
- 23,000 acres in Townships 6 and 7 North and Ranges 15, 16, and 17 West.

Options that could be implemented for groundwater management are described below.

- Option 1: Active Groundwater Pumping from High Groundwater Areas
- Option 2: Passive Lowering of the Groundwater Table
- Option 3: Groundwater Irrigation
- Option 4: Conjunctive Use

Groundwater management has been limited to a total yield no more than 6,000 ac-ft/yr. Nebraska has indicated they will not consider expanding groundwater management unless further investigation and study reveals that higher yields can be sustained. Nebraska also intends to reserve as much of the yield necessary to offset new depletions in that state. However, Nebraska currently estimates that 1,400 ac-ft/yr of the yield of this project (of the 6,000 ac-ft/yr potential) would be in addition to that needed for new depletion offset and therefore could be made available to the Program.

Changes in the status of the groundwater mound will be addressed as part of Phase II.

4.5 Dry Creek/Fort Kearny Cutoffs

There are two Dry Creek/Ft. Kearny Cutoffs projects within Tri-Basin Natural Resources District and within the area influenced by the groundwater mound:

- Option 1: Lost Creek/North Dry Creek Cutoff located south of Kearney in Sections 9 and 16, Township 7 North, Range 16 West.
- Option 2: Lost Creek/Ft. Kearny Cutoff located south of Kearney in Sections 1 and 12 of Township 7 North, Range 16 West.

The projects would be operated to return existing flows in Lost Creek or releases from the Funk Lagoon to the Platte River. These cutoffs could also be operated similar to active pumping from the groundwater mound. This project consists of the construction of a ¾ mile long canal connecting Lost Creek to the Fort Kearny Improvement Project Area (IPA), allowing increased flow through approximately 20 miles of the critical habitat. A pump station located along Crooked Creek may be necessary to expand this project in the vicinity of Lost Creek.

The potential yields from active pumping were not included for these two cutoff projects since the yields were included under the groundwater management option. If active pumping were included with the cutoff projects, well(s) could be installed in high groundwater areas to pump water into Lost Creek during periods of target flow shortage.

4.6 Dawson and Gothenburg Canal Groundwater Recharge

The Dawson and Gothenburg Canals are both located on the north side of the Platte River primarily in Dawson County. The Gothenburg Canal headgate is located approximately eight miles upstream of Gothenburg, Nebraska. The Dawson Canal headgate is located near Cozad, Nebraska.

Recharge projects under the Dawson and Gothenburg Canals would involve diverting surface water directly from the Platte River into these canals during the non-irrigation season. Canal seepage would percolate into the alluvium and recharge the groundwater aquifer. Excess water that is not recharged would be returned to the river via spillways within the same month. Return flows that result from canal seepage would accrue to the river for some duration after the recharge event. Diversions should be possible throughout the non-irrigation season if there is enough hydraulic head in the canals to maintain flow velocities that prevent freezing; however, the potential of winter diversions will require additional analysis.

Another option is to check-up the canals to enhance recharge. This would create a recharge basin along the canal, which may help achieve the same recharge with less diversion. Wells and/or drains could also be used to enhance recharge by lowering areas of high groundwater in the vicinity of the canal. Yields could also be realized sooner if these projects are operated as conjunctive use projects. During late fall and winter, flows that exceed target flows could be diverted into the Gothenburg and Dawson Canals for recharge to the local aquifer. During spring and summer months, an equivalent amount of water could be pumped for irrigation. Pumping during the irrigation season would replace irrigation releases from Lake McConaughy.

The total potential yield associated with these projects is estimated to be 2,600 ac-ft/yr. Nebraska is reserving 800 ac-ft of that yield to offset future depletions; therefore, approximately 1,800 ac-ft/yr is available to the Program (Jim Cook, Nebraska Natural Resources Commission, June 28, 2000 memo).

4.7 Central Platte Power Interference

A power interference project would operate primarily at CNPPID's Kingsley Dam Hydro, the two Johnson Hydros and Jeffrey Hydro in conjunction with the Lake McConaughy EA. The NPPD Sutherland System and North Platte Hydro facility would also be involved as NPPD and CNPPID power generation operations are closely related.

In general, Lake McConaughy releases would be scaled back during times of excess at the critical habitat. The "excess" flow could be stored in the EA to be released at a later time when planned releases and downstream river gains do not meet instream flow recommendations. When the water is subsequently released, it may or may not be available for diversion and routing through the district's hydro facilities.

Nebraska intends to reserve as much of the yield of this project as necessary to offset new depletions in that state; however, they estimate that 1,400 ac-ft/yr of the yield of this project could be made available to the Program. A power interference project entails monetary payment to a hydroelectric generator in order to modify the release of water through the hydropower turbines. This might include a change in the timing of generation or a bypass of the turbines to reduce target flow shortages at the critical habitat. The two Johnson and Jeffrey units are owned by CNPPID, which has expressed an interest in a power interference compensation program. Any change to CNPPID operation also affects NPPD operations.

4.8 Net Controllable Conserved Water by CNPPID

Net controllable conserved water resulted from actions taken by CNPPID to comply with the agreement with the National Wildlife Federation to provide reductions in average annual diversions of surface water. The net controllable conserved water resulting from a grant from the Bureau of Reclamation will be added to the EA at no cost to the Program; however that water not attributed to a grant will be provided to the Program at the average cost of the conservation activities.

Three categories of water conservation measures were implemented to reduce losses in the system and irrigation efficiencies:

- Reservoirs – Water conservation alternative developed for Elwood Reservoir that revised the fill/release operations to minimize seepage.
- Canal distribution and delivery system – Installation of pipelines, earth compaction, membrane lining, canal structures, structure automation and turnout relocation.
- On-farm irrigation – System improvements, such as installation of center pivots, gated pipes, flow meters, and surge valves, or management improvements, such as irrigation scheduling, adjustments to irrigation set times, and alternate furrow irrigation.

CNPPID revised the estimate of net controllable conserved water in 2003 (CNPPID, 2003). The results of the revised analysis estimate a total savings of approximately 10,900 ac-ft/yr. Of the total conserved water, 314 ac-ft/yr is attributable to USBR funds and will be directly contributed to the EA. The balance of the net controllable conserved water will be made available to the Program at the average total cost to achieve the conservation savings (CNPPID, 2003). If the State of Nebraska chooses to retain one half of the yield to offset future depletions (consistent with the Water Action Plan) the yield available would be one half of 10,900 ac-ft, or 5,450 ac-ft.

4.9 Pathfinder Modification Municipal Account (Wyoming)

Pathfinder Dam is located on the North Platte River about three miles below the confluence with the Sweetwater River and about 47 miles southwest of Casper, Wyoming.

The Pathfinder Modification Stipulation increased the capacity of the existing Pathfinder Reservoir by approximately 54,000 ac-ft. The Pathfinder Modification Project will serve both environmental and municipal uses. An environmental account of 34,000 ac-ft will be operated for the endangered species and habitat in Central Nebraska in accordance with certain conditions. A municipal account of 20,000 ac-ft will provide municipal water to North Platte communities in Wyoming, operated by the Bureau of Reclamation, providing an annual estimated firm yield of 9,600 ac-ft. The remaining balance is available to Wyoming for the benefit of the endangered species in the critical habitat in any year that the municipal demand is low. The delivery of water contributed from the municipal account would be considered in addition to the storage and delivery of water from the Pathfinder environmental account.

The amount of water available to the Program is dependent on the amount needed to supplement municipal water rights and/or mitigate excess depletions and cannot exceed the firm yield in any year. Wyoming anticipates that 4,800 ac-ft of storage water from the municipal account could be available for lease to the Program on an average annual basis (Wyoming’s December 16, 1999 proposal). The amount available to the Program will vary on a year-to-year basis depending on Wyoming’s needs. In some years no water from this account will be available to the Program, whereas, in other years, up to 9,600 ac-ft could be available to the Program.

4.10 Glendo Storage (Wyoming)

Glendo Dam is located on the North Platte River about 4.5 miles southeast of the town of Glendo, Wyoming upstream of Guernsey Reservoir.

The 1953 Order Modifying and Supplementing the North Platte Decree (1953 Order) provides for the storage of 40,000 ac-ft in Glendo Reservoir during any water year for the irrigation of lands in western Nebraska and in southeastern Wyoming below Guernsey Reservoir. Of the 40,000 ac-ft available for irrigation, 25,000 ac-ft is allocated for the irrigation of lands in western Nebraska and 15,000 ac-ft of storage is for the irrigation of lands in southeastern Wyoming.

A recent amendment of the 1953 Order, the Glendo Stipulation, relaxes the conditional use of Glendo storage water. Significant changes include:

- Use expanded to municipal, industrial, and other.
- The service area expanded from the North Platte River basin to the Platte River basin.
- Use expanded to fish and wildlife downstream of Glendo Reservoir.

Of the 15,000 ac-ft of Glendo storage water allocated to Wyoming, there are permanent contracts for 4,400 ac-ft. The remaining 10,600 ac-ft is leased by the Bureau of Reclamation under temporary water service contracts for up to one year. Wyoming is considering negotiating a permanent contract with the Bureau of Reclamation for all of the remaining 10,600 ac-ft of storage. Water in excess of that needed to meet Wyoming's contracted demands and replace their potential excess depletions would be available to the Program at an estimated 2,650 ac-ft on an average annual basis (Wyoming's December 16, 1999 proposal). Because the average annual amount that would be moved from Glendo Reservoir to the Lake McConaughy EA is relatively small, the EA manager may choose to move all of the water downstream during the month of September to minimize conveyance losses.

4.11 Temporary Water Leasing in Wyoming

A temporary water leasing program was evaluated for Reaches 1 through 4 and Reach 6. It is assumed that leasing projects are located at the mid-point of each reach because specific irrigation districts and landowners willing to participate in the Program are not yet known. The reaches are:

- Reach 1: Northgate, CO gage to Sinclair, WY gage
- Reach 2: Sinclair, WY gage to Alcova, WY gage
- Reach 3: Alcova, WY gage to Orin, WY gage
- Reach 4: Orin, WY gage to Passing Whalen Diversion Dam gage
- Reach 6: Laramie River below Grayrocks Reservoir gage to Fort Laramie, WY gage

A voluntary temporary water leasing program would provide incentives to farmers to annually lease water supplies that would otherwise have been used in irrigation. The irrigation districts or farmers would not relinquish ownership of their water rights. The amount of water available to the Program consists of the reduction in consumptive use, which is reviewed and approved by the State Engineer or Board of Control, as provided by Wyoming law. The program evaluated assumes that leased water rights are dependent on storage rights. Although it may be feasible to lease natural flow water rights, it will be more difficult to insure protection from downstream water users. To provide maximum flexibility, the mix of farms participating in the leasing program would be allowed to change over time and the length of the temporary lease allowed to vary based on the needs of the irrigation district or farmer.

The leasing program that has been analyzed considers leasing approximately 22,700 ac-ft of water supplies annually, which corresponds to about 16,400 ac-ft delivered on farm and 8,200 ac-ft of historic consumptive use.

4.12 La Prele Reservoir (Wyoming)

La Prele Reservoir is an existing irrigation and industrial supply reservoir in Wyoming located on La Prele Creek approximately 13 miles upstream of the confluence with the North Platte River. The confluence of La Prele Creek and the North Platte River is approximately 115 miles downstream of the Alcova gage.

The current capacity of the La Prele Reservoir is 20,000 ac-ft and is permitted for irrigation, domestic and industrial uses. In 1974 an agreement was made between the Douglas Water Users Association (Association) and the Panhandle Eastern Pipeline Company (PEPL) to rehabilitate the reservoir. The terms of the agreement provided that PEPL buy 5,000 ac-ft of storage space at the price equivalent to the principal and interest of a loan which was used to rehabilitate the reservoir and associated ditches.

This analysis assumes that PEPL's 5,000 ac-ft storage right in La Prele Reservoir is available for lease by the Program. PEPL's share of space in La Prele Reservoir is limited by the yield of its share and the conditions under which it may be put to beneficial use in the context of the Program.

4.13 Groundwater Management – Tamarack III

An expanded Tamarack project (Tamarack Phase III) will likely be located along the south side of the South Platte River in the Tamarack Ranch State Wildlife Area (SWA) and the Pony Express SWA, which is 40 miles upstream from the Colorado/Nebraska state line. Expanded recharge is also being considered for the Peterson and South Reservation Ditches, which divert from the South Platte River just downstream of Sedgwick, Colorado.

Colorado has proposed Tamarack Phase III in order to provide water to the Program. An expanded Tamarack project involves diverting surface water directly from the South Platte River via canals or wells located adjacent to the river. Water that is diverted or pumped is conveyed to recharge sites at various distances from the river where it is allowed to percolate into the alluvium for recharge of the groundwater aquifer. Return flows that result from such recharge accrue to the river for some duration after the recharge event depending on the hydrogeologic conditions and the distance from the site to the river. Colorado is considering sites with SDF factors ranging from 60 days to 300 days.

The Beebe Draw project was removed from the analysis. As a replacement, the yield associated with the Beebe Draw project will be provided by further expansion of Tamarack Phase III. The expanded Tamarack project is expected to reduce target flow shortages by an average of 17,000 ac-ft/yr. The facilities required for an expanded Tamarack Project include wells located adjacent to the South Platte River and existing canals that divert water from the South Platte River, including the Peterson and South Reservation Canals. Excess accretion credits associated with current ditch recharge programs that are not needed for well augmentation will also be targeted for Tamarack Phase I and Phase III.

4.14 Cost Effectiveness

The 13 projects described above are reviewed in relation to their abilities, individually and in combinations, to contribute to the flow objectives of: 1) 5,000 cfs of Program water for three days at the Overton gage when river channel and irrigation system capacity is generally high and 2) a steady 800 cfs flow of Program water at the Overton gage during the irrigation season (May 1 through September 30).

Under the first objective, consideration was given to supplementing existing flows to achieve at least 6,000 cfs in total flow (Program and non-Program water) at Overton in two out of three years. A project's contributions to achieving the flow targets are affected by: 1) the ability to control flows on a daily basis and thereby compliment flows of non-Program and other EA releases from Lake McConaughy and 2) the daily-varying remaining capacities at key points in the Platte River channels and in the irrigation systems upstream of the Overton gage.

Table 4-1 entitled " Project Summary", presents the 13 previously identified projects, their estimated yield (average annual reductions to target flow shortages at the critical habitat), and the estimated unit cost of that yield in 1999 price levels (from Table VI-1 of the Water Action Plan). The table also shows the maximum one-day and three-day contributions that each Project could make toward the 5,000 cfs flow target if the Project could be operated such that the entire annual yield could be delivered to the Overton gage instantaneously, without transit losses, and without conveyance capacity or ramping constraints. The maximum flow rate that could result if all these Projects were on-line simultaneously and operating under these perfect conditions is about 10,000 cfs or approximately double the target rate of 5,000 cfs. Table 4-1 also shows whether the Projects are capable of controlling releases on a daily basis to contribute to the pulse flows, where the Projects would potentially deliver water to the river and irrigation systems or to storage and the travel times for the flows to reach the Overton gage. Of the 13 Projects identified previously, up to 11 could provide flows manageable on a daily basis, if suitable arrangements can be made to deliver the project yield into either the EA or into new or existing storage along the CNPPID's system. Table 4-1 also shows the limited capability of the Projects to meet the 800 cfs irrigation season targets. If all 13 Projects are used solely to meet this objective and there are no transit losses or flow constraints the entire yield of the projects could contribute only about 210 cfs of the 800 cfs target. The precise timing needed to provide Program water to compliment other flows is discussed in the previous section. A 5,000 cfs flow for a three-day duration is equivalent to a volume of 29,800 ac-ft almost half of the total average annual storage reduction identified in the Water Action Plan. An 800 cfs flow for the irrigation season (153 days) is about 243,000 ac-ft or 3.8 times the average annual shortage reduction identified in the Water Action Plan. The Water Action Plan states, "As more in-depth analyses of the project yields and costs are completed, the Governance Committee may choose to replace projects in the Water Action Plan with alternative projects. Each state has expressed its desire to reserve the right to add or remove projects from consideration in the future if an issue arises that cannot be resolved. Circumstances that might result in a project being added to the Water Action Plan include insufficient yield to meet the water goals of the program. A project can be removed from the Water Action Plan if the project is not implementable within the first increment (13 years), generates significantly less yield than was anticipated, is too expensive, is unacceptable to the Governance

Committee for other reasons, or if an agreement cannot be negotiated with the project sponsor. New projects may or may not require a supplement to the Programmatic FEIS. Elements of the Water Action Plan will be subject to site specific National Environmental Policy Act (NEPA) and ESA review as appropriate." (PPRCA 2000).

Modeling results show that for these projects to be effective in meeting the timing of the pulse flow, the water will need to be managed on a daily basis. Work in Phase II will refine the ability to move water into the EA and also to provide water closer to the Critical Habitat.

Table 4-1
Project Summary

	Projects or Elements (from the Water Action Plan BOYLE, 2000)	Annual Yield[1] (ac-ft)	Maximum One Day Contribution to a 5,000 cfs flow (cfs)[2]	Maximum Three Day Contribution to a 5,000 cfs flow (cfs)[2]	Controllable Releases[3]	Potential Delivery or Storage Location(s)[4]	Travel Time to Overton (Days)	Unit Cost ($/ac-ft)[5]	Combine with EA or other storage	Maximum Contribution to 800 cfs target for 153 days (cfs)	Comments
1.	CNPPID Re-regulating Reservoir	5,500	2,800	920	Yes	J2 Return or EA?	J2 – 0 NEA – 4	$790 - $1,720	Not Needed	18	Deliveries to and from the reservoir subject capacity available in the CNPPID system
2.	Water Leasing – Nebraska	7,000	3,500	1,180	Yes	EA	4	$840 - $1,880	Yes	23	Configured to exchange water into the NEA subject to capacity availability
3.	Water Management Incentives	7,000	3,500	1,180	Yes	EA	4	$780 - $3,160	Yes	23	Configured to exchange water into the NEA subject to capacity availability
4.	GW Management	1,400	700	240	Yes	J2 Return or EA	0-4	$510	Possibly	5	Configured to exchange water into the NEA subject to capacity availability
5.	Dry Creek/ Ft. Kearny Cutoffs	4,400	2,200	740	Partially	Platte R. near Kearney	1	$340	No	15	Best used to meet 800 cfs flow target and ave. annual shortage reductions
6.	Dawson/ Gothenberg GW Recharge	1,800	900	300	No	Gothenburg to Overton	Indefinite Lag	$460	No	6	Best used to meet 800 cfs flow target and ave. annual shortage reductions
7.	Power Interference	1,400	700	240	Yes	EA	4	$1,030	NEA – Yes Other – Possibly	5	Configured to exchange water into the NEA subject to capacity availability
8.	Net Controllable Conserved Water[6]	4,500	2,300	760	Yes	EA	4	$600	Yes	15	Configured to exchange water into the NEA subject to capacity availability
9.	Pathfinder Municipal Account	4,800	2,400	800	Yes	EA	4	$420	Possibly	16	Configured to exchange water into the NEA subject to capacity availability
10.	Glendo Storage	2,650	1,400	450	Yes	EA	4	$40 - $660	Possibly	9	Configured to exchange water into the NEA subject to capacity availability
11.	Water Leasing – Wyoming	3,900	1,900	590	Possibly	EA	4	$630	Yes	13	Configured to exchange water into the NEA subject to capacity availability
12.	LaPrele Reservoir	2,200	1,100	370	Yes	EA	4	$1,280	Possibly	7	Configured to exchange water into the NEA subject to capacity availability
13.	Tamarack – Phase III	17,000	8,500	2,860	No	South Platte R.	Indefinite Lag	$460	No (possibly by exchange)	56	Best used to meet 800 cfs flow target and ave. annual shortage reductions
	Total	**63,550**	**31,900**	**10,630**				**$580 - $1,070**		**211**	

(1) Annual average reductions in shortages to target flows as reported in the Water Action Plan (Boyle, 2000)

(2) Flows that would result if the entire annual yield could be managed to occur for the specified duration.

(3) Controllable Releases – Water made available to the Program through implementation of the project or element can contribute to the 5,000 cfs, three-day flow by managed daily flows.

(4) EA – Environmental Account in Lake McConaughy.

(5) Unit Cost of average annual yield as reported in the Water Action Plan (Boyle, 2000)

(6) Per interview with CNPPID personnel (see Appendix 1 and Section 4.8) the revised volume of Net Controllable Conserved Water is 10,900 ac-ft.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Phase I of the WMS evaluated the ability to provide pulse flows of 5,000 cfs of Program water (during low-use periods) and deliveries of 800 cfs of Program water (during the irrigation season) on the Platte River to the gage at Overton, NE. The occurrences of total flow greater than 6,000 cfs were also evaluated. Environmental Account (EA) releases from Lake McConaughy and managed return flows from the Tamarack I Project on the South Platte River in Colorado comprised the sources of Program water. Flow capacities of the Districts' systems and in the North Platte River constrain the delivery of Program water to achieve the target flows. The 5,000 cfs target for Program water is met in some years for a single day, but not for the preferred three day duration. The 800 cfs target flow could be met on most days, but would require a significant volume of Program water (more than 200,000 to 240,000 ac-ft at Overton depending on the definition of the target period).

The thirteen projects identified in the Water Action Plan and the potential of each to contribute to the flow targets were also characterized as part of Phase I. Results from the routing analyses demonstrate that to be effective in meeting the pulse flow targets, the water from these projects will need to be managed either in Lake McConaughy or with other existing or new storage facilities near the Critical Habitat.

The following expands on the main conclusions and presents recommendations for consideration by the Governance Committee for Phase II of the Water Management Study or other future efforts.

5.1 Conclusions

- <u>5,000 cfs Program water - Case I (Districts divert Program water)</u>:
  - Pulse flows of 5,000 cfs of Program water can be achieved about every 1 in 3 years, but only for one day of the three day target duration. The 5,000 cfs is not achieved in any of the Wet years of the study period.
  - The required volume of EA water necessary to be released from Lake McConaughy (from the current and potential projects) is significant for each water year classification in Case I. The average release of EA water is

approximately 72,000 ac-ft in Wet years to nearly 100,000 ac-ft in Dry years to achieve average peak Program water flows ranging from 3,800 cfs to 5,200 cfs for one day.

- o Shortages to the 5,000 cfs target flow occur for various reasons for Case I, including:
  - ▪ North Platte River capacity at North Platte
  - ▪ Capacity and ramping rates of the Keystone Diversion, capacity in Sutherland Canal, and capacity and ramping rates at the North Platte Hydro Return
  - ▪ Regulating capacity in Johnson Lake, both volume and time of year per the "Bypass Agreement"

- <u>5,000 cfs Program water - Case II (Districts Bypass):</u>
  - o The average peak flow of Program water reaching Overton is 2,500 cfs for Average, Wet, and Dry years. The average volume for the 3 day pulse flow is approximately 14,500 ac-ft, approximately half of the target three-day volume.
  - o The required volume of EA releases range from 41,000 ac-ft in average years to 46,300 ac-ft in wet years.
  - o The constraint to target flows in Case II is the choke point capacity on the North Platte River at North Platte.

- <u>6,000 cfs for 3 days at Overton:</u>
  - ▪ Flows in excess of 6,000 cfs occur for durations of 3 days or more approximately 1 in 3 years, in contrast to the goal of 2 in 3 years.
  - ▪ On occasion, EA water contributes to the flow in excess of 6,000 cfs. However, the flow is never entirely EA water. Most occurrences of these target flows are a result of historical flows.

- 800 cfs Program water - Cases I and II:
  - The 800 cfs of Program water for May-September is achievable on most days for each year type assuming there were to be adequate EA water in storage at the start of each year. The 800 cfs flow target equates to a volume of Program water of about 200,000 to 240,000 ac-ft per season, depending on the duration (given either a May 1 or May 11 start date through September 15 or September 30). Releases from Lake McConaughy, in an attempt to meet this target, range from about 280,000 ac-ft in Wet years (Case II), to about 580,000 ac-ft in Dry years (Case II), when losses are highest. Part of the flow target is met by yields of the Tamarack I project on the South Platte, but these are small compared to the required release from Lake McConaughy.
  - Shortages occur on individual days due to system capacity constraints. Shortages are typically a result of:
    - North Platte River capacity at North Platte
    - North Platte River below Keystone ramping limitation
    - Capacity and ramping rates of the Keystone Diversion, capacity in Sutherland Canal, and capacity and ramping rates at the North Platte Hydro Return
- Assessment of the 13 Water Action Plan Projects:
  - The maximum flow rate that could result if all thirteen of these Projects were on-line simultaneously and operating under perfect conditions is about 10,000 cfs or approximately double the target rate of 5,000 cfs.
  - If all thirteen Projects are used solely to meet the 800 cfs objective and there are no transit losses or flow constraints, the entire yield of the projects could contribute only about 210 cfs of the 800 cfs target (250 cfs if the effective period is May 11 to September 15).
  - Of the 13 Projects identified previously, up to 11 could provide flows

manageable on a daily basis, if suitable arrangements can be made to deliver or exchange the project yield into either the EA or into new or existing storage along the CNPPID's system. Modeling results show that for these projects to be effective in meeting the timing of the pulse flow, the water will need to be managed either in Lake McConaughy or by other managed capacities to allow for a timed release.

5.2 Recommendations and Key Issues for Further Analysis

- The routing tool was developed with the ability to adjust system constraints and for sensitivity analyses. With input from the Governance Committee on which constraints to evaluate, the ability to meet flow targets and the estimated volume of EA water required to meet the flow targets in the WMS should be refined. It is recommended the following limitations be evaluated in the sensitivity analysis: the capacity at the North Platte choke point, Johnson Lake reregulation capacity, and ramping rates for the North Platte River, Keystone Diversion, and North Platte Hydro Return.

- The routing tool was developed to facilitate the evaluation of 60 years of data for four different scenarios while minimizing user input and reporting essential values for this study. Further refinement in the input, output, and flexibility of operations will benefit Phase II of the WMS.

- The development on the daily loss rates and travel times were developed on an empirical basis from historic events. These estimates should be refined based on monitoring planned releases at strategic points in the system.

- The routing tool is currently based on losses and travel times in canals being equal to those of the river channel. If the potential for water savings or shorter travel times exists, further investigation of the differences of the two systems should be considered.

- Flood stages for the Platte River reaches were estimated based on readily available information from the National Weather Service, and the most recent rating curve available for individual gage locations. Areas of greater uncertainty, or of more significant impact, should be refined in determining the limitations to a pulse flow. The presence of development, vegetation, or debris build up in areas of potential flooding warrant further analysis. The capacities at Brady, Cozad, and Overton should be evaluated further. If the current estimates of flood stage are overstated these locations could potentially be choke points to the goal of the pulse flow.

- The additional evaluation of the thirteen alternatives and additional alternatives in Phase II are likely to focus on how to place water in the EA in Lake McConaughy or other management opportunities in addition to projects closer to the Critical Habitat.
- There is a potential for use of District(s) deliveries to increase flows during short-duration rainfall events instead of curtailing irrigation deliveries during low demand periods. If District water is used in this fashion, the volume of water used to enhance the pulse flow would need to be determined, and a like amount from the EA would be assigned to the District(s) shortly thereafter. This type of exchange could help with the routing issue and enhance pulse flows. This potential operation requires further analysis in Phase II.

6.0 REFERENCES

Boyle Engineering Corporation, *Water Conservation/Supply Reconnaissance Study*, Governance Committee of the Cooperative Agreement for Platte River Research, December 1999

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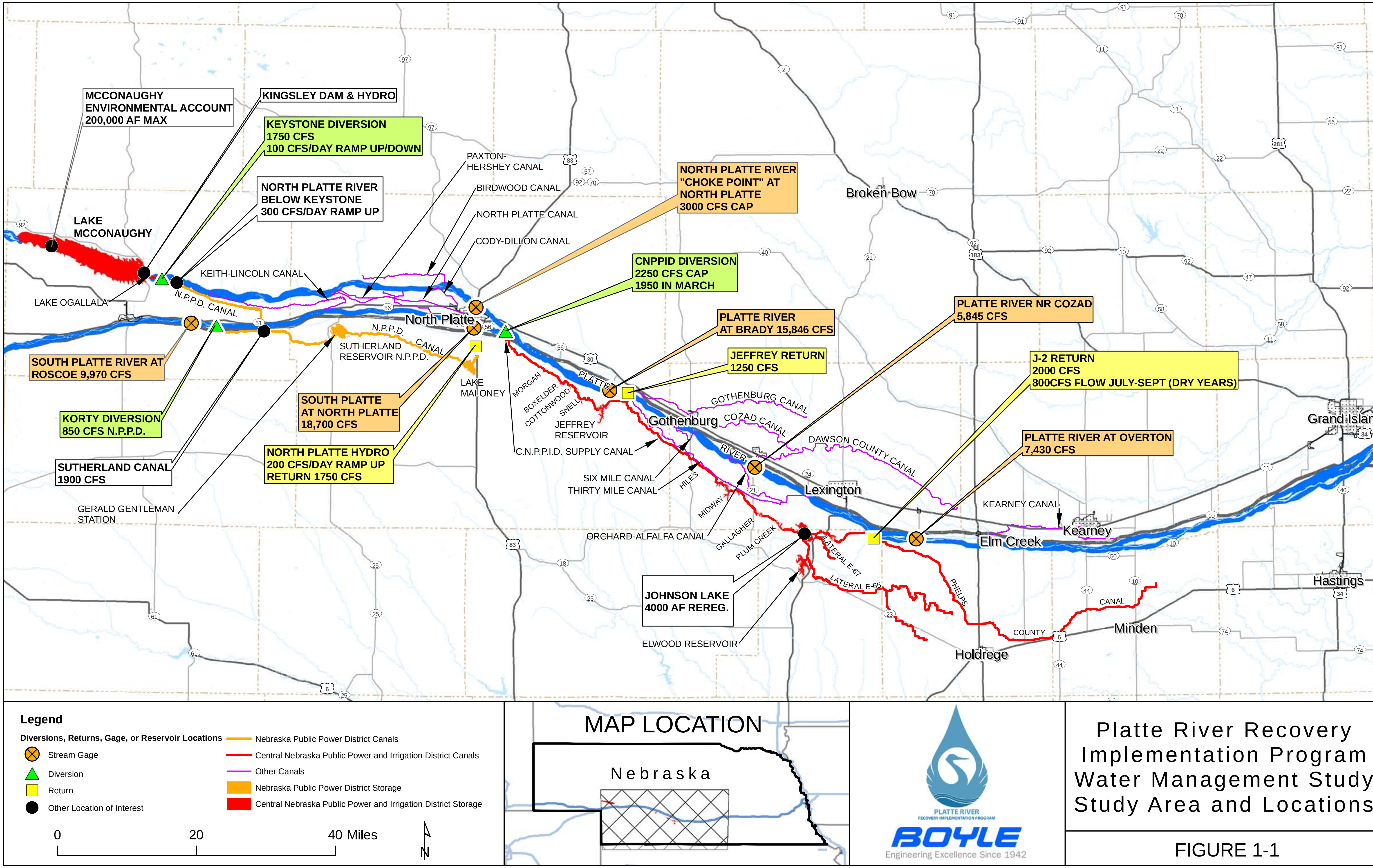
U.S. Department of Interior (USDOI), *Platte River Recovery Implementation Program Final Environmental Impact Statement*, April 2006



Platte River Recovery Implementation Program Water Management Study Study Area and Locations

FIGURE 1-1

WATER MANAGEMENT STUDY, PHASE I
EVALUATION OF PULSE FLOWS FOR THE PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

Phase I Report
April 8, 2008

APPENDIX 1

WMS Interview Meeting Notes

PRRIP WMS – MEETING NOTES

Conversation With: Mark Butler and Don Anderson **By:** Jeff Bandy

Of: USFWS **Job Number:** 16930.00

Subject: Platte River WMS – Project Interview **File No.:**

Date: 8/2/07 **Time:** 9:00 AM **Cross File:**

☒ **Office Visit/Meeting** ☐ **Telephone Call** **Telephone No.:**

Notes:

Jeff Bandy and Blaine Dwyer of Boyle Engineering met with Mark Butler and Don Anderson of USFWS (FWS) at the FWS offices on August 2, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

The discussion started with the reiteration that the objective of the study was to identify how Program water could be used in the system to supplement flows in the Platte River in central Nebraska. Two flow targets currently under study- 5,000 cfs of Program water during months of low demand on the river, and 800 cfs of Program water during the irrigation season. The 5,000 cfs is a pulse flow for 2-3 days that, when run in conjunction with the natural flow could produce pulse flows of 6,000 to 9,000 cfs in the target reach. Mark and Don pointed out that the 5,000 cfs pulse flow is more of a retiming of deliveries and capacity issue, whereas the 800 cfs irrigation season flow may benefit from the steadier contributions potentially met by certain Water Action Plan projects (leasing, fallowing, land management, etc). However, any of these projects that can re-time flows, may contribute to the pulse flows. Also, these projects may have benefit in reducing flows at the choke point (conservation, etc. leaving more room for program water).

Mark and Don discussed that these target flows are a recognition during the EIS that the reduction in shortages by 130k to 150k AF alone was not enough to achieve the goals of the Program. The pulse flows are needed to scour vegetation and build the sand bars. The 800 cfs of Program water is intended to augment the May 11-Sept 15 flow period (1,200 cfs target), with the purposes outlined in the Service's "Instream Flow Recommendations" document.

The 'choke point' in the river was discussed in relation to delivering flows from Lake McConaughy past North Platte. The official flood stage near North Platte is approx. 1,980 cfs (though perhaps as low as 1500-1600 cfs). Work is under way to improve the capacity of the channel at this point. In the future, and for the purposes of the WMS, a capacity of 3,000 cfs is anticipated. FWS suggested performing a simple sensitivity analysis to this capacity as part of the WMS.

Don discussed ramping rates that might limit delivery of flows to the target reach. Don believed CNPPID requests that ramping be limited to 300 cfs/day below Lake McConaughy. The reason for this limit is the potential for mobilizing debris along the river and impacting diversion structures. FWS hopes to improve the ramping rate constraints with the implementation of an early warning system to notify diverters of an imminent rise. Don suggested we confirm these existing constraints with CNPPID.

Ramping concerns of NPPD are on the order of 100 cfs/day at the Keystone Diversion. Ramping rates are not as much of a concern below the confluence areas; they may exist, but haven't been fully discussed.

The choke point and ramping rates factor in to the total volume and timing of releases from the Environmental Account (EA) in Lake McConaughy. Quantifying this total volume of water is part of the WMS scope.

Mark and Don discussed the suggestion by the Districts of reregulation of flow on the systems and also bypassing the flows in accordance with Case I and II in the RFP and WMS Scope. Don suggested that previous analyses show that a combined approach of reregulation and bypassing may be required in drier years. Central is considering the possibility of 4,000 AF of regulating capacity in Johnson Reservoir with the potential to go as high as 12,000 AF in the system. (Reference to the Bypass Agreement in Attachment 5, Section 1.) NPPD may have up to 2,000 AF of reregulating capacity.

Don provided Boyle the Illustrative Case Summary memo that was prepared by FWS, CNPPID, and NPPD dated 8/29/05. This analysis looked at likely pulse flow magnitudes and durations achievable under different scenarios of EA water deliveries. Boyle will review this document for reference in developing the loss and routing spreadsheets. As a note, in previous modeling, the EA in McConaughy maxed out at about 130-135KAF.

FWS suggested looking at interruptible supplies to farmers as another management option to be considered. Perhaps scheduled interruptions for 1 or 2 days.

Mark reiterated that the current WMS is to focus more on the 'plumbing'; that is, how Program water flows through the system.

Action: ☒ **Yes** ☐ **No**

Boyle to touch base with Jeff Runge of FWS Field Office in Grand Island. Jeff Bandy will contact him to interview on NE trip.

Don offered to supply Boyle with the Vol. 3 CD and the Cost memo developed by Jeff Runge. – Done.

PRRIP WMS – MEETING NOTES

Conversation With: Jeff Runge **By:** Jeff Bandy

Of: US Fish and Wildlife Service, Grand Island, NE **Job Number:** 16930.00

Subject: Platte River Recovery Program Water Management Study **File No.:**

Date: 9/5/07 **Time:** 3:30 PM **Cross File:**

☒ **Office Visit/Meeting** ☐ **Telephone Call** **Telephone No.:**

Notes:

At the suggestion of Mark Butler and Don Anderson, Jeff Bandy and Blaine Dwyer of Boyle Engineering, with Becky Mitchell of Headwaters Corp., met with Jeff Runge of the US Fish and Wildlife Service on September 5, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

The meeting started with Jeff Runge walking through his November, 2006 memo on "Associated Costs". Jeff explained the types of costs and the highlights of each. The framework for his analysis was looking at constraints in the system and exceedances of those constraints and how they might impact the Program, Program Participants, and Good Neighbors. "Associated Costs" refers to impacts to NPPD and CNPPID. "Good Neighbor Impacts" are those impacts incurred by private citizens or organizations.

For purposes of the associated costs analysis, Jeff looked at providing 5,000 cfs of total flow to the habitat downstream.

- Associated Cost #1 – 100 cfs ramp rate at NPPD Keystone
  The potential impacts of ramping higher than the 100 cfs rate are canal wall collapse and bank sloughing in Lake Maloney. Canal wall collapse and bank sloughing could also lead to more significant impacts such as power interference and lost irrigation deliveries. According to NPPD officials, the higher exceedeances of this rate in the record are likely due to errors in the gage. Jeff agreed that NPPD would not attempt to exceed the ramp rate by a significant amount because of the potential impacts.

- Associated Cost #2 – Johnson Reservoir Re-Regulation
  The potential impact to Johnson Reservoir is bank sloughing due to too rapid of drawdown. The drawdown limitation is 4,000 AF in 3 days. This appears to have been exceeded in the past without known impacts. The average historic re-regulation is 4,922 AF. Historically, Johnson Reservoir has not been used for irrigation, but has been recently due to drought.

- Associated Cost #3 – Cavitation damage, tailrace damage if exceed normal capacity canal flow at Johnson and Maloney reservoirs.
  Flows cycling from 0-1750 cfs have occurred in the past.

- Associated Cost #4 – Transmission Costs, lost hydro generation if water is not passed through system.

- Associated Cost #5 – damage to private diversion structures/ sand dams
  This cost is the concern that high flows may damage diversion structures and sand dams on the river, for which the Program might be liable. Jeff pointed to a recent rainfall event resulting with corresponding flows of 1300 and 3200 cfs at Brady and Cozad, respectively. (Values to be verified). Observed damage associated with the Orchard-Alfalfa canal was likely due to localized rainfall and not from upstream river flows because the Platte River Sand Dam restricts inflows to the Orchard-Alfalfa diversion.
  Jeff discussed the known breach at Cozad that was fixed in 2004, and that this was not impacted by the peak flow in 2007. Examples of sand dams on the river are at 30-mile and Gothenburg Canals.

- Associated Cost #6 – Damage to Tern/Plover nesting islands
  Maintenance of certain tern and plover nesting areas are a condition of the Districts' FERC licensing.
  Erosion is constantly occurring at these sites, so there is the need to separate and distinguish from a 1-time event in terms of cost.

- Good Neighbor Impact #1: 300 cfs ramp rate on North Platte River
  The 300 cfs ramp rate on the North Platte is in place to prevent damages due to debris buildup. The ramp down is not a concern, and therefore not limited. The at-risk canals for debris damage are the Paxton-Hensley and the North Platte canals whose potential for debris accumulation is relatively minor because of their close proximity to the Keith –Lincoln Canal diversion.

- Good Neighbor Impact #2: Private diversion structure damage.
  Opinion that the structure most "at risk" of damage is Orchard Alfalfa which is protected from low level peak flows by the upstream Platte River Sand Dam.

- Good Neighbor Impact #3: Risk of wind erosion / wave erosion of Johnson Reservoir
  The 4,000 AF of regulation corresponds to approximately 1.7 – 1.8 feet of elevation change. Fluctuations on the order of 4-5 feet have occurred, with as much as 12 feet in the last few years as a result of water conservation actions implemented by CNPPID.

- Good Neighbor Impact #4: Improving lower lake access in Johnson Reservoir.
  By lowering the lake, it may limit access to the boat ramps. Currently the boat ramp access has been lowered to 2,610 ft.

- Good Neighbor Impact #5, Reservoir fisheries in Johnson Reservoir.
  The impact of concern is primarily the young of year fish. There is not really a way to avoid this, therefore restocking is the likely solution.

Given these costs and impacts, Jeff suggested looking at the following possible strategies:

- Increasing the ramp rate on the North Platte

- o Improving the choke point capacity beyond the historic 3,000 cfs safe channel capacity if possible.
- o Combine pulse flows from McConaughy with high water events from the South Platte
- o Possibility of getting EA water into South Platte channel if an economical method exists
- o Continue to look at re-regulation possibilities with the Districts

There is the potential for a choke point in upper reach of the Platte River; likely a result of phragmites.

Service would like to test (in 2008 or so):

- o May use 300 cfs ramp rate on North Platte
- o Use 4,000 AF of Johnson Reservoir

The plan depends on the outcomes of the WMS and weighing the benefits with associated costs.

Jeff discussed general issues or constraints on the system to be considered:

- o During wetter conditions, the canals are likely full, so Program will need to rely more on river capacity to move water downstream.
- o The Keystone Canal System is inefficient in conveying large volumes of EA water efficiently because of the restricted ramp rate. Testing exceedances of the ramp rate may be difficult due to the potential impacts.
- o Currently under existing drought conditions, it would be difficult to make releases out of Johnson and Jeffrey in September as they are typically drawn down as a result of water conservation actions implemented by CNPPID. It would be difficult to convey EA water through the system when the above conditions exist.
- o Currently under existing drought conditions, Maloney Reservoir is cut off after the irrigation season, and fills again in late May. It incurs evaporation losses over the winter. Maloney is currently not storing over the winter due to drought conditions. It would be difficult to convey EA water through this system when the above conditions exist.
- o Drought years in general are difficult to move EA pulse water through the system due to large losses.

Current management of the Environmental Account in Lake McConaughy:

- o Currently at 130,000-140,000 AF
- o 50,000 AF of releases were made in 2007 to prevent zero flow conditions in the river. The target in 2007 was to get 500 cfs to Grand Island, with a release of 800 cfs.
- o The EA gets 10% of storable inflow during the non-irrigation season.
- o Maybe fill back up to 110,000 to 120,000 AF next year, the maximum is 200,000 AF

Jeff mentioned there was a good event in 2005 that resulted in approximately 6,000 cfs at Grand Island.

Moving forward, Jeff is interested in refining the costs estimates for each of the Associated Cost and Good Neighbor Impacts. The refined cost estimates will assist Boyle Engineering and the Platte River Recovery Implementation Program in identifying system constraints that can be “tested” with minimal risk of incurred financial impact. This will help when looking at the benefits and costs and the best way to move forward.

Action: ☒ **Yes** ☐ **No**

Jeff provided his cost memo electronically and later followed up with an email containing meeting notes from the pulse flow sub-committee.

PRRIP WMS – MEETING NOTES

Conversation With: Don Kraus, Mike Drain, and Cory Steinke **By:** Jeff Bandy

Of: Central Nebraska Public Power and Irrigation District **Job Number:** 16930.00

Subject: Platte River Recovery Program Water Management Study **File No.:**

Date: 9/6/07 **Time:** 8:30-2:00 **Cross File:**

☒ **Office Visit/Meeting** ☐ **Telephone Call** **Telephone No.:**

Notes:

Jeff Bandy and Blaine Dwyer of Boyle Engineering, with Becky Mitchell of Headwaters Corp., met with Don Kraus, Mike Drain, and Cory Steinke of Central Nebraska Public Power and Irrigation District (CNPPID) on September 6, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

Mike expressed concern that a monthly spreadsheet model is not useful in analyzing a 5,000 cfs pulse flow. He suggested that looking at historic events and timing for development of the routing.

Mike and Cory discussed historic and recent conditions on the river, highlighting specific events that would be beneficial to consider in relation to the WMS:

Two or three 'good' pulse flows occurred naturally during the winter of 2007. One of which was a result of an ice melt event near North Platte in February or March. Flows from this event made it as far downstream as the Central Platte area. Suggested to look at records for North Platte and Overton gages.

Around June 1, 2007 flow at Overton was approximately 5,000 cfs.
Also around June 15, 2007 flow in the Platte was approximately 3,900 cfs at Central's diversion.

In July 2006 a breach occurred on the supply canal, approximately 1.6 miles from the diversion. The diversion was shut down, resulting in a bypass of 2,200 cfs at North Platte. The corresponding peak flow at Brady was approximately 300 cfs. (To be confirmed.)

The Korty flood occurred on July 5, in either 2001 or 2002. This was the result of a rain event with a peak flow of 11,000 cfs on the South Platte at Roscoe. The Western Canal breached at either the ramp or bridge on Interstate. This event should be looked at to gage the high level of attenuation.

The summer of 2006 saw some of the highest losses in the river.

Summer of 2007 levels were close to flood stage at Cozad (June 1, 2). North Platte was also close.

The North Platte diversion can divert 2250 cfs, passing nearly zero flow downstream.

PWAP model calculates loss by assessing evaporation per river reach and assigning the remaining loss based on the difference in gage values. The model is an accounting model rather than having predictive capabilities for determining losses. It also assumes travel time between gages is 1 day, which is not always the case.

The growth of phragmites on the river are increasing the travel time and therefore affecting 'watering up' of the system. The prevalence of phragmites started around 2002 and this should be captured in the gage records for this period and later.

Mike and Cory walked through the CNPPID (and part NPPD) system and operations. The operations and comments are not in any particular stream or system order:

The travel time from McConaughy to Central's diversion is approximately 2 days. This will affect the timeliness of setting pulse flows downstream. Confirmed the ramp rate of 300 cfs on the North Platte.

McConaughy can release to either NPPD or to the North Platte. CNPPID can then pick up at North Platte. CNPPIDs diversion can pick up anything in the Platte up to 2250 cfs.

CNPPID can return water back to the river at Jeffrey, downstream of Brady at a maximum rate of 1250 cfs. If this release is made here, the water leaves the system and does not make it to Johnson Reservoir and reduces the potential quantity or duration that water could be returned at the J2 Return.

The J-2 return, just downstream of Lexington, and above Overton, may be the best place to return to the river. The capacity of the J-2 is 2,000 cfs. During the irrigation season, J-2 may be able to return about 1200 cfs.

From an operational point of view, the smaller reservoirs on the Supply Canal should not be considered. These reservoirs do not have controls on them.

Travel time through the system is essentially the same as in the river.

Running water through the system instead of the river allows for the opportunity of 2 different return locations.

The District generally does not bypass around the hydros except for maintenance. At one time in the past they have run a bypass for about four months, and needed to repair the apron afterwards. Jeffrey hydro does not have a bypass.

Diversions to Jeffrey Reservoir lose about 250 cfs when run at full capacity. Losses between Jeffrey and Johnson are about 150-200 cfs. However, for accounting purposes, losses are assigned equivalent to what would have been calculated with PWAP.

Elwood Reservoir begins filling in mid March and continues until about June 10 or 15. Water is diverted from the Supply Canal into the E65 Canal upstream from Johnson Lake to fill Elwood. Releases from Elwood are made for irrigation.

The NPPD return releases to the South Platte which enters the Platte downstream of the choke point on the North Platte at Hwy 83.

During drought mode operations, Lake Maloney is dropped over the winter. To make releases from NPPD to river, Lake Maloney would need to fill with EA water.

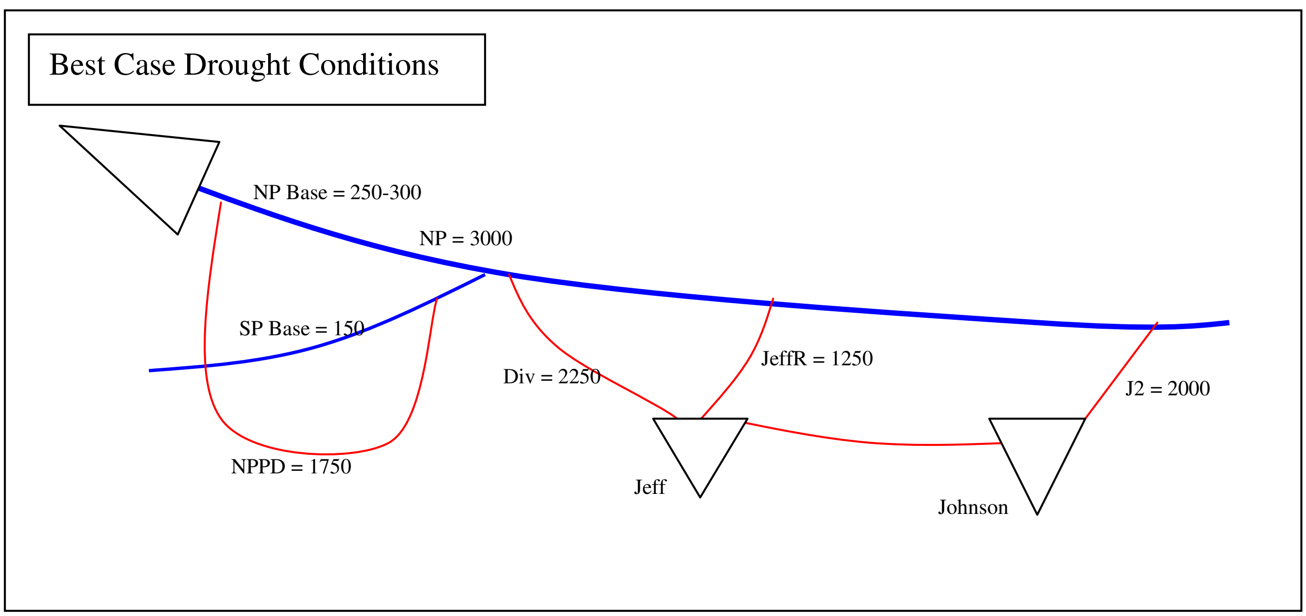
Johnson Lake can currently provide up to 4,000 AF of re-regulation storage for release to the pulse flow. This corresponds to approximately 1.7 feet in elevation. The 4,000 AF is available first as a test with up to 12,000 AF per year depending on the results of the test. The 12,000 AF volume is an annual limit, and individual events may be less limited by acceptable fluctuations in lake levels.

If Lake McConaughy and NPPD North Platte Hydro releases are turned off, the flow through CNPPID's system is approximately 350 – 500 cfs.

Flood stages on the Platte River are determined by the NWS based on stage. This measurement isn't adjusted for shifts in the rating. A summary table of the flood stages is available, perhaps from Don Anderson.

During drought years, a best case scenarios for releases to the river from the Districts (McConaughy EA water) are itemized and illustrated below. Note: These peak rates may be limited in duration.

- 1,750 cfs from NPPD to the South Platte (add 150 base flow)
- 3,000 cfs maximum in the North Platte (250-300 base flow)
- 2,250 cfs diverted (if flows are under 2250, passing flows are zero)
- 2,250 cfs to Jeffrey with 1,250 returning
- 2,000 cfs return at J-2
- Sum = 1750 NPPD + 1250 Jeff + 2000 J-2 = 5000 cfs



CNPPID does not have ramping rates with the exception of on the North Platte. The 300 cfs ramping rate limit is in place to protect sand dams. The district calls structure owners with changes in flows. FWS has new agreements on the operations of the J-2 return as related to hydrocycling, but these should not be a limitation in this study.

Discussion of Water Action Plan Solutions and 'other solutions':

Power Interference: The primary concept is for the Program to pay the Districts not to release from McConaughy, and build the EA. This does not do much to solve the plumbing issue of the pulse flow. Another power interference concept is to pay the Districts not to divert the EA water through their systems.

Timing of Pulse Flow mid summer if demands low:
There is potential to make a pulse flow delivery during the irrigation season given the right hydrologic events. During a rain event, rather than holding water back in canals and local storage, release on top of the natural flow and replace with EA water in subsequent days. This concept is described on pg. 3-41 of the DEIS. It has also been discussed at the pulse flow committee meetings. June of 2007 may have been the best chance to accomplish this year. This concept may not be preferred by FWS because the pulse is not in the spring period that they prefer.

Re-regulating Reservoirs:
Re-regulation reservoirs have the greatest ability to meet the pulse flow targets. The reservoirs identified in the HDR report might be reconsidered with larger outlet works capacities sized to meet the pulse flows. The previous studies considered smaller flows.

In addition to the reservoir sites in the WAP and HDR study, other sites are under consideration by the District and are discussed here:

Elwood Reservoir:

- Existing reservoir that Central does not use all of the time
- Currently the reservoir is filled outside of irrigation season and release during irrigation
- If used for Program, will need to modify for release to river via Plum Creek
- Large operating costs resulting from the required pumping
- Three operating scenarios are possible:
    - Scenario 1: Probably fill twice – fill in fall for program release, and in early spring 2nd fill for irrigation use
    - Scenario 2: Use when so low that not being used for irrigation season (for example, next year and last 3 years) – only used in full delivery years
    - Scenario 3: Eliminate need for Elwood for irrigation use. Combined canal and reservoir outflow around 500 cfs. The need below Elwood is greater than upstream canal capacity, therefore by increasing the canal capacity to meet irrigation demand; this would negate the need for the reservoir.
- The attraction is the benefit of dam and reservoir for the cost of choke point improvements; However, would need to replace/improve/parallel 3 large diameter (6 ½', 7'or 7 ½') siphons
- Flows downstream to Plum Creek would be a potential issue.

- Dam is in OK shape, built in late 70s; pumps working OK
- 3 constant speed pumps
- Existing outlet tube sized for 350 cfs
- Current annual pump costs $50 - $70 K
- Existing cap ≈ 25,700 AF, but pump up to 40,000 AF.
- Could fill with natural flow or EA water. Natural flow would require permit.
- Central has looked for a feasible gravity feed, but have not yet found it.
- Also other interest in Elwood as recharge supply

Phelps 9.8 Reservoir (aka "Kirkman" or "9.8 Reservoir")

- Not Developed
- Feed off of Phelps canal
- Gravity fill, release to Platte
- Pros:
  - Close to river with a high release rate
  - Multi-purpose Reservoir- share with District to buffer irrigation demand, and dampen outflows to benefit limits on J-2 return (eliminates hydrocycling).
- Cons:
  - Moves placement of water farther downstream – past Overton bridge.
  - Requires road and bridge work
- Capacity is estimated at 3,000 AF
- Located 9.8 miles along Phelps canal from J-2 return
- Maybe supplement releases from Johnson Lake

J-2 Return Pool Reservoir:

- Not Developed
- Located near J-2 return, bounded by Supply Canal, Phelps Canal, RD 435, and RD 749.
- A section of the canal is a fill section, and this would act as part of the embankment; the remaining embankment is cut and fill.
- Gravity in and gravity out
- Pros:
  - Located near river
  - Perhaps add outlet to river
  - Current use is corn land (known cost $3000/ac)
  - Potential to re-route road or make into a cellular structure
- Cons:
  - Need to modify canal structures

Robb Lake (Jeffrey Island Reservoir):

- Not Developed
- Located near Jeffrey Island, on south channel
- Concept: Dam South Channel
- J-2 returns to South channel
- Jeffrey Island is 7 miles long, providing several possible sites
- Potential clear water return issue that might move degradation area downstream
- But, perhaps move sand introduction downstream (needs to be placed anyway)

- o Drainage area is small
- o Empty channel is a result of u/s dike crossing south channel

J-2 Forebay Lake Reservoir

- o Take water off of a finger of the existing reservoir
- o Outlet would require modifications of canal
- o See HDR Report, 5380 AF in HDR report vs. 3436 AF in WAP

Water Leasing:

- o If leased enough water, could help with the 800 cfs target by moving deliveries to the river
- o Doesn't do much for 5000 cfs, except as if stored
- o Can shift used channel capacity from irrigation to program flows
- o Likely a lease would cover both natural flow and storage water
- o If 3,000 cfs can pass choke point, likely can get 800 cfs downstream

Water Management Incentives:

- o Similar to Water Leasing

Groundwater Management:

- o To meet pulse – only if actual active pumping (say 2-3 cfs per well)
- o Could help with the 800 cfs
- o Other options are viable, but limited in yield
- o Mound has declined somewhat due to the drought (up a small amount this last year, but down overall for drought period)

Dry Creek/Fort Kearney Cutoff:

- o Tributary flows in previous study are now dried up (for past 4 or 5 years)
- o Idea in Water Action Plan was to return water to river via canal and to add pumped water.
- o Possibility/Interest in using waste water from an Ethanol plant south of Kearney
- o Concept is to run P/L with effluent up to river
- o Piggy back pumped water in P/L
- o Tri-Basin NRD mentioned to Mike Drain (John Thorburn)
- o Currently applying water with pivot sprinklers

Gothenburg

- o No benefit to 5,000 cfs
- o Retiming of high flow water

Power Interference

- o Produces storage water in EA, but not the 5,000 cfs
- o Does not work in dry years - dry years are not running water for power

Net Conserved Controllable Water:

- o Creates water in EA from past conservation efforts
- o 2003 analysis identified 314 AFY to reclaim versus 500 AFY in WAP
- o Central estimated 'controllable' amount to total 10,900 AF, assuming regular irrigation use

- Provided "Supplemental Estimate of Net Controllable Conserved Water", 7/14/03

The WAP projects would likely have been configured differently, or have been different projects if structured to provide pulse flows.

Phase II ideas:

- Dam on Plum Creek, downstream of J-2 Return
    - 100 – 300 kaf capacity
    - Reclamation has studied area

PRRIP WMS – MEETING NOTES

Conversation With: Brian Barels **By:** Jeff Bandy

Of: Nebraska Public Power District **Job Number:** 16930.00

Subject: Platte River Recovery Program Water Management Study **File No.:**

Date: 8/20/07 **Time:** 9:00 AM **Cross File:**

☒ **Office Visit/Meeting** ☐ **Telephone Call** **Telephone No.:**

Notes:

Jeff Bandy and Blaine Dwyer of Boyle Engineering, with Jerry Kenny and Becky Mitchell of Headwaters Corp., met with Brian Barels of the Nebraska Public Power District on August 20th, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

In addition to its power operations, NPPD provides supplemental storage water for irrigation in the central Platte area. NPPD provides 125,000 AF of supplemental water to CNPPID. The District provides water to 7 canals, 3 of which it owns: Gothenburg, Dawson, and Kearney Canals.

NPPD supplies are about an 85/15% split between direct flow and storage supplies, respectively. This is in contrast to CNPPID which is about 15/85% direct flow versus storage supplies.

- NPPD power plants are Gerald Gentleman, North Platte Hydro (Lake Maloney), Canaday Station (natural gas plant located near J-2 return), and the Kearney Canal (a small hydro plant, the oldest water right).

- NPPD purchases all of Central's power generated on the system.

- The 1954 agreement between NPPD and CNPPID provides the framework for how the two systems are operated. The purpose of the agreement is to optimize the power and irrigation benefit of both systems. The districts prepare annual operating plans on October 1st that outline the operations for the coming year. This operating plan and agreement will become a key step in determining how Program water fits into the systems.

- Fish and Wildlife Service also prepares an annual operating plan for the EA.

- The diversion capacity at Keystone is 1900 cfs, but with vegetation and other restrictions, it is physically 1750 cfs.

- The Korty Diversion capacity is 650 cfs. The limitation is the canal capacity. The north side of the canal is a cut and fill section.

- Ramping rates for the NPPD system are consistent with what is published in the Program documents. The system can ramp up faster than it can down based on concerns of subsidence in the fill areas.

- Lake Maloney operations can ramp up the hydro at 200 cfs per day, and shut down immediately. A surge tank is on the system at North Platte.

- In general, system operations can be limited by reservoir and lake levels.

- Lake Maloney has a capacity of 34,000 AF; currently only approximately 10,000 AF is usable. This storage capacity needs to be replaced..

- Hydro is the only way to get water out of system. There are no bypasses on the system except via a canal outlet.

Program Re-regulation on the NPPD system, if done, would likely occur in Sutherland Reservoir. There is flexibility in the operations of the reservoir. Could serve the purpose of reregulating South Platte water, but this would be a significant accounting issue. Sutherland Reservoir does not have a solid bottom and seeps at higer rates as water level increases. If a cost effective lining could be constructed, that would increase the possibility as a reregulation reservoir. The seepage from the reservoir returns to both the North Platte and South Platte.

- A detailed model of Sutherland Reservoir is being developed by Clint Kearney for NPPD, CO-HYST.
- Another possibility for reregulation storage is Sutherland East, an undeveloped reservoir site with approximately 13,000-14,000 AF of capacity.
- NPPD has developed 24 wells around Sutherland Reservoir as a contingency supply if Lake McConaughy were to go dry. This water would be used to run the plant. The wells discharge to cooling water blended with warmer water to comply with NPDES permits. NPPD has developed mitigation plans for nearby irrigation wells. If water levels drop 10 ft, a check is made of the neighboring yields, and irrigators are compensated for injury. In addition irrigators are paid not to irrigate the following year.
- Gerald Gentleman power station uses 1200 cfs for cooling.
- The biggest issue with the pulse flows is the timing. Both NPPD and CNPPID are running full for July, August and sometimes into September.
- It may be possible in the springtime to move water into Maloney or Sutherland for release. Maloney is about 2 days travel time upstream of Overton.
- Johnson Reservoir is closer to the habitat and therefore may work better for a release.
- Bottom line is that it will take both the river and Program water to make the target flows.
- The flows for the 800 cfs flows will likely need to run through the river. Perhaps with the use of exchanges.
- Central would tend to divert more EA water than NPPD.

Power Interference affects both Districts due to the agreement to maximize power generation. The concept of Power Interference for Program water came out of the 1975-1995 period, where excesses were available.

- After 2000, this is not a possibility due to lower flows.
- Currently in drought mode where they shut McConaughy down, and dewater the canal and Lake Maloney during the winter.
- Concept was not to generate in winter
- During drought mode, McConaughy is shut down in September and kept high enough to form an ice cap.
- Slowly fill Sutherland during Nov-Dec-Jan.
- Turn McConaughy back on for irrigation in June.
- Non-irrigation diversion at Keystone is 250-750 cfs. This has been difficult in drought mode.
- These are min flows set by Game & Parks, FWS, and FERC.

Water Leasing as Program water supply:

- How senior of rights could be leased, and how much of these are surface rights?
- What happens to storage water for leased lands?
- New statutes in 2004 were passed for leasing in Nebraska; Leases up to 30 years.
- Storage water would be leased from NPPD/Central.
- Question as to whether this affects "maximize beneficial use" agreement between Districts (1954).
- Accounting is required to get water into Lake McConaughy
- In 2003-2004 CREP started (Conservation Reserve and Enhancement Program)
- This was set up to pay the difference in lease rates between irrigated and dryland.
- The concept is to use a low consumptive cover.

Dawson/Gothenberg ground water recharge:

- COHYST will be able to provide more information on this concept.
- State protected flows (non-species flows) could be diverted in winter to seep back into ground over time.
- The canals are owned by NPPD.

Ground water management:

- NPPD is working with Twin Platte NRD, Central Platte NRD and DNR on CO-HYST project.
- HDR is developing a surface water model connected with the CO-HYST model.
- Surface water model will extend from Lewellen & Julesburg to Duncan.
- This work is an 18 month timeframe.

Other ground water management issues:

- Where should pumping take place and how will it get to the river.
- The mound under Central's System on the north side is 6-40 ft deep.
- The Central Platte study will look at maximizing uses and how to offset depletions.

Elm Creek Reservoir:

- Originally for flood protection with recreation, and depletions.

- Under Nebraska Depletions Plan any additional return flows need to go to species flows.

- Kearney canal is the senior irrigation & hydro right.

- In the years of 2000 and 2002, surface flow was 40%, therefore there was little supplemental supply.

- All 7 NPPD canals are river diversions. These use major screening systems to filter debris.

- Cutoffs are a Tri-basin NRD project with out any connection to NPPD.

- Regarding ground water management concepts, need to know what are the effects on ground water levels and return flows.

- Any change to the system will cause additional change. We need to look at the net effect.

- There is the concept that dry land areas are what need to come under management. Only 5% of Nebraska water goes to irrigation.

- Net Controllable Conserved Water: CNPPID and Bureau conservation program. This included Federal money.

WY/CO projects:

- o These projects would help pulse flows if they could get water into the Lake McConaughy EA.
- o Tamarack retiming might move water into EA or Sutherland, and add to base flows.

The main difference now from the previous studies is more competition for water.

- o The Republican basin (pump from GW to Republican River), groundwater mitigation, etc.
- o Hydrology is drier now.
- o More development since 1997 has competed for water.

PRRIP WMS – MEETING NOTES

Conversation With: Jon Altenhofen **By:** Jeff Bandy

Of: Northern Colorado Water Conservancy District **Job Number:** 16930.00

Subject: Platte River Recovery Program Water Management Study **File No.:**

Date: 9/18/07 **Time:** 1:00 PM **Cross File:**

☒ **Office Visit/Meeting** ☐ **Telephone Call** **Telephone No.:**

Notes:

Jeff Bandy and Blaine Dwyer of Boyle Engineering, with Becky Mitchell of Headwaters Corp., met with Jon Altenhofen of Northern Colorado Water Conservancy District on September 18, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

The discussion focused primarily on the Tamarack projects on the South Platte and how they relate to the Program and specifically to the WMS. In addition, we discussed the Program objectives as well as the South Platte in general. These notes generally follow the order of the conversation and summarize the main points.

The current operating procedures for Tamarack I were developed to limit deliveries during the summer months and to time the majority of delivery to February and March in times of shortages. This reoperation is intended minimize the deliveries during the irrigation season to prevent the water from being diverted by non-program uses. This difference in timing limits the benefit the Tamarack Project will have in meeting the 5,000 cfs pulse flows or the 800 cfs irrigation season targets. By default, a small amount of water from the project will benefit these goals, but the amount is minor and not the intent of Tamarack.

Tamarack I starts on the South Platte River 40 miles upstream of the Colorado state line. The project is credited flows below the Western Diversion. Administration of this water to the critical habitat is carried out by Nebraska DNR.

The timing and average volume of delivery are illustrated on a graph Jon provided. The graph is a representation of the same data presented in Attachment 5, Section 3 of the Water Plan. The target reduction in shortages of Tamarack I is 10,000 AF per year as measured below the Western Canal diversion. The average reduction to shortages as shown on the graph is 12,300 AF per year. Evaporation losses are assessed to the deliveries, but are practically negligible to the total flow. (The original operational goal of Tamarack I was to supply 16,000 AF of reductions, with no consideration of losses. This operation also delivered water on a more uniform basis over the year, and was subsequently modified to its current operation.)

Tamarack I timing for deliveries in February and March is a good match with other augmentation plans because these are targeting other months for return.

Tamarack I gets credit for increased flows in the river below Western Canal in months it is bypassing. This credit is reduced for evaporative losses.

Studies performed to data considered gross losses only and did not consider deep percolation and return flows to the river. Deep percolation on a basin wide scale may need to be studied as the Program moves forward.

There are no identified ‘choke’ points on the South Platte River near the Tamarack area. There may be areas with over bank flooding, but there is limited development in the area.

Tamarack III vs. Tamarack I:
The Tamarack III project is the similar concept to Tamarack I. The primary hurdle appears to be a changing river regime, when fewer excess flows are available to be diverted. Shortage reductions from Tamarack III were estimated as an additional 17,000 AF, based on the hydrology 1975-1995 which was a good period for excess flows. There hasn’t been a discussion as to whether credit would be given with or without canal interception. Refer to p. 87 of WAP.
Tamarack III probably won’t help to meet pulse flow of 5,000 cfs. Its intent was to reduce the 130,000-150,000 AF annual shortage.

- As a note, much of the excess is from periods when McConaughy is spilling.

- Regarding the 800 cfs target- if Program is needing to meet 800 cfs flow in near future, then leasing senior rights may be part of the solution. However, if this is a longer term goal, with use of recharge projects, then system is starting from scratch and it will take time to get going.

- Tamarack II – project identified to meet Colorado’s depletions. This analysis used State Engineer’s Office depletion factors. Little competition with other augmentation plans, so a good match on timing. Tamarack II will retime 10 months of excess for delivery during 2 months of shortages.

- There has been discussion of developing an SDF model for the South Platte, but currently no work going on.

- Ovid Reservoir is possible source of supply to the South Platte, but issues of exporting water remain.

- Current lease rates for recharge water is $40 per AF per year.

- Currently, electrical costs for wells are $10 per acre foot pumped.

- The South Platte Water Related Activities Program (SPWRAP) is maintaining a future depletions spreadsheet. The model is housed at NCWCD. It was originally developed by Hydrosphere.

- Jon did not know what the Tamarack I average values reported in the RFP reflected. He suggested looking into these numbers and comparing to values presented in the WAP tables.

PRRIP WMS – MEETING NOTES

Conversation With:	Mike Purcell	**By:**	Jeff Bandy
Of:	Wyoming Water Development Commission	**Job Number:**	16930.00
Subject:	Platte River WMS – Project Interview	**File No.:**	
Date: 8/9/07	**Time:** 9:00 AM	**Cross File:**	
☒ **Office Visit/Meeting**	☐ **Telephone Call**	**Telephone No.:**	

Notes:

Jeff Bandy and Blaine Dwyer of Boyle Engineering Corp. and Becky Mitchell (Headwaters) met with Mike Purcell of the Wyoming Water Development Commission (WWDC) at his office on August 9, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

Mike opened the discussion by reiterating the main focus of this study is to look at the capacity issue associated with moving Program water down to the critical habitat. Capacity constraints are also one of the big unknowns along the system. Associated with the capacity issue are the limitations on ramping rates and reregulation storage. Boyle's modeling and analysis should help to quantify these limitations on operations and help to quantify the total 'cost' in terms of Program water.

As Mike was the primary author of the RFP, much of the discussion focused on the intent of the project and scope.

The modeling should start with the assumptions as outlined in the RFP regarding system capacities. Interviews and discussions with the Districts may provide more information on these flow capacities, ramping rates, and reregulation capacities. It will be helpful if the model is set up to allow for a sensitivity analysis and adjustment of these capacities. This will help quantify the amount of Program water required to achieve a given result, and also which assumptions and constraints are most limiting.

The problem statement in the RFP describes the goal of the Program to be evaluated in this study. The goals as stated are to deliver 5,000 cfs of Program water to the Overton gage for 3 days each year during the low use period, and pulse flows up to 6,000 cfs in two of every three years. During the irrigation season, the target is 800 cfs of Program water from May 1 through September 30.

It is likely that the best timing to achieve the pulse flows is in the spring months of March-May when runoff is highest and demands are low.

Pathfinder Modification Project:

The Pathfinder Modification Project will provide an additional 54,000 AF (approx.) of storage. The Environmental Account will receive 33,493 AF of storage, and the Wyoming account will have 20,000 AF. These accounts are filled based on pro-rata inflow under the existing storage right. The water right will undergo a partial change of use to allow for the Wyoming account water to be used as municipal supply. This process is ongoing.

It is anticipated that releases from the Pathfinder EA to Lake McConaughy will occur in September of each year. This is to minimize the conveyance loss between the two reservoirs. The gates at Guernsey are typically closed in late September or early October. The EA manager can call for the water at anytime the gates at Guernsey are open. The gates at Guernsey will not be opened to accommodate EA water. Generally it is more beneficial to keep the water in Pathfinder rather than McConaughy for reasons of lower evaporative losses. Mike provided Boyle with the loss schedule downstream of Pathfinder as defined in Exhibit 9 of the Decree.

Design of the Modification Project and the work to authorize are running concurrently. Reclamation is currently modeling the project, with results available in about 2 months. Mike directed Boyle to follow up with John Lawson of Reclamation on the project.

Timing for the completion of the modification is by 2011 for delivery of EA water to the Program.

Glendo Reservoir:

Wyoming has a 15,000 AF account in Glendo Reservoir. Municipal contracts account for 4,400 AF of the storage. The balance, 10,600 AF, is earmarked to replace groundwater depletions. The yield of the 10,600 AF is projected to be 40%. The remaining groundwater depletions may be replaced by deliveries out of the Pathfinder account.

WAP Projects:

Mike provided a brief summary of a few of the 13 projects identified in the WAP. He indicated that no additional work has been performed regarding these projects. He did indicate that some have been identified as more likely to provide benefit to the target flows than others.

Central Platte Power Interference – Power interference costs relate to the reason for modeling Cases I and II in the RFP and scope. Per the FERC license agreement, the Districts are allowed to run Program water through their systems when capacity is available. The full use of Program water limited to capacity is Case I in the analysis. If the Districts bypass water, they are compensated for the power interference. This relates to Case II and the desire to quantify the cost associated with bypassing the Districts' systems. The program has approximately $3M set aside for power interference charges. Mike directed Boyle to the *Program Document* for more information on power interference charges.

Reregulation Reservoir – regulation is definitely needed.

Water Leasing – Likely a significant contribution will be made via water leasing. However, participants are unknown at this time. In Wyoming, the water supplied via temporary leases will need storage in Glendo Reservoir via 1 yr leases. The limit of storage capacity in Glendo Reservoir available for leasing is set by USBR. There exists at least 10,000 AF of storage capacity that may be available for this purpose. This leasing of storage will result in higher costs for the temporary leasing.

PRRIP WMS – MEETING NOTES

Conversation With: John Lawson, Lyle Myler **By:** Jeff Bandy

Of: Bureau of Reclamation **Job Number:** 16930.00

Subject: Platte River Recovery Program Water Management Study **File No.:**

Date: 8/17/07 **Time:** 8:30 AM **Cross File:**

☒ **Office Visit/Meeting** ☐ **Telephone Call** **Telephone No.:**

Notes:

Jeff Bandy and Blaine Dwyer of Boyle Engineering, with Jerry Kenny and Becky Mitchell of Headwaters Corp., met with John Lawson and Lyle Myler of the Bureau of Reclamation on August 17, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

John and Lyle discussed the Pathfinder Project and Modification, operations on the North Platte River in Wyoming, and how these fit in with the Program and the current Water Management Study.

The Pathfinder Dam and water right are the property of the Bureau of Reclamation. Reclamation owns the facilities and operates them to meet contract obligations for water delivery.

The Pathfinder Dam and Reservoir project was authorized in 1903.

- The authorization was only for irrigation use of the water. Irrigation use has paid for the total cost of the dam. No other party has paid any costs.
- The Pathfinder Modification Project is a raise of the existing dam to recapture 54,000 AF of original storage space lost to sedimentation since the original construction. The water right is not being enlarged, only recovering storage.
- The 54,000 AF will need to go through a change of use to municipal & fish and wildlife purposes. This requires Board of Control & Wyoming State Engineer's Office approval for change of use for 54,000 AF.
- 34,000 AF of the new storage will go to the Environmental Account.
- 20,000 AF will be contracted to the State of Wyoming. The State can then subcontract to other purposes including back to Program. The standard contract is for 40 years.

If the Program folds, a reconsultation will be performed by Reclamation to allow other uses.

Reclamation's continued involvement in the Program requires authorization by Congress via House Bill 1462 and Senate Document 752. It is expected that the full Senate Committee will move the authorization forward. If the legislation does not pass, the Secretary of Interior is limited in its participation in the Program.

Reclamation is still operating under the first authorization budget. Construction activities and maintenance cannot occur until a specific authorization is passed. Title 1 authorizes participation in the Program. Title 2 authorizes the Pathfinder Modification Project (Project).

Wyoming is funding 100% of the Project. The work is executed by Reclamation with Wyoming funding it. URS has been selected for the design and construction management of the project. The total Project involves 7 phases, the last two are design and construction.

Construction of the Modification Project is anticipated to be accomplished in one season. The contractor with mobilize in August and construct through April. If this is not possible, then a phased construction will be necessary. The contract will be awarded next year at the earliest, mobilize in August of 2008, and finish in 2009.

The final Project will be owned and operated by Reclamation and contracted to the Program.

The Programmatic EIS addressed hydrologic effects of the Modification Project and was presented to USACE. The impacts to the area at the dam site were not included.

- The following assumptions of how EA would be operated were considered in the modeling:
    - To maximize water for program
    - 1 fill rule – no 2nd fill – beginning October 1st and ending September 30th
    - Water in account as of October 1 counts against space for the upcoming year
    - Made assumption that account would empty every year by Sept. 30th (to McConaughy) - move water in August and September (Best chance to get water to McConaughy without additional losses from diversions.)

- Losses through Wyoming and Nebraska were established by agreement and incorporated by decree.
- EA manager cannot move water earlier than about August or September, based on assumptions in the EIS because power plants are maxed out and more water cannot be moved without bypassing. Operations are fully reimbursable, therefore need to ensure maximum power is generated. The water released from Pathfinder runs through the following facilities: Pathfinder, Fremont, Alcova, Glendo, and Guernsey.
- Water in the Glendo account is delivered in a similar manner as Pathfinder, that is using a deficit accounting and replacing later in the year (September).
- BBA developed the initial loss estimates for diversions and evaporation.
- No irrigation deliveries are made prior to May 1 or after September 30. There is ability to move or relocate water, but not as a delivery to an end user.
- Delivery capacity is limited by power generation at Alcova (2300 – 2500 cfs depending on Casper/Alcova demand).
- System runs flushing flows of 500 – 4000 - 500 cfs in 24 hour period for five days in a row. This is to re-establish the trout fishery between Casper and Grey Reef Dam.
- 4,800 cfs delivered out of Guernsey, up to 5000 cfs for irrigatin demand.
- The amount of water delivered to the stateline is a big issue. Reclamation gets calls even over very minor flow issues.

Comments on 13 Projects in WAP

La Prele Reservoir – This may likely be taken off the table. The concept was to contract with the owner of a private reservoir for Program water. It is likely to stay with an oil company or irrigation.

Glendo Storage – 1953 stipulation to 1945 decree
- Reclamation could store water for irrigation of no more than 45,000 AFY, with 25,000 AF contracted to Nebraska and 15,000 to Wyoming
- Cannot contract or release more in any year
- 100,000 AF storage capacity
- The 25,000 AF for Nebraska is fully allocated
- 5,000 AF of the15,000 AF is contracted in Wyoming, the other 10,000 AF is not under short-term contract.
- One concept is to contract 10,000 AF to the Program. However, under the current renewal processes, Wyoming is likely to want to contract this water.
- There is uncertainty as to the amount of water available for the Program, especially in drought years.
- Wyoming is currently looking for water to offset well pumping, and the standing Glendo account is the first supply.
- Bottom line regarding Glendo storage is that in a drought year, there is no water available to the Program, at least not in the amounts previously thought.
- Also, Glendo water cannot be submarketed, therefore leasing of water is problematic. If an entity wants to give up water offered to other uses, this would need to be discussed and worked out. Or, Wyoming could release water for the Program but could not be reimbursed for it; this would be marketing.
  - If details could be worked out, and the Program could buy water from Reclamation (not free water), it might work on a temporary basis, but would be hard to contract long term. Wyoming water is supposed to be used in Wyoming and this might pose export issues. Reclamation cannot market Wyoming account to Nebraska uses, but may be able to contract with the Program.
- If the program did have Glendo water, it would likely be released to and delivered by CNPPID.

Water Leasing:
- Through the EIS process, it was determined that leased water would need to be stored water for release. Storage releases are protected, whereas natural flow is subject to the next appropriator diversion and use
- Wyoming law currently limits leasing to 2 years
- Therefore, the EIS tied leasing to storage with approximately 8,000 AF from Casper/Alcova project
  - For example, if a smaller project of 3,000 AF were diverted, assume 50% is consumed, and 50% is return flow.
  - Divided 75%/25%, NE/WYO, if water is below Guernsey (about 50% total efficiency rule of thumb)
  - Say the 3,000 AF corresponds to 1000 acres rested, and 1500 AF consumed, 1500 AF required to be released to match timing of historic returns.

        - The 1500 AF is shepherded through system, probably in September
        - This results in Program buying 3000 AF but only get 1500 AF, and the rest would be released as natural flow to river.
        - The 1500 AF of natural flow cannot make it to Nebraska unless diverted above Tri-State Dam (except in flood situation)
    - This would require an agreement with Reclamation and the diverter.
        - An example is Casper/Alcova Irrigation District where Casper benefits from improvements on system.
    - The Contractee cannot market water, this is solely done by Reclamation.
    - Another example is Kendrick Storage, a tri-party contract
        - 7000 AF, based on what Alcova District would save in a year (no carryover)
        - Available between May 1st – September 30th
        - City of Casper has not exercised due to the operations cost required by Reclamation.
    - The Alcova District contract is a 20 year contract; A leasing contract is likely to be 2-3 years because at 5 years it may open the right up to abandonment.
    - Likely participants:
        - Kendrick Project
        - Perhaps La Prele users
    - No possibility for leasing in Pathfinder because water for sale would go to other accounts
    - EIS looked at depletions to reaches (La Prele or Kendrick)

Pathfinder Modification Municipal Account:

- Use of this water for the Program is up to Wyoming. Wyoming could market this water to Program (the exception). This is spelled out in a stipulation (drafted in 1999 to 2001 when stipulation was approved).
- However, if Wyoming had the account in place now, it would likely be using it offset ground water depletions, so might not be available to Program.
- Great uncertainty in terms of yield given hydrologic conditions
- WMS needs to look at it in terms of Wet, Dry, Average conditions

Nebraska Projects:

- Water leasing depends on where you lease the water and how to protect it. Lake McConaughy may be one possibility. If leased near the habitat, there is a better chance of being successful of getting water to habitat (w/fewer diversions between).
- Re-Reg reservoirs – The idea is that CNPPID might build, operate, and market storage. Or, the Program builds a dam but this will be difficult for Program to do.
    - There is discussion of an Elm Creek reservoir. This will be discussed at the Governance Committee. 7,500 AF of storage in addition to flood control, located in a good location for the Program. Dependent on PMF; issues are big, can drive cost out of control.
    - Locating storage near habitat would act as faucet, earlier pulse flows to send slug down river.
    - What about and inflatable dam on the river to create pulse flows as a reregulation concept?

- Providing the pulse flows will be difficult. Phragmites might pose additional constraint since they act as a dam to the flow. In addition, flood flow may help dispersion of seeds and plants.

- Sand Dams – if adversely affected by Program operations, the Program might be held liable; natural occurrence is different and there is no liability to the Program.

- Program needs to start experimenting with solutions to see what works.

- Modeling on the North Platte system had the following progression:
  - Pathfinder model – OPSTUDY format
  - Western Water modeled Deer Creek
  - Reclamation modified Deer Creek model for Seminoe Dam Requirements
  - Added on segments to get to Lewellen
  - Any alternative had to be coded in
  - The NPRWUM model was modified to produce the NPR-EIS model which was used to model alternatives on a monthly time step.
  - This model gain/loss by reach but does not model return flows.

PRRIP WMS – MEETING NOTES

Conversation With: Ann Bleed **By:** Jeff Bandy

Of: Nebraska Department of Natural Resources **Job Number:** 16930.00

Subject: Platte River Recovery Program Water Management Study **File No.:**

Date: 9/5/07 **Time:** 9:00 AM **Cross File:**

☒ **Office Visit/Meeting** ☐ **Telephone Call** **Telephone No.:**

Notes:

Jeff Bandy and Blaine Dwyer of Boyle Engineering, with Becky Mitchell of Headwaters Corp., met with Ann Bleed of Nebraska Department of Natural Resources on September 5, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

Ann discussed the role of the Department of Natural Resources (DNR) is to protect streamflow from unauthorized diversions. As part of this protection, DNR tracks storage releases, including EA water, downstream to the permitted user. Losses are assessed to storage water in the same manner as natural flows.

The Natural Resource Districts (NRDs) regulate and manage ground water appropriations in the State. Legislation in 2004 defined portions of the aquifers to be “hydrologically’ connected with the surface waters. The 10/50 line defines whether an aquifer is hydrologically connected. From the “Integrated Water Management Planning Process” publication: “A well located along this line that pumps, for example 100 acre feet a year for 50 years will cause a depletion to the river equal to 10% of what was pumped during that 50 years or, in this example, an average per year of 10 acre feet.”. Based on the 10/50 line, the NRDs produce an annual report for each basin and make a determination of whether a basin is fully appropriated. Once a basin is declared Fully Appropriated, no new uses are permitted, as these take water away from existing uses. Once a basin is determined to be over appropriated, it remains so unless evidence exists that the conditions have changed.

Once a basin is deemed to be over appropriated, DNR works with the NRDs and others to develop integrated management plans. This puts in place a “Depletions Plan” for each basin. The current 3-year deadline for the integrated development plans expires this September 15. This deadline will likely be extended 8 months.

Ann mentioned that the Upper Big Blue NRD is involved in a lawsuit to define the groundwater basin equivalent to the surface water basin boundaries.

Ann provided several pamphlet publications describing the levels of appropriation, surface water and groundwater basin delineations, and related legislation.

Though basins may be fully appropriated, there is the possibility that some water is available on more of a piece-meal basis. Planning for the WAP projects needs to move forward since it is likely that the Program will be competing for other uses of the water supplies remaining. DNR is working with the NRDs and Districts to determine which projects are viable.

Ann said that there are no new permits for surface water on the Platte since 1993. (Above the confluence with the Loup Rivers).

Administration of Program Water/ PWAP Model:
The State maintains the accounting of storage releases and natural flows with the use of the Platte Water Accounting Program (PWAP). PWAP tracks water downstream from gage to gage and assigns losses and gains as appropriate. Natural flow is tracked separately from storage water. Both types of water are assigned losses; however, only the natural flow water benefits from any gains. EA water would be tracked the same as any other storage water. The program starts on the North Platte above Pathfinder Reservoir and extends downstream on the Platte to Grand Island. The South Platte River is not included in the model. However, generally speaking the South Platte has a losing reach east of the Colorado State line and then gains based on return flows from NPPD.

The general operation of the PWAP model is that it tracks water from gage to gage from upstream to downstream. If a diversion is made, that flow is subtracted from the flow in the river. Conveyance losses are applied based on the month, not the year type or amount of water. As mentioned above, storage water only loses water, it does not gain unless there is an additional release. Losses are assigned on a pro-rata basis to each class of water, based on the upstream gage. If water is diverted through the NPPD or CNPPID systems, the same loss is applied as if the water were to remain in the river. The calculations are made on a cfs basis at each gage. Errors in gage readings could be as high as ± 20% on the Platte due to the movable beds.

PWAP is run daily with out put generated on the order of 28 pages. The model is executed in the Bridgeport office. Ann provided Tom Hayden's name and phone number to discuss the model in relation to operations and Jim Ostiek to discuss programming of the model.

Ann thought the PWAP model may have been reviewed by others on the GC, but wasn't certain. The North Platte segments in Wyoming use the same conveyance loss factors as in the North Platte Decree.

Ann suggested PWAP as a possible tool in developing the loss and routing models.

A "Conduct Water Permit" would be required to shepherd Program water downstream to the habitat. This type of permit protects water not normally in the stream. It will be assessed applicable carriage losses and cannot be protected from ground water pumping. Each project would likely be assigned its own permit to protect its water to the point of use.

Related to the losing influence of the ground water pumping, the State is working on offsetting depletions for diversions after 1997. Otherwise moving water downstream through the system is not a problem.

The agreement between NPPD/CNPPID in 1954 determines the amount of water returned at the end of the system based on operations of the Districts.

Nebraska has taken over some of the gaging stations from USGS and makes as many as three measurements a week depending on the site. Tom Hayden has information on specific sites.

Work on the choke point appears to be proceeding well. However, development is still occurring in the flood zone. The State does not have jurisdiction over this issue; it is a County zoning issue.

The State is working with the Districts to develop an MOU addressing some of the institutional issues associated with the Water Action Plan. The primary concern is where to get water for the alternatives.

An issue with ground water management is that for wells prior to 1983, well users cannot be charged for ground water originating as seepage water. For example the seepage from the Dawson and Gothenburg canals could be pumped without any ability to charge the well owner.

Legislation allows for "Temporary" water leasing for 20-50 years. The lease can be renewed, but not obligated for longer terms.

The State and the NRDs will share the cost of the ground water offsets. Payment will be made with either augmentation or reduced pumping. The solutions will likely require restrictions which will be painful. If parties cannot agree on the approach, then the issue goes before the "Interrelated Water Review Board". The board consists of 5 Governor appointees, and has yet to be used.

Action: ☒ **Yes** ☐ **No**

Ann will send Boyle a fax of a day's PWAP accounting output. – received.

PRRIP WMS – MEETING NOTES

Conversation With: Duane Woodward **By:** Jeff Bandy

Of: Central Platte Natural Resource District **Job Number:** 16930.00

Subject: Platte River Recovery Program Water Management Study **File No.:**

Date: 9/5/07 **Time:** 1:00 PM **Cross File:**

☒ **Office Visit/Meeting** ☐ **Telephone Call** **Telephone No.:**

Notes:

Jeff Bandy and Blaine Dwyer of Boyle Engineering, with Becky Mitchell of Headwaters Corp., met with Duane Woodward of the Central Platte Natural Resource District on September 5, 2007 to discuss the on-going Platte River Recovery Implementation Program Water Management Study being prepared by Boyle.

The Central Platte NRD encompasses 890,000 irrigated acres, with approximately 2,000 to 2,500 landowners. This acreage is supplied by 17,000 wells. In Dawson County, 20,000 to 25,000 acres are subirrigated lands.

Since 2004 there has been a moratorium on new development of groundwater resources. The CPNRD is currently finishing up the acreage certification from 2004. The certification is based on imagery from August 2004. In addition to this imagery, they are also using FSA mapping records and are able to access data from the last 10 years.

Related to routing Program water through the Central Platte reach (CPNRD), ramping rates are not likely to be a large concern, but may impact some diverters during the irrigation season. Most irrigation starts in May of each year, but the Kearney Canal begins diverting in April. A potential constriction exists near the Gothenburg Canal, but this is currently not defined. It is in the vicinity of the KOA campground. Constrictions are more likely from Gothenburg upstream to North Platte. There are likely no constrictions downstream of the J-2 return.

Glen Sanders of the Bureau of Reclamation performed loss work in 1998. He made several transects near Elm Creek, Overton, Kearney, since about 1996. This work was included in the EIS work as part of the Technical Report Appendices, *Ground Water and River Flow Analysis*, May 2001, revised June 2001. This worked showed a strong interaction between river stage and monitoring well levels. The monitoring wells were located at the river transects. Might be able to calculate bank storage estimate from stage, with K= 100-200, and S = 0.2.

Duane mentioned that with the high rains around 1998 and 1999, ground water levels were up. During the drought, levels dropped and are now beginning to recover.

Generally, the river loses water to the alluvium during pumping and high rains, but at other times the gradient shifts back to the river. CPNRD performs water level mapping in April and Fall of each year.

Duane has been looking at local storm events and the river's response. For example, a storm flow at Grand Island of about 10-11,000 cfs may correspond to flows of 2,000 cfs upstream at Lexington. (Cited a storm in Spring 2007). This was also seen in a previous analysis where little correlation was shown between high flows downstream with high flows upstream, due to local storm events.

There is approximately a 3 day travel time from McConaughy to Grand Island area.

A significant rainfall can raise the groundwater elevation 1 foot or so.

Regarding the Program, if releases are made when bank storage is high, this is the best bet to get water downstream. (By minimizing losses). The majority of pumping begins after June 20th. Systems in Dawson County are filling in May – June, so delivery at this time might minimize losses due to pumping. Once in to July and August, pumping downstream is increasing. Also would be beneficial to time the release with a rainfall event.

During normal years, the Districts continue to run hydropower (1000 cfs) into the fall, though irrigation is off.

Based on LB962, Dawson County area is determined to be over appropriated, so CPNRD is undertaking a surface water modeling effort tied to the COHYST model. The CROPSIM model will be used to match up stream flows and precipitation and this will feed the surface water model. The linked model will be useful in analyzing different Offset projects such as the Gothenburg Canal recharge option. However, the project is not set up to address the Program's pulse flow concept. HDR is about to start the project with a duration of about 18 months.

COHYST Project:
The study period in the COHYST model is 1997 to 2048. The study started by reducing acreage, and then the impact on baseflows. The 2nd report study period was 1997 to 2005 and looked at surface water to groundwater conversion. COHYST is also being used to prepare depletion factors based on distance from the river. This is a result of LB962 and the change from the 10/50 line to 28/40 line. Additional use of the conjuctive model will be to evaluate recharge pits and the amount of offset they provide.

- Over-appropriated area is upstream of Elm Creek/ Highway 183.
- Initial estimates are that about 50,000 AF need to be offset. This is considered on the high end and additional study will refine this number.
- COHYST is analyzed by reach, and therefore does not route flows.
- Website: cohyst.dnr.ne.gov

Water Supply Alternatives:
Elm Creek Dam and Reservoir is currently being studied by Olsson and Associates. The reservoir is being considered for both flood control and water supply purposes. Supply for the reservoir would come from the end of Dawson County Canal supplied by NPPD. The capacity of the Dawson County Canal starts at 300 cfs and ends at 5 cfs, therefore the canal would require enlarging. The reservoir is being considered possibly for meeting offsets, or for Program water. Another possibility is the use of the reservoir as part of a pump/storage project.

The current incentive for taking acreage out of production is $2,500 per acre for buyout. Offered by the District (CPNRD).

There are possible savings through crop conversion. Currently Dawson County produces a lot of alfalfa. The potential is to convert to corn or another crop with a lower ET. (ET for alfalfa is approximately 36" vs. 27" for corn.)

Rich Halloway of Tri-Basin NRD, Holdrege can provide more information on groundwater management and allocation reduction.

WATER MANAGEMENT STUDY, PHASE I
EVALUATION OF PULSE FLOWS FOR THE PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

Phase I Report
April 8, 2008

APPENDIX 2

WMS Loss Model Update Technical Memorandum and Tables

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Technical Memorandum

To: File

From: Heather Thompson, Jacqueline Arcaris

Project: Platte River Recovery Implementation Program

Re: Water Budget Spreadsheet Model Extension (1995-2006)

Boyle Engineering (Boyle) and Ecological Resource Consultants, Inc. (ERC) has completed an extension of the Boyle/Water Management Committee (WMC) water budget spreadsheet model (loss model or model) to include hydrology for the water years (WY) 1995 through 2006. The original water budget spreadsheet study spanned 20 water years from 1975 through 1994. The model study period has been extended through WY 2006 to provide for a more comprehensive analysis by inclusion of the 2002-2006 drought years, some of the driest on record. The following memo summarizes the data and approach used to extend the model.

Water Budget Spreadsheet Model Overview

A water budget spreadsheet model was developed in 1999 by the WMC and Boyle to route local net hydrologic effects associated with a water conservation/supply alternative to the critical habitat to determine the potential reductions to target flow shortages. The water budget spreadsheet model includes loss factors for 19 study reaches from the headwaters of the North Platte River in Wyoming and South Platte River in Colorado downstream to Grand Island, Nebraska, as shown in **Figure 1** and **Table 1**. The upstream and downstream ends of each reach are defined by United States Geologic Survey (USGS) streamflow gages. For each reach, monthly loss factors attributed to seepage, diversion and evaporation were developed by the WMC for the period from WY 1975 through 1994 from historical records as described in the memorandum, *Determination of Monthly Loss Factors for the Platte River for the Historical 1975-1994 Water Year Period and Addendums 1 through 6* (WMC, January 1999).

Baseline conditions in the model reflect historical inflows and outflows from each reach (USGS gage data), diversions, evaporation, and other measured inflows from tributaries, canals, reservoir releases, and wastewater treatment plant returns.

Monthly loss factors are developed for diversions, evaporation and seepage. Diversion losses include the major diversion structures in each reach for which there are records. Diversion losses represent the gross amount diverted from the stream and do not account for return flows to the river. However, four hydropower returns (NPPD return, Jeffrey return, J-2 return and Kearney return) are included in the model as discussed in the Diversion Loss section. Diversion losses can be turned off in any reach to simulate the protection of water from existing diversions as it is routed to the critical habitat. Diversion losses are not applied to additional water in reaches for which diversion losses have been turned off.

Evaporation losses are calculated from estimated river surface evaporation as a function of river channel width and length, and monthly pan evaporation values from weather stations along the Platte River. The Modified Blaney-Criddle equation was used when pan evaporation data was not available.

A water balance is calculated for the flowing river channel to determine the monthly gains and losses within each reach, as illustrated in **Figure 2**. Return flows from diversions are included in the gain/loss term. Seepage losses equal the estimated loss calculated in the water balance analysis. Seepage losses are zero during months the river is gaining.

The diversion, evaporation and seepage losses are expressed as a percent loss per mile within a given reach. Percent loss factors are applied to water contributions as they are routed downstream to the critical habitat. An underlying assumption is that losses are shared by and prorated among all inflows regardless of where they occur in the reach. After the additional water is routed downstream, the additions to the streamflow at Grand Island, Nebraska are compared to historical target flow shortages and excesses to determine reductions to target flow shortages associated with an alternative.

Available Data and Sources

Boyle and ERC staff collected and reviewed available stream flow, evaporation and diversion records from WY 1995 through 2006. Data used to develop the loss factors is from:

- USGS
- Northern Colorado Water Conservancy District (NCWCD)
- U.S. Bureau of Reclamation (USBR)
- Colorado Division of Water Resources
- High Plains Regional Climate Center
- Nebraska Department of Natural Resources (NDNR)
- Wyoming State Engineers Office (SEO)
- National Weather Service
- Water Commissioners from various reaches

The same methodology and procedures that are used to develop loss factors for the earlier period from WY 1975 through 1994 are applied to develop loss factors for the extension period from WY 1995 through 2006. Slight modifications are made where data is limited or missing. The following is a more detailed description of the methodology used to calculate the percent loss factors and any modifications made to the approach used for the earlier period.

Evaporation Loss

The model uses monthly gross pan evaporation data from several weather stations. The weather stations in Wyoming along the North Platte River are located at Seminoe Reservoir, Pathfinder Reservoir, and Whalen Diversion Dam. Due to the lack of weather stations with pan evaporation data in Colorado along the South Platte River, temperature data from the Greeley, Brighton, Longmont, Fort Collins, Fort Morgan, Sterling and Julesburg weather stations are used to compute an open water surface gross evaporation estimate based on the Modified Blaney-Criddle equation. The weather stations used for analysis in Nebraska are Bridgeport, NE, Kingsley Dam, North Platte Experimental Farm and Grand Island Airport.

The following modifications are made when pan evaporation data was not available in Nebraska:

- Reaches 14-19 use average evaporation data from the Kingsley, North Platte, and Grand Island stations for the WY 1975-1995 summer months
- Reach 12 uses the Bridgeport station evaporation data
- Reach 13 uses the average evaporation data from the Kingsley and Bridgeport stations
- All Nebraska reaches use the winter month evaporation data from the Bridgeport station
- Due to the lack of available data for the model extension period, monthly averages for the period from WY 1975 through 1994 are used for the extension period (evaporation data deviation from the average is approximately less than 1 inch)

Average monthly evaporation values for Reaches 12, 13, and 14 through 19 are shown below in **Table 2**.

The following modifications are made when pan evaporation data was not available in Colorado:

- Reaches 7, 8, 9, and 11 use the Modified Blaney-Criddle equation for the earlier period
- Temperature data from NOAA-NWS weather stations is used to compute an open water surface gross evaporation
- Reaches 7, 8, 9, and 11 use the Modified Blaney-Criddle equation for the extension period; however, temperature data is missing for several months or years
- Sterling and Brighton stations use average monthly temperatures for missing data
- Julesburg, Fort Morgan and Longmont stations use monthly temperature data correlated with the closest station for the overlapping period from WY 1975-2006. Average correlation factors are developed for each month and are multiplied by the monthly temperature at the nearest station to fill missing months of data.

Evaporation estimates for Reach 10 in the original study period are an average of:

- Calibrated open water Blaney-Criddle value at Julesburg
- Pan evaporation data from the North Platte weather station
- Summer months values are multiplied by a factor of 0.7

- Bridgeport, Nebraska pan evaporation data is used for the winter months because North Platte did not record winter pan evaporation data

Pan evaporation data is not available for the model extension period after WY 1991 for the North Platte and Bridgeport stations. Other weather station data from Nebraska were reviewed to determine whether pan evaporation data is available from a nearby station. However, data from WY 1995 and later at the Kingsley Dam and Grand Island stations is limited because of several days of missing data each month. Due to the lack of available pan evaporation data, North Platte pan data is estimated for the period from WY 1995 through 2006 based on a correlation with the modified Blaney-Criddle value at Julesburg for the overlapping period from WY 1975 through 1991. Average correlation factors are developed for each month and multiplied by the monthly Blaney-Criddle values at Julesburg to estimate pan evaporation at the North Platte station. The summer months use the average calibrated open water Blaney-Criddle value at Julesburg and the estimated pan evaporation data for the North Platte weather station multiplied by 0.7. The winter months use the calibrated Blaney-Criddle value at Julesburg.

The monthly gross evaporation, measured in inches, is determined for each reach. The monthly reach losses due to gross evaporation from the river water surface are calculated using the same approach for WY 1975-1994. River surface evaporation is calculated as a function of river channel length and width, and monthly gross evaporation values.

Diversion Loss

Table 3 lists the measured diversions which are included in the water balance calculations and the % diversion loss factor computations for each reach. Boyle and ERC staff collected and reviewed available diversion data for the model extension period. Diversions in Colorado are from Colorado's Decision Support Systems (CDSS) Hydrobase unless otherwise noted below. Diversions in Wyoming are from Wyoming SEO. Diversions in Nebraska were obtained from NDNR.

Wyoming and Nebraska monthly diversion data for the extension period is available for all ditches included in **Table 3**. Colorado monthly diversion data for the extension period is available for the majority of ditches included in **Table 3**. Diversion data was not available for:

- Reach 7 – Buckers Ditch was abandoned
- Reach 9 – Davis Brothers Canal, Sterling No. 2 Canal, Lone Tree Canal, Chambers Ditch, Tamarack Ditch, and Red Lion Canal for the entire model extension period, because these ditches are either abandoned or the ditch was transferred to municipal use
- Reach 11 – Ideal Cement, Josh Ames Ditch and Chaffee Ditch because these ditches are abandoned or data is not recorded

Boyle contacted Brent Schantz, the water commissioner for Districts 1 and 64, who confirmed that diversions associated with the ditches listed above have been discontinued. He also provided WY 2006 data for Empire Reservoir Inlet Canal in Reach 8.

Mr. Schantz referred Boyle to James Yahn, manager for both the North Sterling and Prewitt irrigation companies, regarding WY 1995 missing data for Reach 9 Prewitt Reservoir Inlet Canal.

Mr. Yahn provided data for the model extension period for both the North Sterling and Prewitt Reservoirs, which also includes the missing WY 1995 data.

Data for the Fossil Creek Reservoir inlet is from the NCWCD as opposed to the CDSS Hydrobase.

The diversion losses calculated for each reach are gross values and do not account for lagged groundwater and surface water returns to the river that may result from water being diverted. An exception to this rule is direct returns to the river from hydropower diversions. The water diverted by the Korty Canal in Reach 10 is combined with water diverted by NPPD's Keystone Canal and returned to the river at their North Platte Hydroplant Return in Reach 15. **Table 4** lists the monthly percent of diverted water returned to the river through NPPD's North Platte Hydroplant Return from their Korty and Keystone diversions. Similarly, a portion of the diversion by CNPPID's Canal in Reach 15 is returned to the river through the Jeffrey River Return in Reach 16, and a portion is returned through the Johnson River Return (J-2 Return) in Reach 17. **Table 5** lists the monthly percent of diverted water returned to the river from CNPPID's diversion. A portion of the water diverted by the Kearney Canal in Reach 18 is returned to the river in Reach 19. **Table 6** lists the monthly percent of diverted water returned to the river from the Kearney diversion.

Seepage Loss

A monthly water balance is calculated for the river channel within each reach. Net gains/losses are computed as the sum of measured outflows minus the sum of measured inflows. The gain/loss term for each reach is as follows:

Gain/Loss = Outflows – Inflows

Where:

Outflows= Downstream Measured Gage Outflow + Evaporation + Diversions
Inflows = Upstream Measured Gage Inflow + Other Measured Inflows

Outflows are the gauged flow at the downstream end of the reach, plus all measured diversions, plus monthly gross evaporation. Inflows are the gauged flow at the upstream end of the reach plus other measured inflows such as tributary inflows, hydropower/canal returns, reservoir releases, and wastewater treatment plant returns.

Gage data is from USGS and NDNR. The Wyoming Alcova gage (downstream gage in Reach 2) was discontinued in WY 1998 because it was inundated by Grey Reef Reservoir. Alcova Reservoir releases, provided by the USBR, are used in place of gage data for the extension period. Evaporation and total diversions for each reach are calculated as discussed in the previous sections. Other measured inflows for each reach are listed in **Table 7** and are not available for the model extension period, so they are not included in the water balance calculation. Data is not available for the Lodgepole Creek near Ralton, Nebraska gage after WY 1979. Release data for Bijou Reservoir is not available after WY 1992 and Bijou Creek gage data is not available after WY 1987. The Birdwood Creek gage switched to summer month operation only from WY 1995 through 1999. There was no flow in September 2002 for all diversion canals in Reach 16. The Kearney Power Return gage was only operational in the summer months from WY 1989 through 2004.

Development of Loss Factors

The evaporation, diversion and seepage loss factors are calculated by dividing the monthly reach loss (evaporation, diversion and seepage) by the sum of all inflows in each reach where:

Sum of All Inflows = Upstream Measured Gage Inflow + Other Measured Inflows + Positive Net Gains Computed in River Water Balance

For example, the monthly loss factor due to diversions is calculated as the ratio of total measured diversions divided by the "Sum of All Inflows" for each reach. Months with negative value water balance calculation (i.e. a loss) has a percent loss factor due to seepage. Seepage loss factors are zero during months the river is gaining. The loss factors are divided by the number of miles in each reach and multiplied by 100 to develop the percent loss factors per mile for each reach. These percent loss factors are incorporated in the water budget spreadsheet model. Tables of the percent loss factors per mile (Percent Evaporation, Seep, and Diversion) are attached in Addendum 1 for the 19 Reaches.

Changes Made to Loss Factors for the Earlier Period (1975 through 1994)

Earlier period data was checked to a limited degree and corrected if errors were found. The following changes made to loss factors for the earlier period were incorporated in the updated water budget spreadsheet.

- Henderson gage data for Reach 7 in the Colorado loss factor spreadsheet (SPloss.xls) was incorrect for months November and December in years 1982 through 1994. The correct data was obtained from USGS.
- Diversion data for Reach 7 in the Colorado loss factor spreadsheet (SPloss.xls) was incorrect for months November and December in years 1982 through 1994. This data was replaced with the correct Evans No. 2 diversion data from CDSS Hydrobase.
- Korty Canal, Keystone, CNPPID Canal, Western Canal diversions and Kearney, Jeffrey, Southerland, and Johnson return data in the Nebraska loss factor spreadsheet (PRNEloss.xls) were incorrect in the online database in several months for the earlier period. The loss and return flow factors in the affected reaches (10, 16 and 17) were changed based on hard-copy annual report data provided by NDNR.

Table 1
Platte River Reaches Included in the Water Budget Spreadsheet Model

Reach Number	Reach Description
Region 1 - North Platte River Upstream of Lake McConaughy	
1	Northgate, CO Gage to Sinclair, WY Gage
2	Sinclair, WY Gage to Alcova, WY Gage
3	Alcova, WY Gage to Orin, WY Gage
4	Orin, WY Gage to Passing Whalen Diversion Dam Gage
6	Laramie River below Grayrocks Reservoir Gage to Fort Laramie, WY Gage
5	Passing Whalen Diversion Dam Gage to WY-NE Stateline Gage
12	WY-NE Stateline Gage to Bridgeport, NE Gage
13	Bridgeport, NE Gage to Lewellen, NE Gage
Region 2 - South Platte River Upstream of Western Canal Diversion	
7	Henderson, CO Gage to Kersey, CO Gage
8	Kersey, CO Gage to Balzac, CO Gage
9	Balzac, CO Gage to Julesburg, CO Gage
11	Poudre River Canyon Mouth Gage to Greeley, CO Gage
Region 3 - Platte River below Lake McConaughy and Western Canal	
10	Julesburg, CO Gage to South Platte at North Platte, NE Gage
14	Keystone Diversion Gage to North Platte at North Platte, NE Gage
15	North Platte at North Platte, NE Gage to Brady, NE Gage
16	Brady, NE Gage to Cozad, NE Gage
17	Cozad, NE Gage to Overton, NE Gage
18	Overton, NE Gage to Odessa, NE Gage
19	Odessa, NE Gage to Grand Island, NE Gage

Table 2
Average Monthly Evaporation (inches)

Reaches	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
12	2.65	1.41	0.91	0.78	1.24	2.04	3.91	5.45	6.61	7.71	6.45	4.76
13	2.67	1.41	0.91	0.78	1.24	2.04	4.20	5.49	6.29	6.98	5.95	4.52
14 - 19	3.34	1.41	0.91	0.78	1.24	2.04	4.53	5.72	6.66	7.29	6.23	5.04

Table 3: LIST OF DIVERSIONS USED IN WATER BALANCE CALCULATIONS

DIVERSIONS FOR NORTH PLATTE RIVER REACH #5 IN WYOMING: Passing Whalen to WY/NE Stateline

1 Grattan
2 North Platte Ditch
3 Rock Ranch
4 Pratte-Ferris
5 Burbank
6 Torrington
7 Lucerne
8 Narrows
9 Mitchell
10 Gering

DIVERSIONS FOR THE TWO NORTH PLATTE RIVER REACHES ABOVE LAKE MCCONAUGHY IN NEBRASKA

Reach 12: WY/NE Stateline to Bridgeport
1 Castle Rock-Steamboat Canal
2 Central Canal
3 Enterprise Canal
4 Minatare Canal
5 Tri-State Canal
6 Winters Creek Canal
7 Belmont Canal
8 Chimney Rock Canal
9 Nine Mile Canal
10 Short Line Canal

Reach 13: Bridgeport to Lewellen
1 Beerline Canal
2 Browns Creek Canal
3 Lisco Canal
4 Midland-Overland Canal

DIVERSIONS FOR THE SIX PLATTE RIVER REACHES BELOW LAKE MCCONAUGHY IN NEBRASKA

Reach 14: Keystone to North Platte at North Platte
1 Keith-Lincoln Irrigation Canal
2 North Platte Irrigation Canal
3 Paxton-Hershey Irrigation Canal
4 Suburban Irrigation Canal
5 Cody-Dillon Irrigation Canal
NOTE: NPPD's (Nebraska Public Power District's) Keystone Canal diverts just above the Keystone Gage and therefore is not included in the Water Balance Calculation for Reach 14

Reach 15: North Platte at North Platte to Brady
1 Central Nebraska Public Power and Irrigation District (CNPPID) Canal

Reach 16: Brady to Cozad
1 Thirty Mile Canal
2 Gothenburg Canal (NPPD)
3 Six Mile Canal
4 Cozad Canal
5 Orchard-Alfalfa Canal
6 Dawson County Canal (NPPD)

Reach 17: Cozad to Overton
No Diversions

Reach 18: Overton to Odessa
1 Kearney Canal (NPPD)

Reach 19: Odessa to Grand Island
No Diversions

TABLE 3: LIST OF DIVERSIONS (Continued)
DIVERSIONS FOR THE FIVE SOUTH PLATTE RIVER REACHES

Reach 7: Henderson to Kersey, Colorado

1 Brighton Canal
2 Lupton Bottom Canal
3 Platteville Irrigation
4 Side Hill / Meadow Island 1
5 Platte Valley System
6 Mutual / Beeman-Meadow Island 2
7 Buckers Canal
8 Farmers Independent Canal
9 Western Canal
10 Jay Thomas Canal
11 Union Ditch
12 Godfrey Canal
13 Lower Latham Canal
14 Patterson Canal
15 Highland / Plumb Canal

Reach 8: Kersey to Balzac, Colorado

1 Empire Reservoir Inlet Canal
2 Riverside System
3 Illinois Canal
4 Bijou System (includes Corona Ranch / Putnam)
5 Jackson Lake Inlet Canal
6 Weldon Valley Canal
7 Fort Morgan Canal
8 Deuel and Snyder Canal
9 Upper Platte and Beaver Canal
10 Tremont / Smith-Snyder Canal
11 Lower Platte and Beaver Canal
12 North Sterling Reservoir Inlet Canal
13 Union Canal
14 Tetsel Canal
15 Prewitt Reservoir Inlet Canal
16 Johnson-Edwards Canal

NOTE: Balzac Gage was moved upstream 6 miles in Oct 1987 which resulted in the Tetsel, Prewitt Res Inlet, and Johnson-Edwards being downstream of the Gage since Oct. 1987. This is accounted for in the Reach Water Balance Calculations

Reach 9: Balzac to Julesburg, Colorado

1 South Platte Canal
2 Farmers-Pawnee Canal
3 Davis Brothers Canal
4 Schneider Canal
5 Springdale Canal
6 Sterling No 1 Irrigation Co Canal
7 Sterling No 2 Canal
8 Henderson Smith
9 Lowline Canal
10 Bravo Canal
11 Farmers Canal
12 Iliff and Platte Valley Canal
13 Lone Tree Canal
14 Powell Canal
15 Ramsey Canal
16 Chambers Ditch
17 Harmony No 1 Canal / Julesburg Reservoir Inlet
18 Tamarack Ditch
19 Red Lion Canal
20 Peterson Canal
21 South Reservation Canal
22 Liddle Ditch
23 Carlson Canal

Reach 10: Julesburg, Colorado to South Platte at North Platte, Nebraska

1 Western Canal
2 Korty Canal (NPPD; Nebraska Public Power District)

Reach 11: Cache la Poudre River Canyon Mouth to Greeley, Colorado

1 Greeley Pipeline
2 Pleasant Valley and Lake Canal
3 Larimer County Canal
4 Jackson Ditch
5 Little Cache Ditch
6 Taylor and Gill
7 New Mercer
8 Larimer No 2
9 Ideal Cement
10 Arthur Ditch
11 Larimer and Weld Canal
12 Josh Ames
13 Lake Canal
14 Coy Ditch
15 Timnath Reservoir Inlet Canal
16 Chaffee Ditch
17 Boxelder Ditch
18 Fossil Creek Reservoir Inlet
19 Greeley No 2 Canal
20 Whitney Ditch
21 B.H. Eaton Ditch
22 Jones Ditch
23 Greeley No 3 Canal
24 Boyd-Freeman Ditch
25 Ogilvy Ditch

Table 4
NPPD Percent of Water Returned through the North Platte Hydro Return

Water Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	104%	117%	53%	66%	71%	107%	65%	91%	58%	94%	100%	59%
1976	95%	106%	50%	60%	82%	88%	92%	92%	46%	86%	377%	0%
1977	0%	30%	70%	74%	82%	53%	56%	50%	58%	88%	106%	84%
1978	60%	74%	73%	71%	60%	83%	106%	63%	60%	91%	101%	89%
1979	68%	69%	71%	67%	54%	54%	72%	85%	49%	90%	87%	120%
1980	52%	34%	83%	102%	80%	67%	101%	93%	69%	92%	104%	109%
1981	65%	59%	69%	81%	96%	89%	66%	67%	61%	90%	131%	59%
1982	109%	51%	88%	87%	95%	89%	66%	45%	45%	86%	93%	65%
1983	230%	87%	81%	71%	80%	78%	94%	96%	83%	74%	88%	85%
1984	0%	84%	73%	68%	82%	86%	92%	74%	67%	89%	94%	85%
1985	85%	90%	94%	99%	75%	81%	87%	66%	81%	86%	99%	71%
1986	88%	90%	82%	80%	91%	77%	83%	87%	72%	88%	93%	90%
1987	63%	81%	85%	97%	95%	72%	86%	87%	81%	93%	100%	95%
1988	79%	74%	94%	68%	67%	83%	85%	80%	77%	81%	103%	81%
1989	57%	70%	59%	78%	83%	75%	58%	66%	68%	95%	94%	60%
1990	70%	54%	55%	63%	70%	71%	83%	75%	72%	85%	99%	81%
1991	84%	52%	54%	47%	50%	69%	57%	57%	70%	82%	88%	60%
1992	208%	35%	41%	53%	64%	80%	72%	69%	68%	80%	82%	77%
1993	42%	75%	69%	65%	76%	97%	51%	53%	38%	75%	96%	71%
1994	86%	85%	82%	82%	83%	78%	53%	84%	63%	85%	94%	66%
1995	83%	62%	63%	63%	58%	64%	55%	69%	82%	86%	90%	93%
1996	90%	88%	76%	72%	73%	83%	82%	76%	78%	84%	97%	91%
1997	82%	90%	72%	71%	87%	98%	83%	82%	76%	83%	81%	82%
1998	121%	82%	82%	75%	92%	81%	80%	88%	89%	87%	95%	82%
1999	93%	90%	76%	76%	95%	86%	79%	78%	80%	88%	84%	95%
2000	88%	91%	93%	91%	86%	89%	87%	82%	81%	84%	92%	79%
2001	90%	86%	76%	79%	77%	88%	75%	73%	77%	94%	83%	78%
2002	111%	57%	90%	76%	79%	71%	66%	61%	75%	93%	80%	58%
2003	161%	14%	47%	45%	39%	52%	56%	57%	54%	88%	89%	23%
2004	0%	0%	0%	43%	29%	295%	37%	76%	62%	87%	94%	17%
2005	0%	0%	0%	5%	0%	0%	0%	30%	51%	89%	84%	22%
2006	0%	0%	0%	0%	0%	0%	0%	40%	66%	89%	86%	4%
Max	230%	117%	94%	102%	96%	295%	106%	96%	89%	95%	377%	120%
Min	0%	0%	0%	0%	0%	0%	0%	30%	38%	74%	80%	0%
Avg	80%	65%	66%	68%	70%	81%	69%	72%	67%	87%	103%	70%

Note: Percent of NPPD diversions returned through the North Platte Hydro Return = NPPD Return/(Korty Diversion + Keystone Diversion) * 100

Table 5
CNPPID Percent of Water Returned through the Jeffrey and Johnson Returns

Water Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	78%	67%	78%	74%	74%	76%	73%	46%	49%	6%	22%	66%
1976	63%	67%	73%	77%	80%	75%	70%	42%	27%	7%	11%	45%
1977	64%	58%	71%	65%	65%	65%	70%	38%	22%	2%	26%	68%
1978	59%	56%	67%	93%	90%	73%	57%	24%	17%	7%	19%	40%
1979	52%	53%	70%	73%	64%	71%	52%	27%	45%	39%	19%	43%
1980	40%	44%	76%	79%	78%	83%	74%	52%	39%	3%	14%	55%
1981	49%	57%	74%	78%	78%	70%	42%	21%	17%	22%	32%	40%
1982	64%	61%	72%	75%	78%	77%	39%	13%	9%	12%	19%	50%
1983	35%	64%	78%	75%	81%	82%	72%	63%	42%	1%	5%	48%
1984	63%	63%	88%	59%	77%	80%	74%	66%	56%	20%	18%	57%
1985	65%	69%	52%	75%	79%	81%	71%	57%	46%	21%	32%	66%
1986	75%	59%	74%	78%	82%	81%	74%	57%	34%	19%	37%	72%
1987	75%	72%	82%	81%	87%	85%	71%	58%	46%	33%	27%	70%
1988	69%	73%	76%	75%	70%	81%	64%	54%	24%	23%	33%	60%
1989	56%	51%	64%	78%	73%	78%	38%	24%	31%	29%	23%	47%
1990	46%	57%	67%	77%	70%	69%	70%	42%	27%	6%	26%	31%
1991	66%	87%	79%	80%	76%	67%	26%	31%	25%	3%	16%	39%
1992	28%	58%	56%	77%	79%	79%	62%	43%	58%	64%	56%	55%
1993	83%	68%	77%	76%	78%	76%	59%	23%	37%	60%	44%	84%
1994	79%	86%	83%	83%	85%	86%	56%	38%	30%	31%	18%	60%
1995	55%	76%	79%	79%	77%	67%	55%	57%	65%	21%	16%	47%
1996	79%	84%	85%	83%	82%	76%	70%	59%	59%	38%	53%	74%
1997	77%	85%	89%	79%	86%	77%	72%	60%	45%	5%	35%	69%
1998	75%	85%	85%	81%	85%	76%	72%	60%	49%	23%	39%	72%
1999	80%	89%	88%	86%	88%	74%	69%	64%	62%	22%	52%	68%
2000	80%	85%	86%	86%	82%	74%	66%	51%	37%	27%	18%	48%
2001	71%	74%	87%	81%	81%	73%	68%	44%	35%	23%	41%	83%
2002	93%	38%	89%	80%	79%	64%	39%	23%	38%	8%	22%	69%
2003	50%	37%	70%	58%	73%	49%	33%	22%	38%	29%	29%	24%
2004	0%	72%	79%	75%	83%	47%	2%	22%	21%	35%	43%	7%
2005	28%	59%	71%	65%	77%	57%	49%	33%	45%	38%	59%	26%
2006	63%	67%	68%	61%	49%	79%	27%	35%	35%	32%	50%	20%
Max	93%	89%	89%	93%	90%	86%	74%	66%	65%	64%	59%	84%
Min	0%	37%	52%	58%	49%	47%	2%	13%	9%	1%	5%	7%
Avg	61%	66%	76%	76%	78%	73%	57%	42%	38%	22%	30%	53%

Note: Percent of CNPPID diversions returned through the Jeffrey and Johnson Returns = (Johnson + Jeffrey Returns)/CNPPID Diversion* 100

Table 6
Percent of Water Returned through the Kearney Return

Water Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	78%	74%	0%	0%	0%	34%	70%	78%	80%	70%	69%	74%
1976	80%	81%	0%	0%	0%	73%	76%	67%	76%	66%	56%	77%
1977	81%	87%	0%	0%	0%	72%	79%	78%	78%	62%	78%	84%
1978	64%	31%	0%	0%	0%	0%	63%	82%	77%	43%	61%	81%
1979	0%	0%	0%	0%	0%	0%	43%	86%	78%	90%	81%	90%
1980	93%	108%	0%	0%	0%	0%	94%	91%	93%	63%	64%	87%
1981	92%	97%	0%	0%	0%	89%	85%	91%	83%	75%	80%	87%
1982	88%	0%	0%	0%	0%	0%	0%	61%	89%	77%	77%	84%
1983	94%	0%	0%	0%	0%	0%	94%	64%	88%	80%	76%	86%
1984	84%	0%	0%	0%	0%	0%	0%	49%	92%	77%	73%	87%
1985	106%	98%	0%	0%	0%	0%	35%	46%	49%	69%	78%	84%
1986	92%	108%	0%	0%	0%	0%	96%	89%	77%	74%	74%	79%
1987	80%	75%	0%	0%	0%	0%	0%	83%	75%	64%	78%	88%
1988	91%	91%	0%	0%	0%	0%	8%	94%	77%	64%	78%	92%
1989	86%	0%	0%	0%	0%	0%	69%	88%	77%	80%	81%	85%
1990	88%	0%	0%	0%	0%	0%	47%	85%	87%	71%	67%	73%
1991	86%	50%	0%	0%	0%	0%	31%	86%	69%	51%	55%	73%
1992	0%	0%	0%	0%	0%	0%	25%	84%	74%	77%	59%	74%
1993	82%	0%	0%	0%	0%	0%	0%	16%	74%	88%	78%	82%
1994	0%	0%	0%	0%	0%	0%	0%	0%	71%	70%	59%	68%
1995	0%	0%	0%	0%	0%	0%	0%	75%	55%	61%	80%	77%
1996	0%	0%	0%	0%	0%	0%	0%	81%	66%	71%	56%	62%
1997	74%	22%	0%	0%	0%	0%	72%	77%	67%	60%	74%	78%
1998	77%	193%	0%	0%	0%	0%	85%	83%	88%	75%	75%	89%
1999	86%	0%	0%	0%	0%	31%	88%	94%	111%	80%	83%	85%
2000	86%	84%	0%	0%	0%	0%	62%	83%	89%	72%	61%	83%
2001	87%	0%	0%	0%	0%	0%	0%	0%	76%	82%	82%	90%
2002	94%	93%	0%	0%	0%	0%	56%	88%	61%	54%	62%	84%
2003	90%	0%	0%	0%	0%	0%	0%	77%	89%	75%	77%	75%
2004	0%	0%	0%	0%	0%	0%	0%	34%	65%	65%	56%	66%
2005	1484%	0%	0%	0%	0%	3%	82%	88%	81%	61%	77%	83%
2006	88%	92%	0%	0%	0%	48%	89%	82%	83%	71%	86%	88%
Max	1484%	193%	0%	0%	0%	89%	96%	94%	111%	90%	86%	92%
Min	0%	0%	0%	0%	0%	0%	0%	0%	49%	43%	55%	62%
Avg	114%	43%	0%	0%	0%	11%	45%	71%	78%	70%	72%	81%

Note: Percent of diversion at the Kearney Canal returned through the Kearney Return = Kearney Return/ (Kearney Canal Diversion) * 100

Table 7
Other Measured Inflows Included in the Water Balance Calculation

Reach Number	Other Measured Inflows
Region 1 - North Platte River Upstream of Lake McConaughy	
1	None
2	None
3	None
4	None
6	None
5	None
12	Horse Creek Sheep Creek Dry Spottedtail Creek Tub Springs Winters Creek Gering Creek Ninemile Creek Bayard Sugar Facotry Creek Red Willow Creek
13	Pumpkin Creek Blue Creek
Region 2 - South Platte River Upstream of Western Canal Diversion	
7	C-BT South Platte Supply Canal St. Vrain Creek Big Thompson River Cache La Poudre River
8	Riverside Outlet Canal[1] Jackson Lake Outlet Canal Bijou Creek and Bijou No. 2 Outlet Canal
9	Prewitt Reservoir Outlet Canal Lodgepole Creek at Ralton, NE[2]
11	C-BT Charles Hansen Supply Canal Claymore Lake Seeley Lake Fossil Creek Reservoir Canal #3 Returns Ft. Collins, Greeley, Box Elder, Kodak and Windsor WWTP Returns
Region 3 - Platte River below Lake McConaughy and Western Canal	
10	None
14	Birdwood Creek
15	NPPD North Platte Hydro Return and South Platte River
16	Jeffrey Return
17	Johnson River Return
18	None
19	Kearney Return

Notes:
1) The Riverside Reservoir Outlet Canal releases water to Jackson Lake and Bijou Reservoirs, which then release water to the South Platte River. These releases are included in Jackson Lake and Bijou Reservoir releases.
2) Lodgepole Creek at Ralton, NE was …

Platte River Basin Study Reaches

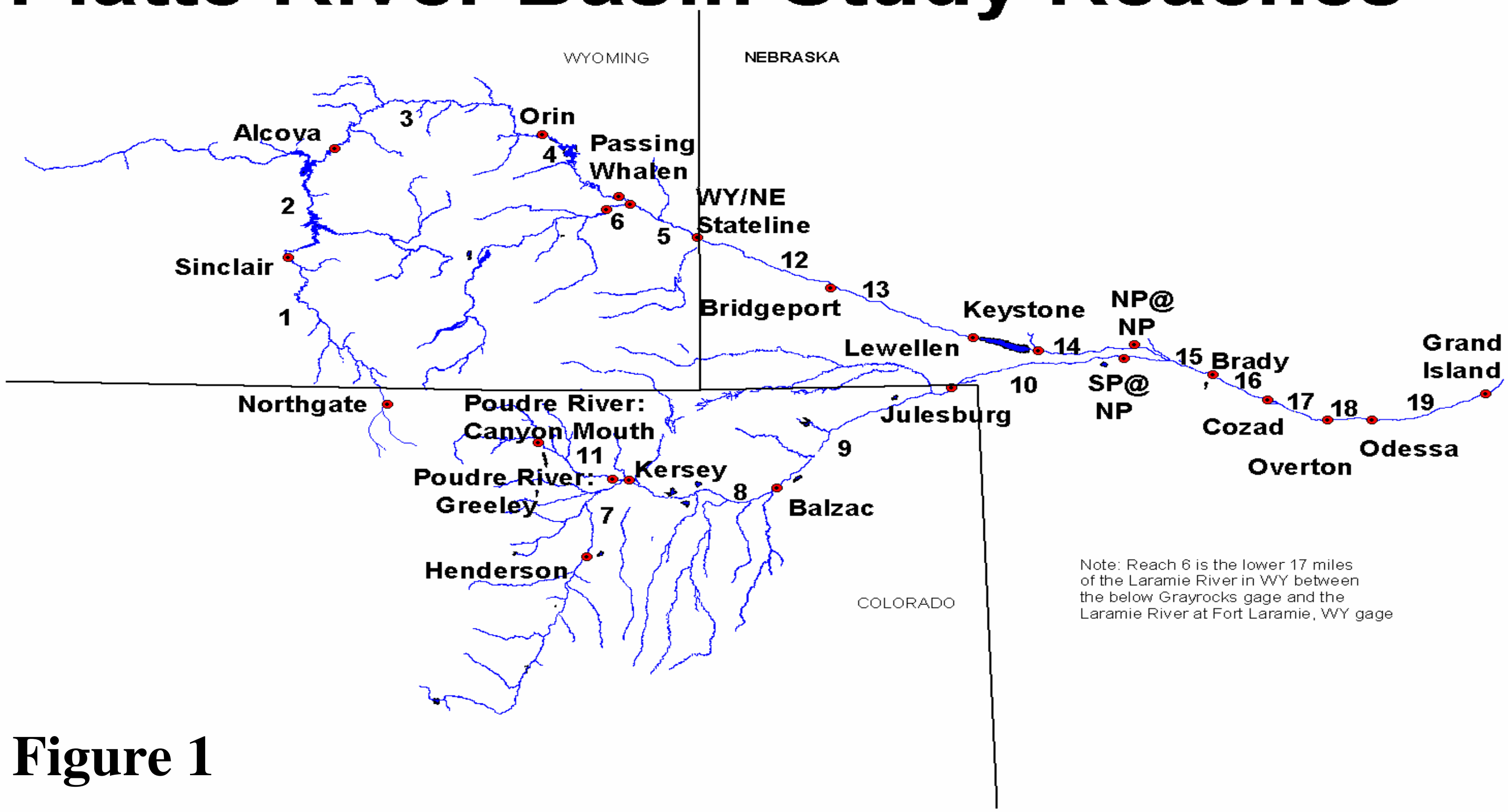
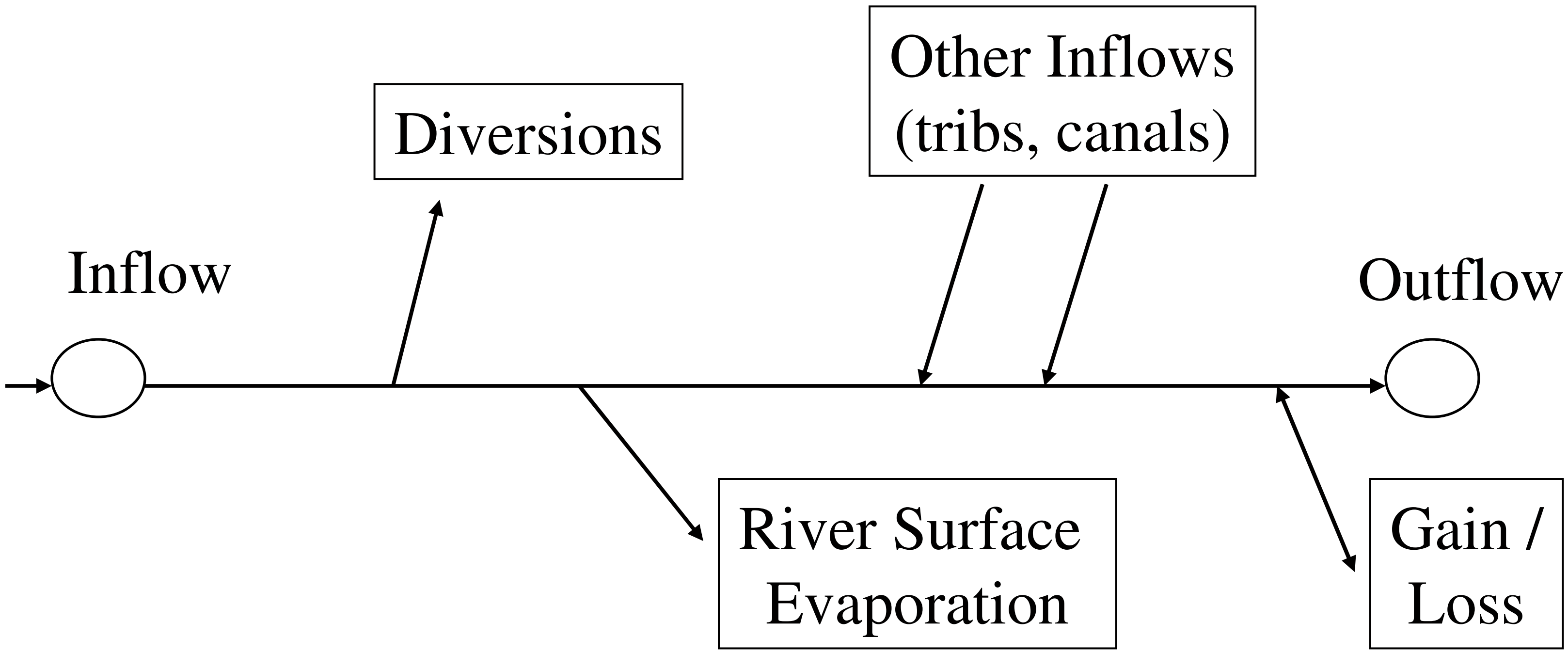


Figure 1

Figure 2 - Study Reach Representation in Water Budget Spreadsheet



Gain/Loss = Outflows - Inflows

(Outflow + Evap + Diversions) - (Inflow + Other Inflows)

Total Inflows = Inflow + Other Inflows + Gain

% EVAP PER MILE

Reach **1** **Northgate (Co/WY Stateline) Gage to Sinclair Gage** Length 100 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0242	0.0105	0.0066	0.0047	0.0062	0.0120	0.0087	0.0039	0.0038	0.0072	0.0284	0.0416
1976	0.0321	0.0141	0.0115	0.0046	0.0069	0.0171	0.0107	0.0052	0.0062	0.0180	0.0316	0.0411
1977	0.0315	0.0162	0.0094	0.0095	0.0172	0.0149	0.0139	0.0096	0.0174	0.0716	0.0606	0.0718
1978	0.0493	0.0170	0.0109	0.0052	0.0062	0.0150	0.0109	0.0048	0.0035	0.0088	0.0280	0.0496
1979	0.0345	0.0123	0.0068	0.0053	0.0066	0.0097	0.0087	0.0028	0.0038	0.0112	0.0199	0.0441
1980	0.0316	0.0155	0.0081	0.0048	0.0068	0.0076	0.0066	0.0018	0.0052	0.0160	0.0472	0.0445
1981	0.0244	0.0150	0.0092	0.0104	0.0159	0.0206	0.0239	0.0077	0.0107	0.0306	0.0535	0.0566
1982	0.0207	0.0200	0.0150	0.0113	0.0108	0.0124	0.0116	0.0038	0.0030	0.0058	0.0164	0.0145
1983	0.0094	0.0061	0.0030	0.0046	0.0072	0.0086	0.0052	0.0032	0.0016	0.0040	0.0115	0.0239
1984	0.0149	0.0089	0.0035	0.0045	0.0037	0.0041	0.0047	0.0020	0.0025	0.0061	0.0116	0.0128
1985	0.0071	0.0080	0.0041	0.0035	0.0031	0.0064	0.0052	0.0039	0.0061	0.0168	0.0340	0.0328
1986	0.0144	0.0054	0.0075	0.0089	0.0044	0.0080	0.0049	0.0032	0.0027	0.0084	0.0223	0.0192
1987	0.0078	0.0051	0.0077	0.0120	0.0096	0.0068	0.0096	0.0062	0.0207	0.0390	0.0458	0.0561
1988	0.0337	0.0103	0.0045	0.0051	0.0066	0.0027	0.0059	0.0039	0.0055	0.0248	0.0615	0.0578
1989	0.0335	0.0135	0.0063	0.0117	0.0053	0.0062	0.0096	0.0104	0.0114	0.0431	0.0406	0.0441
1990	0.0339	0.0167	0.0053	0.0123	0.0105	0.0082	0.0075	0.0082	0.0062	0.0151	0.0368	0.0384
1991	0.0285	0.0111	0.0035	0.0144	0.0126	0.0117	0.0093	0.0058	0.0075	0.0272	0.0366	0.0393
1992	0.0359	0.0057	0.0098	0.0083	0.0111	0.0102	0.0157	0.0099	0.0105	0.0224	0.0453	0.0561
1993	0.0282	0.0143	0.0098	0.0044	0.0045	0.0080	0.0056	0.0035	0.0025	0.0105	0.0215	0.0254
1994	0.0118	0.0046	0.0027	0.0078	0.0029	0.0071	0.0083	0.0057	0.0134	0.0448	0.0657	0.0731
1995	0.0205	0.0186	0.0092	0.0056	0.0039	0.0081	0.0104	0.0027	0.0023	0.0043	0.0208	0.0213
1996	0.0112	0.0059	0.0044	0.0092	0.0084	0.0045	0.0032	0.0025	0.0036	0.0116	0.0286	0.0310
1997	0.0124	0.0046	0.0058	0.0041	0.0049	0.0074	0.0059	0.0026	0.0023	0.0118	0.0150	0.0097
1998	0.0046	0.0018	0.0031	0.0033	0.0049	0.0026	0.0072	0.0054	0.0036	0.0091	0.0156	0.0281
1999	0.0098	0.0108	0.0069	0.0068	0.0060	0.0115	0.0052	0.0047	0.0031	0.0131	0.0255	0.0208
2000	0.0180	0.0147	0.0114	0.0086	0.0051	0.0071	0.0067	0.0049	0.0089	0.0442	0.0831	0.0455
2001	0.0153	0.0055	0.0035	0.0038	0.0035	0.0051	0.0092	0.0053	0.0150	0.0475	0.0662	0.0490
2002	0.0258	0.0118	0.0082	0.0101	0.0142	0.0070	0.0109	0.0341	0.0370	0.1299	0.1584	0.1043
2003	0.0265	0.0049	0.0076	0.0076	0.0043	0.0027	0.0106	0.0066	0.0035	0.0333	0.0607	0.0385
2004	0.0265	0.0046	0.0070	0.0089	0.0143	0.0087	0.0106	0.0085	0.0085	0.0154	0.0445	0.0232
2005	0.0074	0.0052	0.0054	0.0055	0.0039	0.0121	0.0037	0.0038	0.0039	0.0157	0.0279	0.0507
2006	0.0104	0.0140	0.0049	0.0067	0.0030	0.0071	0.0074	0.0031	0.0058	0.0253	0.0485	0.0213
Avg	0.0217	0.0104	0.0070	0.0073	0.0073	0.0088	0.0087	0.0059	0.0075	0.0248	0.0410	0.0402
Max	0.0493	0.0200	0.0150	0.0144	0.0172	0.0206	0.0239	0.0341	0.0370	0.1299	0.1584	0.1043
Min	0.0046	0.0018	0.0027	0.0033	0.0029	0.0026	0.0032	0.0018	0.0016	0.0040	0.0115	0.0097
Std	0.0109	0.0049	0.0029	0.0030	0.0039	0.0041	0.0040	0.0056	0.0071	0.0245	0.0277	0.0198

% SEEP PER MILE

Reach **1** **Northgate (Co/WY Stateline) Gage to Sinclair Gage** Length 100 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
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2004												
2005												
2006												

% DIVERSION PER MILE

Reach 1 Northgate (Co/WY Stateline) Gage to Sinclair Gage Length 100 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
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2000												
2001												
2002												
2003												
2004												
2005												
2006												
Avg												
Max												
Min												
Std												

% EVAP PER MILE

Reach **2** **Sinclair Gage to Alcova Gage** Length 40 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0181	0.0080	0.0052	0.0035	0.0046	0.0092	0.0092	0.0067	0.0078	0.0121	0.0205	0.0261
1976	0.0229	0.0104	0.0083	0.0035	0.0053	0.0136	0.0120	0.0086	0.0118	0.0178	0.0228	0.0265
1977	0.0221	0.0120	0.0068	0.0067	0.0119	0.0116	0.0120	0.0117	0.0193	0.0455	0.0364	0.0459
1978	0.0347	0.0128	0.0087	0.0043	0.0047	0.0127	0.0144	0.0055	0.0173	0.0143	0.0210	0.0331
1979	0.0237	0.0099	0.0054	0.0040	0.0049	0.0081	0.0119	0.0082	0.0105	0.0160	0.0148	0.0301
1980	0.0214	0.0119	0.0064	0.0043	0.0047	0.0069	0.0074	0.0044	0.0097	0.0165	0.0305	0.0280
1981	0.0167	0.0114	0.0072	0.0081	0.0122	0.0194	0.0261	0.0095	0.0196	0.0249	0.0329	0.0360
1982	0.0151	0.0163	0.0133	0.0102	0.0086	0.0119	0.0135	0.0060	0.0161	0.0144	0.0177	0.0134
1983	0.0091	0.0060	0.0030	0.0039	0.0060	0.0077	0.0047	0.0030	0.0032	0.0042	0.0098	0.0180
1984	0.0131	0.0083	0.0031	0.0037	0.0029	0.0028	0.0035	0.0029	0.0030	0.0067	0.0118	0.0123
1985	0.0064	0.0074	0.0038	0.0030	0.0027	0.0055	0.0061	0.0065	0.0103	0.0147	0.0225	0.0207
1986	0.0118	0.0052	0.0067	0.0072	0.0040	0.0090	0.0059	0.0054	0.0056	0.0083	0.0172	0.0147
1987	0.0069	0.0040	0.0064	0.0094	0.0078	0.0059	0.0109	0.0136	0.0232	0.0275	0.0297	0.0389
1988	0.0236	0.0080	0.0038	0.0038	0.0053	0.0026	0.0086	0.0076	0.0160	0.0198	0.0374	0.0344
1989	0.0239	0.0104	0.0051	0.0092	0.0045	0.0088	0.0115	0.0140	0.0158	0.0316	0.0275	0.0296
1990	0.0280	0.0144	0.0045	0.0100	0.0092	0.0090	0.0118	0.0134	0.0204	0.0185	0.0243	0.0351
1991	0.0262	0.0112	0.0034	0.0116	0.0105	0.0122	0.0090	0.0066	0.0125	0.0262	0.0262	0.0259
1992	0.0290	0.0047	0.0083	0.0071	0.0103	0.0108	0.0200	0.0158	0.0120	0.0179	0.0346	0.0364
1993	0.0226	0.0136	0.0086	0.0038	0.0041	0.0081	0.0061	0.0058	0.0057	0.0119	0.0166	0.0244
1994	0.0112	0.0050	0.0027	0.0075	0.0032	0.0094	0.0110	0.0106	0.0138	0.0279	0.0372	0.0429
1995	0.0166	0.0157	0.0082	0.0051	0.0034	0.0085	0.0111	0.0023	0.0044	0.0154	0.0220	0.0185
1996	0.0110	0.0068	0.0047	0.0100	0.0092	0.0043	0.0038	0.0038	0.0060	0.0127	0.0216	0.0245
1997	0.0108	0.0047	0.0054	0.0037	0.0041	0.0066	0.0053	0.0035	0.0037	0.0097	0.0138	0.0163
1998	0.0058	0.0023	0.0036	0.0034	0.0058	0.0023	0.0057	0.0087	0.0085	0.0114	0.0134	0.0193
1999	0.0078	0.0105	0.0072	0.0061	0.0057	0.0128	0.0051	0.0049	0.0044	0.0135	0.0232	0.0179
2000	0.0169	0.0139	0.0104	0.0073	0.0045	0.0060	0.0066	0.0074	0.0119	0.0280	0.0470	0.0302
2001	0.0135	0.0047	0.0029	0.0032	0.0030	0.0047	0.0090	0.0086	0.0148	0.0308	0.0394	0.0302
2002	0.0201	0.0095	0.0067	0.0079	0.0102	0.0053	0.0131	0.0339	0.0288	0.0742	0.0883	0.0657
2003	0.0210	0.0043	0.0068	0.0070	0.0040	0.0025	0.0102	0.0108	0.0082	0.0248	0.0431	0.0323
2004	0.0239	0.0045	0.0065	0.0086	0.0143	0.0106	0.0150	0.0119	0.0093	0.0132	0.0353	0.0238
2005	0.0102	0.0061	0.0056	0.0058	0.0044	0.0130	0.0075	0.0063	0.0087	0.0156	0.0206	0.0393
2006	0.0127	0.0148	0.0044	0.0071	0.0036	0.0077	0.0084	0.0043	0.0074	0.0193	0.0314	0.0228
Avg	0.0174	0.0090	0.0060	0.0063	0.0062	0.0084	0.0099	0.0085	0.0116	0.0202	0.0278	0.0285
Max	0.0347	0.0163	0.0133	0.0116	0.0143	0.0194	0.0261	0.0339	0.0288	0.0742	0.0883	0.0657
Min	0.0058	0.0023	0.0027	0.0030	0.0027	0.0023	0.0035	0.0023	0.0030	0.0042	0.0098	0.0123
Std	0.0073	0.0039	0.0023	0.0025	0.0031	0.0038	0.0047	0.0057	0.0062	0.0129	0.0144	0.0108

% SEEP PER MILE

Reach **2** **Sinclair Gage to Alcova Gage** Length 40 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
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2006												

% DIVERSION PER MILE

Reach **2** **Sinclair Gage to Alcova Gage** Length 40 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
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2002												
2003												
2004												
2005												
2006												
Avg												
Max												
Min												
Std												

% EVAP PER MILE

Reach **3** **Alcova Gage to Orin Gage** Length 132 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0119	0.0056	0.0039	0.0023	0.0031	0.0065	0.0097	0.0095	0.0118	0.0171	0.0126	0.0106
1976	0.0136	0.0067	0.0050	0.0024	0.0037	0.0101	0.0132	0.0121	0.0174	0.0176	0.0141	0.0118
1977	0.0127	0.0078	0.0042	0.0038	0.0067	0.0083	0.0100	0.0139	0.0212	0.0194	0.0123	0.0200
1978	0.0202	0.0086	0.0065	0.0034	0.0032	0.0103	0.0179	0.0062	0.0311	0.0198	0.0140	0.0167
1979	0.0129	0.0076	0.0040	0.0026	0.0032	0.0066	0.0152	0.0136	0.0171	0.0208	0.0098	0.0162
1980	0.0111	0.0083	0.0047	0.0039	0.0026	0.0062	0.0082	0.0070	0.0142	0.0170	0.0138	0.0114
1981	0.0091	0.0078	0.0052	0.0058	0.0085	0.0182	0.0282	0.0114	0.0286	0.0193	0.0123	0.0154
1982	0.0094	0.0126	0.0116	0.0091	0.0064	0.0114	0.0154	0.0083	0.0292	0.0229	0.0191	0.0122
1983	0.0088	0.0059	0.0030	0.0032	0.0049	0.0067	0.0043	0.0029	0.0048	0.0045	0.0081	0.0121
1984	0.0113	0.0077	0.0027	0.0029	0.0021	0.0016	0.0024	0.0039	0.0036	0.0074	0.0121	0.0118
1985	0.0058	0.0067	0.0035	0.0026	0.0022	0.0047	0.0070	0.0090	0.0145	0.0126	0.0110	0.0086
1986	0.0091	0.0051	0.0060	0.0056	0.0036	0.0099	0.0069	0.0077	0.0086	0.0081	0.0121	0.0102
1987	0.0060	0.0029	0.0051	0.0067	0.0060	0.0051	0.0122	0.0210	0.0257	0.0160	0.0136	0.0218
1988	0.0135	0.0057	0.0031	0.0025	0.0041	0.0024	0.0114	0.0114	0.0265	0.0149	0.0133	0.0110
1989	0.0143	0.0073	0.0039	0.0068	0.0037	0.0114	0.0133	0.0176	0.0201	0.0201	0.0143	0.0150
1990	0.0220	0.0121	0.0038	0.0076	0.0079	0.0099	0.0161	0.0186	0.0347	0.0218	0.0118	0.0318
1991	0.0239	0.0114	0.0033	0.0089	0.0084	0.0126	0.0088	0.0073	0.0175	0.0252	0.0158	0.0126
1992	0.0221	0.0037	0.0069	0.0059	0.0095	0.0114	0.0243	0.0217	0.0134	0.0133	0.0239	0.0166
1993	0.0171	0.0128	0.0073	0.0033	0.0038	0.0082	0.0066	0.0080	0.0088	0.0132	0.0116	0.0233
1994	0.0107	0.0053	0.0027	0.0072	0.0034	0.0117	0.0138	0.0155	0.0143	0.0110	0.0087	0.0126
1995	0.0128	0.0129	0.0073	0.0047	0.0029	0.0090	0.0118	0.0019	0.0066	0.0264	0.0233	0.0158
1996	0.0107	0.0076	0.0050	0.0108	0.0100	0.0040	0.0043	0.0051	0.0085	0.0138	0.0145	0.0181
1997	0.0093	0.0047	0.0049	0.0033	0.0032	0.0057	0.0047	0.0044	0.0052	0.0075	0.0126	0.0229
1998	0.0070	0.0027	0.0041	0.0035	0.0066	0.0020	0.0041	0.0121	0.0133	0.0137	0.0112	0.0104
1999	0.0058	0.0102	0.0076	0.0055	0.0055	0.0141	0.0050	0.0052	0.0056	0.0139	0.0209	0.0149
2000	0.0158	0.0130	0.0094	0.0059	0.0038	0.0049	0.0065	0.0099	0.0150	0.0117	0.0110	0.0149
2001	0.0117	0.0038	0.0024	0.0026	0.0025	0.0043	0.0087	0.0119	0.0146	0.0142	0.0126	0.0114
2002	0.0143	0.0071	0.0051	0.0057	0.0063	0.0036	0.0153	0.0337	0.0207	0.0184	0.0182	0.0270
2003	0.0155	0.0038	0.0059	0.0064	0.0037	0.0024	0.0099	0.0150	0.0129	0.0163	0.0255	0.0260
2004	0.0213	0.0044	0.0060	0.0083	0.0142	0.0125	0.0194	0.0153	0.0100	0.0111	0.0261	0.0243
2005	0.0131	0.0071	0.0058	0.0061	0.0049	0.0139	0.0113	0.0089	0.0134	0.0155	0.0133	0.0278
2006	0.0150	0.0157	0.0040	0.0074	0.0041	0.0083	0.0094	0.0055	0.0090	0.0134	0.0142	0.0243
Avg	0.0131	0.0076	0.0051	0.0052	0.0051	0.0081	0.0111	0.0111	0.0156	0.0156	0.0146	0.0169
Max	0.0239	0.0157	0.0116	0.0108	0.0142	0.0182	0.0282	0.0337	0.0347	0.0264	0.0261	0.0318
Min	0.0058	0.0027	0.0024	0.0023	0.0021	0.0016	0.0024	0.0019	0.0036	0.0045	0.0081	0.0086
Std	0.0048	0.0033	0.0020	0.0023	0.0027	0.0040	0.0058	0.0065	0.0081	0.0051	0.0046	0.0061

% SEEP PER MILE

Reach **3** **Alcova Gage to Orin Gage** Length 132 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975											0.0344	
1976										0.0500		
1977									0.0466	0.0370		0.0088
1978											0.0138	
1979												
1980										0.0041	0.0139	
1981							0.0126		0.0163	0.0000	0.0317	
1982												
1983												
1984												
1985									0.0241		0.0136	
1986											0.0183	
1987										0.0693	0.0194	
1988			0.0636						0.0609	0.0548	0.0343	
1989			0.0633						0.0001	0.0410	0.0634	
1990										0.0769		
1991			0.0084							0.0012	0.0232	
1992								0.0419				
1993												
1994									0.0375	0.0189	0.0233	
1995											0.0215	
1996												
1997												
1998										0.0461		
1999											0.0390	
2000									0.0010	0.0315		
2001									0.0381	0.0075	0.0005	
2002									0.1093	0.0333		
2003												
2004								0.0965	0.0082			
2005										0.0390		
2006									0.0325	0.0558		

% DIVERSION PER MILE

Reach **3** **Alcova Gage to Orin Gage** Length 132 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
1982												
1983												
1984												
1985												
1986												
1987												
1988												
1989												
1990												
1991												
1992												
1993												
1994												
1995												
1996												
1997												
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												
2006												
Avg												
Max												
Min												
Std												

% EVAP PER MILE

Reach **4** **Orin Gage to Passing Whalen Diversion Dam Gage** Length 40 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975							0.0152	0.0148	0.0145	0.0151	0.0138	0.0123
1976							0.0181	0.0144	0.0189	0.0161	0.0141	0.0118
1977							0.0196	0.0181	0.0224	0.0172	0.0132	0.0185
1978							0.0236	0.0090	0.0257	0.0168	0.0128	0.0158
1979							0.0211	0.0184	0.0171	0.0171	0.0108	0.0153
1980							0.0081	0.0067	0.0139	0.0160	0.0131	0.0124
1981							0.0386	0.0177	0.0253	0.0160	0.0123	0.0143
1982							0.0310	0.0144	0.0325	0.0177	0.0156	0.0111
1983							0.0053	0.0032	0.0041	0.0044	0.0062	0.0081
1984							0.0026	0.0040	0.0037	0.0073	0.0095	0.0089
1985							0.0111	0.0134	0.0145	0.0125	0.0115	0.0097
1986							0.0058	0.0077	0.0076	0.0071	0.0109	0.0081
1987							0.0142	0.0189	0.0230	0.0146	0.0132	0.0168
1988							0.0172	0.0135	0.0249	0.0139	0.0133	0.0119
1989							0.0253	0.0216	0.0205	0.0184	0.0140	0.0141
1990							0.0283	0.0297	0.0411	0.0192	0.0126	0.0235
1991							0.0179	0.0167	0.0171	0.0191	0.0136	0.0123
1992							0.0275	0.0255	0.0215	0.0118	0.0161	0.0134
1993							0.0152	0.0109	0.0120	0.0115	0.0102	0.0160
1994							0.0203	0.0198	0.0168	0.0113	0.0094	0.0118
1995							0.0125	0.0057	0.0060	0.0182	0.0166	0.0120
1996							0.0088	0.0078	0.0080	0.0126	0.0126	0.0140
1997							0.0042	0.0054	0.0056	0.0082	0.0114	0.0159
1998							0.0045	0.0155	0.0172	0.0124	0.0110	0.0116
1999							0.0066	0.0049	0.0059	0.0103	0.0172	0.0123
2000							0.0117	0.0117	0.0146	0.0128	0.0115	0.0133
2001							0.0158	0.0163	0.0173	0.0127	0.0122	0.0113
2002							0.0214	0.0363	0.0195	0.0178	0.0196	0.0260
2003							0.0145	0.0230	0.0192	0.0157	0.0195	0.0219
2004							0.0335	0.0256	0.0219	0.0109	0.0195	0.0195
2005							0.0297	0.0166	0.0235	0.0143	0.0124	0.0227
2006							0.0373	0.0137	0.0191	0.0140	0.0132	0.0200
Avg							0.0177	0.0150	0.0174	0.0138	0.0132	0.0146
Max							0.0386	0.0363	0.0411	0.0192	0.0196	0.0260
Min							0.0026	0.0032	0.0037	0.0044	0.0062	0.0081
Std							0.0098	0.0076	0.0082	0.0037	0.0030	0.0045

% SEEP PER MILE

Reach **4** **Orin Gage to Passing Whalen Diversion Dam Gage** Length 40 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
1982												
1983												
1984												
1985												
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1994												
1995												
1996												
1997												
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												
2006												

% DIVERSION PER MILE

Reach 4 Orin Gage to Passing Whalen Diversion Dam Gage Length 40 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.6269						0.4969	0.7537	0.5247	0.5509	0.6468	0.8149
1976	0.7648						0.7548	0.7291	0.6381	0.5932	0.6918	0.8150
1977	0.7074						0.7738	0.7297	0.6720	0.6035	0.6661	0.7526
1978							0.8823	0.4922	0.6958	0.5915	0.6720	0.8201
1979	0.5261						0.8934	0.7892	0.5207	0.5781	0.6568	0.8430
1980	0.8061						0.0378	0.4135	0.4686	0.5963	0.6536	0.7933
1981	0.7689						0.9103	0.9097	0.6280	0.6007	0.6551	0.8215
1982	0.8030						0.9188	0.7230	0.6097	0.5690	0.6425	0.8182
1983	0.6759						0.2001	0.1161	0.2598	0.3111	0.3137	0.3278
1984	0.1584						0.1487	0.1626	0.2270	0.4387	0.4833	0.6013
1985	0.6632						0.5160	0.7233	0.5163	0.5974	0.6487	0.7437
1986	0.8228						0.1703	0.4447	0.2066	0.4061	0.6283	0.6427
1987	0.0638						0.4095	0.6006	0.5961	0.6389	0.7157	0.7468
1988							0.6447	0.5798	0.5676	0.6319	0.6699	0.7812
1989	0.7754						0.9012	0.7606	0.5161	0.6007	0.6331	0.6284
1990							0.8823		0.6623	0.5890	0.6404	0.6482
1991	0.8552						0.9640	0.9416	0.5848	0.6053	0.6501	0.7574
1992	0.6745						0.9742	0.0361	0.5686	0.5881	0.6131	0.7102
1993							0.9755	0.7758	0.7088	0.5795	0.6641	0.7843
1994	0.6509						0.9123	0.7596	0.6229	0.6411	0.6675	0.8155
1995	0.7154						0.9158	0.3926	0.1955	0.6473	0.6232	0.7456
1996	0.7495						0.8129	0.5814	0.2681	0.6060	0.6660	0.8364
1997	0.8045						0.0253	0.3808	0.1308	0.5330	0.6950	0.7711
1998	0.7069						0.1455	0.7466	0.6617	0.6112	0.6742	0.8016
1999							0.3606	0.2787	0.1432	0.4161	0.6727	0.7576
2000	0.8694						0.6940	0.5932	0.5590	0.6079	0.6355	0.7830
2001							0.9641	0.6957	0.5839	0.6062	0.6453	0.7652
2002	0.8594							0.8476	0.5092	0.6269	0.7354	
2003								0.9459	0.7628	0.5739	0.6596	0.0280
2004								0.8347	0.8220	0.5394	0.6089	
2005								0.9310	0.8052	0.5616	0.6207	0.7188
2006							0.9582	0.7151	0.5974	0.5736	0.6452	0.7390
Avg	0.4703						0.5701	0.6058	0.5260	0.5692	0.6405	0.6754
Max	0.8694						0.9755	0.9459	0.8220	0.6473	0.7354	0.8430
Min									0.1308	0.3111	0.3137	
Std	0.3576						0.3725	0.2607	0.1894	0.0737	0.0712	0.2345

% EVAP PER MILE

Reach **5** **Passing Whalen Diversion Dam Gage to WY/NE Stateline Gage** Length 47 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0154	0.0064	0.0048	0.0070	0.0069	0.0109	0.0206	0.0202	0.0172	0.0130	0.0151	0.0140
1976	0.0155	0.0083	0.0065	0.0033	0.0078	0.0143	0.0231	0.0168	0.0203	0.0147	0.0142	0.0119
1977	0.0132	0.0071	0.0050	0.0059	0.0084	0.0137	0.0292	0.0223	0.0237	0.0150	0.0142	0.0170
1978	0.0170	0.0112	0.0098	0.0071	0.0056	0.0159	0.0293	0.0119	0.0202	0.0137	0.0116	0.0149
1979	0.0151	0.0063	0.0059	0.0039	0.0078	0.0094	0.0270	0.0231	0.0172	0.0134	0.0118	0.0144
1980	0.0180	0.0055	0.0069	0.0041	0.0047	0.0068	0.0080	0.0064	0.0136	0.0150	0.0124	0.0135
1981	0.0163	0.0098	0.0058	0.0057	0.0072	0.0157	0.0491	0.0240	0.0220	0.0127	0.0124	0.0131
1982	0.0127	0.0092	0.0073	0.0054	0.0114	0.0210	0.0467	0.0206	0.0359	0.0125	0.0121	0.0100
1983	0.0100	0.0055	0.0036	0.0081	0.0113	0.0132	0.0062	0.0036	0.0034	0.0043	0.0044	0.0041
1984	0.0069	0.0045	0.0030	0.0049	0.0037	0.0019	0.0027	0.0041	0.0038	0.0073	0.0068	0.0060
1985	0.0054	0.0048	0.0034	0.0019	0.0031	0.0047	0.0153	0.0178	0.0145	0.0124	0.0120	0.0107
1986	0.0107	0.0042	0.0062	0.0018	0.0060	0.0135	0.0046	0.0077	0.0067	0.0062	0.0097	0.0060
1987	0.0033	0.0031	0.0105	0.0087	0.0078	0.0106	0.0162	0.0167	0.0203	0.0133	0.0127	0.0119
1988	0.0149	0.0066	0.0067	0.0036	0.0061	0.0136	0.0229	0.0157	0.0233	0.0130	0.0132	0.0129
1989	0.0147	0.0099	0.0034	0.0167	0.0038	0.0093	0.0372	0.0255	0.0209	0.0166	0.0136	0.0131
1990	0.0186	0.0089	0.0025	0.0085	0.0094	0.0178	0.0405	0.0409	0.0475	0.0165	0.0135	0.0153
1991	0.0172	0.0125	0.0072	0.0045	0.0104	0.0147	0.0270	0.0260	0.0167	0.0130	0.0115	0.0120
1992	0.0171	0.0044	0.0041	0.0047	0.0089	0.0173	0.0306	0.0293	0.0297	0.0102	0.0083	0.0102
1993	0.0100	0.0068	0.0055	0.0031	0.0050	0.0083	0.0238	0.0138	0.0152	0.0099	0.0088	0.0087
1994	0.0094	0.0044	0.0037	0.0059	0.0078	0.0184	0.0269	0.0242	0.0194	0.0117	0.0102	0.0109
1995	0.0102	0.0049	0.0040	0.0085	0.0079	0.0130	0.0133	0.0096	0.0055	0.0099	0.0099	0.0083
1996	0.0097	0.0053	0.0051	0.0044	0.0074	0.0056	0.0133	0.0105	0.0076	0.0113	0.0108	0.0098
1997	0.0112	0.0026	0.0066	0.0069	0.0075	0.0102	0.0036	0.0065	0.0059	0.0089	0.0102	0.0089
1998	0.0151	0.0056	0.0041	0.0041	0.0039	0.0020	0.0048	0.0190	0.0211	0.0112	0.0109	0.0128
1999	0.0080	0.0061	0.0057	0.0032	0.0090	0.0151	0.0083	0.0047	0.0063	0.0068	0.0134	0.0097
2000	0.0125	0.0086	0.0038	0.0059	0.0067	0.0107	0.0169	0.0136	0.0142	0.0140	0.0120	0.0118
2001	0.0089	0.0044	0.0032	0.0034	0.0041	0.0099	0.0230	0.0206	0.0200	0.0113	0.0118	0.0112
2002	0.0110	0.0035	0.0050	0.0078	0.0089	0.0078	0.0275	0.0389	0.0183	0.0173	0.0211	0.0250
2003	0.0235	0.0118	0.0043	0.0076	0.0122	0.0109	0.0191	0.0311	0.0255	0.0151	0.0135	0.0178
2004	0.0193	0.0091	0.0034	0.0053	0.0119	0.0277	0.0476	0.0360	0.0339	0.0107	0.0128	0.0146
2005	0.0112	0.0050	0.0042	0.0085	0.0087	0.0285	0.0482	0.0244	0.0337	0.0130	0.0116	0.0176
2006	0.0151	0.0090	0.0035	0.0123	0.0115	0.0097	0.0653	0.0219	0.0293	0.0146	0.0122	0.0157
Avg	0.0130	0.0067	0.0051	0.0060	0.0076	0.0126	0.0243	0.0190	0.0191	0.0121	0.0118	0.0123
Max	0.0235	0.0125	0.0105	0.0167	0.0122	0.0285	0.0653	0.0409	0.0475	0.0173	0.0211	0.0250
Min	0.0033	0.0026	0.0025	0.0018	0.0031	0.0019	0.0027	0.0036	0.0034	0.0043	0.0044	0.0041
Std	0.0043	0.0026	0.0019	0.0030	0.0025	0.0060	0.0153	0.0097	0.0100	0.0030	0.0027	0.0040

% SEEP PER MILE

Reach **5** **Passing Whalen Diversion Dam Gage to WY/NE Stateline Gage** Length 47 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978								0.0850				
1979												
1980							0.1951					
1981									0.1145			
1982												
1983							0.3265					
1984							0.0220					
1985												
1986							0.0653					
1987							0.1028					
1988												
1989												
1990									0.3732			
1991												
1992												
1993								0.0024				
1994												
1995								0.1765				
1996												
1997						0.2759	0.0198					
1998						0.2049						
1999							0.0740					
2000												
2001												
2002									0.2781			
2003									0.4275			
2004									0.0702	0.1818		
2005									0.2983	0.0316		
2006												

% DIVERSION PER MILE

Reach **5** **Passing Whalen Diversion Dam Gage to WY/NE Stateline Gage** Length 47 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975								0.7300	0.6800	0.5372	0.6545	0.6914
1976								0.7315	0.6815	0.5977	0.6570	0.7142
1977								0.7668	0.7260	0.5697	0.6609	0.7210
1978								0.2587	0.6678	0.6219	0.7177	0.7349
1979								0.8085	0.6268	0.6078	0.6727	0.8834
1980								0.1606	0.3943	0.5979	0.5895	0.7170
1981								1.2398	0.6789	0.5221	0.5796	0.7207
1982								0.8226	0.3761	0.5406	0.5883	0.6524
1983								0.0365	0.0907	0.1664	0.1966	0.1599
1984								0.0507	0.1061	0.2880	0.3199	0.3229
1985								0.6529	0.5251	0.6168	0.6176	0.5057
1986								0.2118	0.1584	0.2839	0.5735	0.3842
1987								0.4862	0.4766	0.6007	0.6738	0.6034
1988								0.4514	0.6628	0.6072	0.6435	0.5593
1989								0.8901	0.7407	0.6282	0.6805	0.6612
1990								1.5481	0.8990	0.5967	0.6789	0.7032
1991								0.6512	0.2335	0.6432	0.6699	0.5537
1992								1.1002	1.6823	0.6184	0.6604	0.6689
1993	0.1691							0.6174	0.3663	0.5931	0.5787	0.6154
1994								0.6269	0.6509	0.5742	0.6514	0.6524
1995								0.2150	0.1142	0.5422	0.6588	0.5582
1996								0.4712	0.1857	0.6493	0.6674	0.5856
1997								0.1840	0.0844	0.4628	0.6529	0.6812
1998								0.6174	0.5457	0.5752	0.6239	0.6476
1999								0.0776	0.1131	0.2624	0.5584	0.4304
2000								0.3695	0.4710	0.5440	0.5659	0.5655
2001								0.4118	0.5734	0.4450	0.5404	0.5497
2002								1.9241	0.2727	0.5153	0.6854	0.6226
2003								1.6707	0.8719	0.4365	0.5478	1.1512
2004								2.0917	1.7775	0.4656	0.5589	1.4109
2005								2.1032	0.9823	0.4638	0.4598	0.6866
2006								0.7647	0.9907	0.5319	0.5759	0.6452
Avg	0.0053							0.7420	0.5752	0.5221	0.5988	0.6487
Max	0.1691							2.1032	1.7775	0.6493	0.7177	1.4109
Min								0.0365	0.0844	0.1664	0.1966	0.1599
Std	0.0294							0.5697	0.3994	0.1188	0.1051	0.2133

% EVAP PER MILE

Reach **6** **Laramie River - below Gray Rocks Gage to Fort Laramie Gage** Length 17 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981	0.0746	0.0610	0.0276	0.0344	0.0265	0.0558	0.0795	0.0626	0.1096	0.1115	0.0961	0.0760
1982	0.0560	0.0433	0.0325	0.0168	0.0347	0.0589	0.0406	0.0836	0.0772	0.1067	0.0984	0.0592
1983	0.0373	0.0219	0.0139	0.0282	0.0378	0.0359	0.0093	0.0026	0.0026	0.0050	0.0192	0.0215
1984	0.0150	0.0055	0.0036	0.0042	0.0036	0.0044	0.0033	0.0032	0.0072	0.0369	0.0182	0.0180
1985	0.0060	0.0046	0.0028	0.0018	0.0046	0.0151	0.0439	0.0463	0.0868	0.1064	0.0868	0.0545
1986	0.0364	0.0139	0.0166	0.0034	0.0101	0.0173	0.0123	0.0194	0.0067	0.0233	0.0566	0.0191
1987	0.0080	0.0132	0.0192	0.0145	0.0205	0.0170	0.0402	0.0606	0.0561	0.0990	0.0727	0.0577
1988	0.0442	0.0192	0.0190	0.0085	0.0132	0.0256	0.0272	0.0351	0.0941	0.0770	0.1035	0.0667
1989	0.0440	0.0301	0.0099	0.0446	0.0094	0.0229	0.0513	0.0795	0.0841	0.1372	0.1032	0.0731
1990	0.0504	0.0286	0.0069	0.0239	0.0240	0.0471	0.0665	0.0935	0.1423	0.1312	0.0763	0.0753
1991	0.0489	0.0374	0.0100	0.0112	0.0216	0.0329	0.0424	0.0295	0.0297	0.0259	0.0864	0.0614
1992	0.0496	0.0124	0.0123	0.0132	0.0229	0.0443	0.0449	0.0623	0.0615	0.0485	0.0594	0.0496
1993	0.0304	0.0204	0.0161	0.0075	0.0113	0.0201	0.0420	0.0211	0.0223	0.0702	0.0372	0.0359
1994	0.0258	0.0131	0.0098	0.0139	0.0172	0.0400	0.0432	0.0642	0.1039	0.0817	0.0772	0.0519
1995	0.0255	0.0132	0.0108	0.0191	0.0160	0.0281	0.0204	0.0178	0.0061	0.0180	0.0629	0.0448
1996	0.0319	0.0113	0.0075	0.0054	0.0085	0.0068	0.0108	0.0288	0.0495	0.0944	0.0807	0.0499
1997	0.0339	0.0068	0.0179	0.0132	0.0148	0.0101	0.0286	0.0466	0.0304	0.0852	0.0548	0.0456
1998	0.0417	0.0164	0.0099	0.0086	0.0075	0.0178	0.0424	0.0728	0.0674	0.0797	0.0680	0.0611
1999	0.0238	0.0174	0.0128	0.0068	0.0185	0.0302	0.0287	0.0087	0.0176	0.0483	0.0832	0.0343
2000	0.0363	0.0228	0.0092	0.0106	0.0094	0.0147	0.0196	0.0155	0.0501	0.0879	0.0842	0.0550
2001	0.0185	0.0070	0.0039	0.0036	0.0040	0.0091	0.0134	0.0158	0.0718	0.0694	0.0755	0.0497
2002	0.0326	0.0095	0.0120	0.0162	0.0165	0.0142	0.0277	0.0670	0.1080	0.1089	0.0930	0.0561
2003	0.0300	0.0251	0.0091	0.0151	0.0234	0.0198	0.0264	0.0509	0.0728	0.1238	0.0916	0.0617
2004	0.0651	0.0299	0.0107	0.0160	0.0282	0.0638	0.0523	0.0703	0.0966	0.0822	0.0889	0.0551
2005	0.0401	0.0162	0.0096	0.0161	0.0189	0.0598	0.0512	0.0680	0.0761	0.1031	0.0776	0.0729
2006	0.0534	0.0296	0.0096	0.0317	0.0215	0.0197	0.0783	0.0823	0.1315	0.1463	0.1270	0.0687
Avg	0.0300	0.0166	0.0101	0.0121	0.0139	0.0229	0.0296	0.0377	0.0519	0.0659	0.0618	0.0430
Max	0.0746	0.0610	0.0325	0.0446	0.0378	0.0638	0.0795	0.0935	0.1423	0.1463	0.1270	0.0760
Min												
Std	0.0204	0.0139	0.0077	0.0109	0.0104	0.0190	0.0227	0.0305	0.0433	0.0462	0.0370	0.0252

% SEEP PER MILE

Reach **6** **Laramie River - below Gray Rocks Gage to Fort Laramie Gage** Length 17 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981			2.3325	0.8097	1.1898		0.1559	0.5609	1.1736			
1982		0.6380	0.3755	0.8455	1.3936		1.5248	0.3942	0.7566		0.8667	
1983							0.4175	0.0488				0.0064
1984		0.3222			0.0628			0.4196	0.1019			
1985			0.1314		0.0791	0.2730					0.1612	
1986			0.1277	0.4892	0.3925							0.6109
1987	0.0174	0.9663	0.0447	0.0888	0.4697			0.5093			1.2530	
1988	0.6495	0.6688	0.9149	1.3833	0.8815	0.0622	0.0010	0.2558		0.1268		
1989					0.7267	0.0173	0.4916		1.5984	0.3402	0.0816	
1990			0.8235	0.1524	0.3010		0.1416	0.5679	0.4511		0.7259	
1991			3.4678	0.4362	0.5863	0.0807				4.3439		
1992							0.3314	1.2528	0.7322			
1993				0.6828				0.0709				
1994			0.3709		0.3856						0.3967	
1995			0.0091	0.5039			0.8629		0.1089		0.9560	
1996		0.5937	0.3699	1.0425	0.9631		0.4629					
1997			0.0611	1.3568	0.1567	0.2516			1.5813			
1998												
1999			0.6637				0.4137					
2000			0.1579	0.2402	0.3051	0.1922	0.1496					
2001	1.4119	2.5831	3.0779	3.1227	2.9340	3.1284	3.9761	2.6942		0.1488		
2002	0.0616		0.0211				0.0440	0.6768		0.8466		
2003				0.2893	0.4818		0.3707	0.2189				
2004							0.1097	0.8803	0.0585			
2005		0.3139	0.8927	1.4672	0.2690		0.2444	0.3542	0.7918			
2006					1.0320							

% DIVERSION PER MILE

Reach 6 Laramie River - below Gray Rocks Gage to Fort Laramie Gage Length 17 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
1982												
1983												
1984												
1985												
1986												
1987												
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1994												
1995												
1996												
1997												
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												
2006												
Avg												
Max												
Min												
Std												

% EVAP PER MILE

Reach **7** **Henderson Gage to Kersey Gage** Length 54.9 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0065	0.0029	0.0014	0.0017	0.0020	0.0045	0.0074	0.0073	0.0059	0.0079	0.0069	0.0067
1976	0.0065	0.0024	0.0020	0.0012	0.0036	0.0038	0.0109	0.0089	0.0092	0.0102	0.0066	0.0068
1977	0.0055	0.0028	0.0022	0.0010	0.0035	0.0047	0.0104	0.0112	0.0124	0.0120	0.0085	0.0104
1978	0.0075	0.0034	0.0022	0.0005	0.0014	0.0063	0.0121	0.0063	0.0063	0.0091	0.0074	0.0082
1979	0.0061	0.0031	0.0004		0.0020	0.0044	0.0094	0.0045	0.0038	0.0081	0.0063	0.0084
1980	0.0064	0.0014	0.0013	0.0004	0.0011	0.0020	0.0042	0.0028	0.0047	0.0081	0.0069	0.0075
1981	0.0058	0.0032	0.0031	0.0022	0.0026	0.0044	0.0134	0.0081	0.0097	0.0106	0.0079	0.0090
1982	0.0054	0.0046	0.0020	0.0014	0.0022	0.0061	0.0121	0.0086	0.0065	0.0071	0.0071	0.0059
1983	0.0055	0.0020	0.0012	0.0017	0.0029	0.0023	0.0028	0.0025	0.0033	0.0050	0.0060	0.0067
1984	0.0061	0.0023	0.0000	0.0003	0.0014	0.0025	0.0031	0.0039	0.0047	0.0070	0.0053	0.0047
1985	0.0024	0.0017	0.0011	0.0005	0.0007	0.0041	0.0082	0.0056	0.0059	0.0077	0.0067	0.0058
1986	0.0057	0.0010	0.0006	0.0021	0.0024	0.0055	0.0056	0.0063	0.0053	0.0072	0.0066	0.0062
1987	0.0051	0.0023	0.0011	0.0013	0.0025	0.0027	0.0072	0.0044	0.0065	0.0085	0.0070	0.0074
1988	0.0069	0.0031	0.0010	0.0003	0.0015	0.0035	0.0081	0.0073	0.0085	0.0084	0.0071	0.0070
1989	0.0068	0.0038	0.0009	0.0015	0.0002	0.0045	0.0099	0.0088	0.0077	0.0097	0.0071	0.0074
1990	0.0064	0.0039	0.0008	0.0021	0.0019	0.0026	0.0071	0.0071	0.0083	0.0081	0.0068	0.0076
1991	0.0060	0.0037	0.0005	0.0008	0.0035	0.0054	0.0100	0.0093	0.0061	0.0083	0.0067	0.0070
1992	0.0065	0.0020	0.0016	0.0013	0.0034	0.0035	0.0096	0.0081	0.0069	0.0076	0.0060	0.0076
1993	0.0068	0.0019	0.0004	0.0004	0.0010	0.0044	0.0081	0.0086	0.0065	0.0078	0.0065	0.0060
1994	0.0049	0.0016	0.0015	0.0018	0.0012	0.0049	0.0085	0.0084	0.0084	0.0099	0.0085	0.0085
1995	0.0062	0.0024	0.0022	0.0018	0.0035	0.0052	0.0077	0.0031	0.0033	0.0051	0.0072	0.0061
1996	0.0057	0.0034	0.0018	0.0009	0.0020	0.0034	0.0086	0.0062	0.0058	0.0077	0.0070	0.0062
1997	0.0063	0.0024	0.0018	0.0007	0.0018	0.0055	0.0052	0.0060	0.0038	0.0077	0.0055	0.0066
1998	0.0045	0.0017	0.0011	0.0015	0.0022	0.0029	0.0045	0.0057	0.0059	0.0079	0.0067	0.0080
1999	0.0056	0.0034	0.0009	0.0019	0.0034	0.0055	0.0052	0.0034	0.0044	0.0082	0.0058	0.0058
2000	0.0052	0.0037	0.0020	0.0016	0.0029	0.0045	0.0095	0.0079	0.0081	0.0106	0.0084	0.0077
2001	0.0062	0.0016	0.0010	0.0014	0.0013	0.0042	0.0097	0.0073	0.0096	0.0099	0.0079	0.0083
2002	0.0059	0.0041	0.0019	0.0017	0.0024	0.0030	0.0132	0.0101	0.0152	0.0195	0.0158	0.0123
2003	0.0056	0.0038	0.0030	0.0037	0.0020	0.0051	0.0086	0.0074	0.0061	0.0120	0.0104	0.0076
2004	0.0080	0.0030	0.0022	0.0021	0.0021	0.0073	0.0082	0.0093	0.0082	0.0088	0.0069	0.0077
2005	0.0050	0.0029	0.0021	0.0021	0.0034	0.0052	0.0071	0.0065	0.0057	0.0112	0.0072	0.0091
2006	0.0056	0.0041	0.0013	0.0034	0.0021	0.0038	0.0118	0.0098	0.0104	0.0105	0.0085	0.0067
Avg	0.0059	0.0028	0.0015	0.0014	0.0022	0.0043	0.0084	0.0069	0.0070	0.0090	0.0073	0.0074
Max	0.0080	0.0046	0.0031	0.0037	0.0036	0.0073	0.0134	0.0112	0.0152	0.0195	0.0158	0.0123
Min	0.0024	0.0010	0.0000		0.0002	0.0020	0.0028	0.0025	0.0033	0.0050	0.0053	0.0047
Std	0.0010	0.0009	0.0007	0.0008	0.0009	0.0012	0.0027	0.0022	0.0026	0.0025	0.0018	0.0015

% SEEP PER MILE

Reach **7** **Henderson Gage to Kersey Gage** Length 54.9 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
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2000												
2001												
2002												
2003												
2004												
2005												
2006												

% DIVERSION PER MILE

Reach 7 Henderson Gage to Kersey Gage Length 54.9 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.3859	0.0588					0.3122	0.8493	0.2650	0.9463	1.0491	0.7169
1976	0.4867	0.2603				0.0214	0.6597	0.9403	1.2985	1.4564	1.1125	0.5542
1977	0.3812	0.2612	0.0043	0.0113	0.1620	0.2064	0.7903	1.2086	1.5658	1.0213	1.2355	1.1582
1978	0.7508	0.4519	0.1298	0.2875	0.2189		0.6605	0.3691	0.5073	1.3587	1.2775	1.0464
1979	0.5710	0.0225	0.2463	0.3071	0.2862	0.0377	0.2179	0.0958	0.1024	1.1975	0.6093	0.8337
1980	0.4497	0.0061	0.0095	0.0120	0.0101	0.0078	0.0043	0.0170	0.2722	1.0066	1.1412	0.6993
1981	0.5685	0.1524	0.0115	0.0130	0.0252	0.0216	0.5624	0.6763	0.7201	1.4205	1.3084	1.0919
1982	0.7832	0.3438	0.2045	0.1277	0.0212	0.1314	1.2176	0.9257	0.6501	0.7942	1.1252	0.6057
1983	0.1441							0.0284	0.0453	0.2475	0.5670	0.5376
1984	0.2902							0.0832	0.2637	0.8539	0.4216	0.3585
1985	0.0673						0.4161	0.1668	0.5578	0.8969	1.1467	0.6281
1986	0.2061			0.0004	0.0023	0.1513	0.1183	0.6412	0.2397	0.9651	1.1024	0.6807
1987	0.2752						0.1872	0.1402	0.5080	1.2612	1.0860	0.8184
1988	0.4322						0.2977	0.5189	0.8079	1.2261	1.1130	0.7894
1989	0.7904					0.0574	0.9053	1.0642	0.7696	1.3392	1.1561	0.5644
1990	0.4036				0.0966	0.0259	0.1007	0.9190	0.7960	1.0883	1.1493	0.7070
1991	0.4270	0.0341				0.2362	0.9423	0.9160	0.3988	1.0801	1.0588	0.8227
1992	0.3820						0.2099	1.0485	0.7214	1.1563	0.8017	0.9412
1993	0.4529	0.0012				0.0067	0.2484	0.9281	0.5874	1.2333	1.2103	0.6855
1994	0.4665					0.1973	0.6197	0.9075	1.0698	1.4793	1.1628	0.9780
1995	0.5745	0.3137				0.2743	0.9696	0.0894	0.0255	0.2253	1.1332	0.5655
1996	0.1236	0.3833	0.0623		0.1042	0.0343	0.8314	0.6608	0.4222	0.9449	1.1236	0.4333
1997	0.2032	0.0199	0.1934	0.3868	0.1284	0.1223	0.4134	0.6602	0.1011	0.9977	0.4082	0.5747
1998	0.2613	0.0099	0.0121			0.0461	0.1674	0.3552	0.7859	1.0143	1.0036	0.9872
1999	0.3656	0.0222	0.0186		0.1274	0.3186	0.3369	0.0690	0.1910	1.0576	0.4774	0.2996
2000	0.1149	0.0727	0.0085		0.0360	0.0813	0.7096	0.8112	1.2165	1.3409	1.2932	0.8277
2001	0.3126	0.0412	0.3437	0.0922		0.2259	0.3307	0.3435	0.9793	1.0026	1.3406	0.9121
2002	0.7418	0.0595	0.0105		0.1507	0.1038	1.1559	1.2852	1.4167	1.4276	1.4815	1.3014
2003	0.8405	0.0301				0.1535	0.7343	0.6609	0.5464	1.4584	1.3700	0.8003
2004	0.8902	0.1115		0.2055	0.2256	0.4317	0.9705	1.0470	1.1248	1.1028	1.0625	0.8809
2005	0.4122	0.0559	0.1020	0.2865	0.0334	0.1663	0.5498	0.6091	0.2912	1.4374	1.2815	1.1721
2006	0.3653	0.1787	0.4591	0.0992	0.0187	0.2197	1.2264	1.5077	1.5348	1.2030	1.3180	1.0739
Avg	0.4350	0.0903	0.0568	0.0572	0.0515	0.1025	0.5271	0.6420	0.6494	1.1013	1.0665	0.7827
Max	0.8902	0.4519	0.4591	0.3868	0.2862	0.4317	1.2264	1.5077	1.5658	1.4793	1.4815	1.3014
Min	0.0673							0.0170	0.0255	0.2253	0.4082	0.2996
Std	0.2172	0.1288	0.1115	0.1092	0.0794	0.1114	0.3644	0.4066	0.4342	0.2951	0.2759	0.2391

% EVAP PER MILE

Reach **8** **Kersey Gage to Balzac Gage** Length 69.7 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0082	0.0022	0.0012	0.0013	0.0014	0.0034	0.0097	0.0106	0.0102	0.0141	0.0133	0.0100
1976	0.0071	0.0016	0.0014	0.0009	0.0027	0.0035	0.0132	0.0113	0.0156	0.0193	0.0151	0.0118
1977	0.0043	0.0014	0.0013	0.0003	0.0021	0.0041	0.0119	0.0173	0.0182	0.0204	0.0149	0.0138
1978	0.0094	0.0019	0.0008	0.0002	0.0005	0.0030	0.0149	0.0097	0.0113	0.0186	0.0135	0.0144
1979	0.0073	0.0013	0.0000		0.0015	0.0034	0.0117	0.0064	0.0056	0.0159	0.0108	0.0123
1980	0.0103	0.0015	0.0014	0.0005	0.0012	0.0026	0.0060	0.0036	0.0075	0.0155	0.0123	0.0101
1981	0.0044	0.0029	0.0024	0.0019	0.0017	0.0040	0.0135	0.0097	0.0148	0.0180	0.0130	0.0128
1982	0.0051	0.0023	0.0012	0.0007	0.0013	0.0029	0.0104	0.0109	0.0101	0.0144	0.0121	0.0080
1983	0.0035	0.0016	0.0013	0.0016	0.0034	0.0033	0.0037	0.0033	0.0041	0.0078	0.0102	0.0095
1984	0.0070	0.0027		0.0002	0.0014	0.0027	0.0038	0.0053	0.0074	0.0124	0.0092	0.0064
1985	0.0033	0.0021	0.0008	0.0004	0.0007	0.0037	0.0087	0.0082	0.0092	0.0139	0.0113	0.0078
1986	0.0052	0.0007	0.0002	0.0012	0.0017	0.0038	0.0085	0.0074	0.0084	0.0135	0.0118	0.0086
1987	0.0053	0.0021	0.0010	0.0013	0.0027	0.0024	0.0095	0.0067	0.0106	0.0147	0.0121	0.0093
1988	0.0040	0.0019	0.0011	0.0001	0.0014	0.0037	0.0082	0.0112	0.0152	0.0164	0.0135	0.0097
1989	0.0054	0.0022	0.0012	0.0016	0.0003	0.0040	0.0106	0.0134	0.0108	0.0192	0.0126	0.0086
1990	0.0061	0.0023	0.0006	0.0015	0.0018	0.0038	0.0085	0.0111	0.0142	0.0162	0.0126	0.0114
1991	0.0044	0.0021	0.0003	0.0008	0.0034	0.0054	0.0101	0.0142	0.0106	0.0163	0.0125	0.0105
1992	0.0056	0.0015	0.0014	0.0010	0.0035	0.0045	0.0095	0.0133	0.0103	0.0132	0.0110	0.0104
1993	0.0056	0.0014	0.0001	0.0002	0.0005	0.0044	0.0094	0.0122	0.0103	0.0154	0.0124	0.0082
1994	0.0064	0.0016	0.0013	0.0014	0.0011	0.0054	0.0093	0.0124	0.0138	0.0159	0.0160	0.0126
1995	0.0063	0.0014	0.0013	0.0009	0.0025	0.0055	0.0079	0.0044	0.0044	0.0073	0.0118	0.0078
1996	0.0061	0.0027	0.0015	0.0009	0.0023	0.0037	0.0098	0.0106	0.0101	0.0138	0.0113	0.0082
1997	0.0066	0.0013	0.0016	0.0008	0.0022	0.0066	0.0067	0.0091	0.0055	0.0144	0.0086	0.0100
1998	0.0059	0.0021	0.0011	0.0016	0.0029	0.0034	0.0063	0.0084	0.0104	0.0154	0.0113	0.0126
1999	0.0079	0.0029	0.0010	0.0019	0.0037	0.0054	0.0078	0.0050	0.0062	0.0146	0.0085	0.0076
2000	0.0064	0.0040	0.0023	0.0017	0.0036	0.0054	0.0115	0.0118	0.0121	0.0184	0.0160	0.0129
2001	0.0052	0.0012	0.0009	0.0018	0.0014	0.0038	0.0116	0.0094	0.0135	0.0169	0.0128	0.0133
2002	0.0073	0.0028	0.0015	0.0013	0.0021	0.0024	0.0143	0.0110	0.0212	0.0268	0.0326	0.0207
2003	0.0088	0.0030	0.0013	0.0023	0.0015	0.0047	0.0109	0.0116	0.0101	0.0174	0.0129	0.0114
2004	0.0105	0.0017	0.0010	0.0015	0.0016	0.0075	0.0136	0.0161	0.0143	0.0156	0.0126	0.0107
2005	0.0073	0.0023	0.0021	0.0018	0.0026	0.0051	0.0070	0.0087	0.0096	0.0173	0.0128	0.0141
2006	0.0082	0.0030	0.0012	0.0015	0.0013	0.0043	0.0125	0.0160	0.0219	0.0229	0.0153	0.0105
Avg	0.0064	0.0021	0.0011	0.0011	0.0019	0.0041	0.0097	0.0100	0.0112	0.0160	0.0130	0.0108
Max	0.0105	0.0040	0.0024	0.0023	0.0037	0.0075	0.0149	0.0173	0.0219	0.0268	0.0326	0.0207
Min	0.0033	0.0007			0.0003	0.0024	0.0037	0.0033	0.0041	0.0073	0.0085	0.0064
Std	0.0018	0.0007	0.0006	0.0006	0.0009	0.0012	0.0027	0.0035	0.0043	0.0036	0.0040	0.0027

% SEEP PER MILE

Reach **8** **Kersey Gage to Balzac Gage** Length 69.7 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975									0.0012			0.0784
1976												
1977												
1978								0.0513	0.0282			
1979								0.4831	0.4285			
1980							0.0305	0.1496	0.1139			
1981												
1982												
1983							0.1212	0.2447	0.1919			
1984							0.0939	0.0515			0.0585	
1985												
1986							0.0535					
1987								0.1633				
1988												
1989												
1990												
1991									0.0138			
1992												
1993												
1994												
1995								0.4207	0.0482			
1996								0.0964	0.0623			
1997									0.3374			
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005			0.0035						0.0812			
2006												

% DIVERSION PER MILE

Reach **8** **Kersey Gage to Balzac Gage** Length 69.7 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	1.2329	1.3495	1.1986	0.9814	0.9390	1.1976	0.8966	0.9312	0.6577	0.9233	0.9153	0.8578
1976	1.2894	1.3728	1.1225	0.9145	1.2181	0.9082	1.0357	1.1067	1.0997	1.1338	1.0314	1.0893
1977	1.4030	1.4063	1.3374	1.2642	1.3623	1.0753	1.2376	1.0797	1.2633	1.0880	1.0584	1.2783
1978	1.3017	1.4076	1.4072	1.3399	1.3806	1.3991	0.9537	1.1605	1.1182	1.0830	1.0526	1.0491
1979	1.2429	1.4012	1.3488	1.1358	0.8950	1.3485	1.1466	0.4061	0.1373	0.9656	0.4886	0.9774
1980	1.1530	1.0308	0.5018	0.3902	0.3639	0.4410	0.2404	0.1306	0.3618	1.0319	1.1121	0.9745
1981	1.3745	1.1446	1.0175	0.6745	1.2530	1.1965	0.9381	1.1091	0.6835	1.1713	1.0855	1.0959
1982	1.3674	1.4146	1.3697	1.1954	1.1888	1.3902	1.1948	1.1764	1.2437	1.0016	1.0476	1.1568
1983	1.3883	1.3372	0.4632	0.2043	0.2587	0.3633	0.1129	0.0985	0.0773	0.3477	0.4967	0.4766
1984	0.8189	0.7209	0.3217	0.2374	0.3233	0.7546	0.2660	0.2320	0.4577	1.0895	0.5064	0.4177
1985	0.3357	0.4275	0.6096	0.3363	0.3335	1.2725	1.1602	0.4011	0.5899	0.9291	0.9094	0.7352
1986	0.9206	0.9921	0.3656	0.4191	0.9027	1.3872	0.3412	1.1749	0.3311	0.9087	1.0478	0.5984
1987	1.1117	1.0282	0.6987	0.6331	0.8320	0.3588	0.7293	0.2851	0.4756	1.0587	0.9324	0.9029
1988	1.3835	1.2978	0.7898	0.1860	0.1838	0.7679	1.0665	0.8242	0.8258	1.0485	1.0556	1.0088
1989	1.3652	1.3921	0.8401	0.6347	0.5789	1.1153	1.2424	0.9443	1.0960	1.1421	1.0195	1.1305
1990	1.3419	1.3911	1.0269	0.8383	0.7096	0.6287	0.6656	1.0918	1.0156	0.9737	0.9508	1.0298
1991	1.3706	1.3997	1.1191	0.6352	0.8345	1.0133	1.1695	1.0088	0.7973	0.9871	1.0114	0.9628
1992	1.2947	1.3319	1.3109	0.5371	0.5662	0.4639	0.9826	0.9478	1.1010	1.1730	0.8580	0.9353
1993	1.2878	1.3249	0.6042	0.4624	0.6042	0.5913	0.8794	1.0162	1.1429	0.9849	1.0522	0.5766
1994	1.2024	1.1368	1.1186	0.8681	0.5161	0.8399	1.1316	1.0005	1.1730	1.0941	0.9553	0.9342
1995	1.3318	1.4021	1.3518	1.2280	1.2643	0.9555	1.1623	0.3512	0.0720	0.2908	1.0838	0.7272
1996	0.7402	1.3406	1.1353	0.4743	0.4828	0.7971	1.1723	0.9177	0.9253	1.0694	1.0637	0.4523
1997	0.8814	1.4095	0.9313	0.4586	0.6165	0.7787	1.1199	1.0488	0.1614	0.9747	0.5967	0.6256
1998	0.7560	0.6528	0.5836	0.1543	0.3165	0.5779	0.5241	0.6670	0.6920	0.8877	1.0576	0.7383
1999	0.5388	1.1892	0.8761	0.6016	0.7436	1.1088	1.1025	0.2470	0.3117	1.0186	0.4926	0.4536
2000	0.9311	1.0445	0.3131	0.5319	0.3337	0.5647	0.9739	1.1200	1.2054	1.0716	0.9782	0.8851
2001	1.3867	1.2504	1.0782	0.8005	0.8812	1.2903	0.9463	0.8577	1.0207	0.9419	1.0052	0.9208
2002	1.2310	1.3497	1.2782	1.0861	1.1988	1.2552	1.1013	1.1517	1.0844	1.0764	0.8791	1.0697
2003	0.8319	1.1454	1.3902	1.2847	1.1980	1.2684	1.2392	1.1445	1.1264	1.1226	1.1553	1.0160
2004	1.1843	1.3950	1.3943	1.2775	1.3287	1.2740	1.0274	0.9122	1.0693	1.0909	1.0603	1.1505
2005	1.1436	1.3492	1.2037	1.0471	1.3243	1.1965	1.3722	1.1797	0.6596	1.1046	1.1390	1.0740
2006	1.0393	1.3660	1.0838	1.4026	1.2346	1.2814	1.2706	1.0422	1.0738	0.9940	1.0510	1.0905
Avg	1.1307	1.2251	0.9747	0.7573	0.8177	0.9644	0.9501	0.8364	0.7828	0.9931	0.9422	0.8872
Max	1.4030	1.4146	1.4072	1.4026	1.3806	1.3991	1.3722	1.1797	1.2633	1.1730	1.1553	1.2783
Min	0.3357	0.4275	0.3131	0.1543	0.1838	0.3588	0.1129	0.0985	0.0720	0.2908	0.4886	0.4177
Std	0.2708	0.2409	0.3452	0.3763	0.3802	0.3292	0.3219	0.3500	0.3758	0.1897	0.1963	0.2332

% EVAP PER MILE

Reach 9 Balzac Gage to Julesburg Gage Length 97.6 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0232	0.0107	0.0030	0.0026	0.0025	0.0084	0.0122	0.0134	0.0144	0.0144	0.0135	0.0134
1976	0.0248	0.0050	0.0032	0.0018	0.0059	0.0064	0.0158	0.0141	0.0168	0.0200	0.0176	0.0198
1977	0.0086	0.0079	0.0072	0.0013	0.0062	0.0079	0.0187	0.0167	0.0178	0.0260	0.0147	0.0145
1978	0.0181	0.0076	0.0029	0.0006	0.0015	0.0068	0.0170	0.0187	0.0209	0.0188	0.0164	0.0196
1979	0.0140	0.0036	0.0002		0.0027	0.0065	0.0143	0.0120	0.0086	0.0154	0.0125	0.0132
1980	0.0145	0.0032	0.0020	0.0006	0.0014	0.0032	0.0082	0.0030	0.0095	0.0179	0.0132	0.0140
1981	0.0063	0.0059	0.0045	0.0028	0.0032	0.0069	0.0178	0.0124	0.0174	0.0170	0.0128	0.0140
1982	0.0086	0.0034	0.0026	0.0018	0.0028	0.0047	0.0132	0.0134	0.0177	0.0182	0.0135	0.0129
1983	0.0075	0.0048	0.0019	0.0020	0.0039	0.0045	0.0048	0.0040	0.0027	0.0089	0.0134	0.0122
1984	0.0106	0.0047		0.0003	0.0020	0.0049	0.0057	0.0063	0.0104	0.0151	0.0120	0.0090
1985	0.0046	0.0028	0.0012	0.0005	0.0008	0.0067	0.0204	0.0115	0.0132	0.0178	0.0127	0.0107
1986	0.0090	0.0019	0.0002	0.0016	0.0027	0.0077	0.0109	0.0127	0.0114	0.0139	0.0122	0.0126
1987	0.0108	0.0048	0.0018	0.0022	0.0047	0.0032	0.0155	0.0100	0.0129	0.0154	0.0134	0.0120
1988	0.0090	0.0048	0.0019	0.0001	0.0019	0.0058	0.0130	0.0152	0.0182	0.0158	0.0129	0.0130
1989	0.0089	0.0038	0.0022	0.0023	0.0005	0.0070	0.0168	0.0143	0.0147	0.0163	0.0136	0.0130
1990	0.0083	0.0041	0.0014	0.0023	0.0024	0.0055	0.0129	0.0106	0.0177	0.0152	0.0127	0.0136
1991	0.0091	0.0043	0.0005	0.0009	0.0046	0.0080	0.0126	0.0127	0.0174	0.0162	0.0137	0.0140
1992	0.0091	0.0027	0.0030	0.0016	0.0049	0.0062	0.0151	0.0159	0.0142	0.0153	0.0135	0.0144
1993	0.0123	0.0048	0.0002	0.0002	0.0007	0.0054	0.0131	0.0138	0.0148	0.0152	0.0132	0.0116
1994	0.0094	0.0034	0.0025	0.0023	0.0012	0.0075	0.0139	0.0147	0.0182	0.0168	0.0177	0.0181
1995	0.0104	0.0026	0.0034	0.0020	0.0060	0.0066	0.0136	0.0076	0.0031	0.0093	0.0132	0.0127
1996	0.0084	0.0064	0.0030	0.0012	0.0031	0.0052	0.0137	0.0135	0.0180	0.0150	0.0129	0.0110
1997	0.0104	0.0028	0.0031	0.0012	0.0027	0.0073	0.0109	0.0115	0.0077	0.0166	0.0117	0.0130
1998	0.0106	0.0033	0.0017	0.0017	0.0034	0.0046	0.0078	0.0122	0.0177	0.0221	0.0165	0.0193
1999	0.0105	0.0061	0.0020	0.0029	0.0059	0.0084	0.0142	0.0063	0.0085	0.0172	0.0113	0.0100
2000	0.0096	0.0075	0.0029	0.0023	0.0042	0.0066	0.0143	0.0144	0.0150	0.0203	0.0175	0.0142
2001	0.0081	0.0028	0.0017	0.0027	0.0023	0.0065	0.0174	0.0136	0.0165	0.0198	0.0136	0.0137
2002	0.0086	0.0062	0.0030	0.0027	0.0041	0.0043	0.0160	0.0132	0.0207	0.0255	0.0187	0.0142
2003	0.0074	0.0062	0.0025	0.0042	0.0028	0.0088	0.0220	0.0165	0.0149	0.0237	0.0170	0.0133
2004	0.0100	0.0027	0.0011	0.0025	0.0028	0.0092	0.0153	0.0158	0.0153	0.0187	0.0139	0.0131
2005	0.0092	0.0045	0.0035	0.0023	0.0038	0.0078	0.0110	0.0136	0.0139	0.0152	0.0124	0.0154
2006	0.0079	0.0045	0.0018	0.0018	0.0021	0.0046	0.0126	0.0139	0.0189	0.0240	0.0163	0.0126
Avg	0.0106	0.0047	0.0023	0.0017	0.0031	0.0063	0.0138	0.0124	0.0143	0.0174	0.0141	0.0137
Max	0.0248	0.0107	0.0072	0.0042	0.0062	0.0092	0.0220	0.0187	0.0209	0.0260	0.0187	0.0198
Min	0.0046	0.0019			0.0005	0.0032	0.0048	0.0030	0.0027	0.0089	0.0113	0.0090
Std	0.0042	0.0019	0.0014	0.0010	0.0016	0.0015	0.0037	0.0035	0.0045	0.0039	0.0020	0.0025

% SEEP PER MILE

Reach 9 Balzac Gage to Julesburg Gage Length 97.6 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980							0.0413	0.0282				
1981												
1982												
1983			0.1801				0.1442	0.0312				
1984			0.1913								0.0577	
1985	0.0987							0.0256	0.0761			
1986		0.0347	0.1620						0.0376			
1987												
1988			0.3152	0.2252								
1989												
1990												
1991												
1992				0.0294								
1993												
1994												
1995								0.2540	0.0467			
1996												
1997									0.0354			
1998	0.2138	0.3742	0.4351	0.4174	0.2692	0.5082	0.5312	0.3128	0.0862			0.2606
1999								0.0620				
2000												
2001												
2002												
2003												
2004												
2005												
2006												

% DIVERSION PER MILE

Reach **9** **Balzac Gage to Julesburg Gage** Length 97.6 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.3857	0.0666		0.0090	0.0194		0.2411	0.6703	0.1727	0.9262	0.9153	0.7956
1976	0.2407	0.0719	0.0143		0.0262	0.0055	0.6642	0.8350	0.9116	0.9595	0.9706	0.8773
1977	0.5560	0.0488				0.0072	0.1902	0.6968	0.7075	0.9091	0.9151	0.8739
1978	0.4734	0.0400	0.0762	0.1632	0.0639	0.0234	0.8315	0.8370	0.6279	0.9541	0.9731	0.9665
1979	0.6914	0.5499	0.4351	0.2102	0.0407	0.3143	0.4400	0.3769	0.0759	0.7106	0.5127	0.6403
1980	0.3973	0.0127				0.0670	0.0083	0.0280	0.1167	0.8527	0.9596	0.7673
1981	0.7621	0.3524	0.1337	0.1132	0.1179	0.2763	0.4260	0.5037	0.3870	0.9276	0.9439	0.9686
1982	0.6609	0.6569	0.2059	0.1006	0.0438	0.4059	0.7408	0.8195	0.4965	0.6138	0.9304	0.7137
1983	0.6638	0.1139	0.0203	0.0215	0.0077	0.0723	0.0076	0.0211	0.0120	0.1342	0.3764	0.3213
1984	0.1636	0.0384				0.0050	0.0105	0.0524	0.1631	0.8024	0.4877	0.1553
1985	0.0799	0.0791	0.0282	0.0061	0.0007	0.1802	0.6326	0.1560	0.3744	0.8455	0.8722	0.5080
1986	0.1469				0.0028	0.1539	0.0071	0.5561	0.1559	0.9104	0.9377	0.3013
1987	0.2873	0.0134	0.0001		0.0078	0.0043	0.0397	0.0589	0.1551	0.8189	0.8821	0.5274
1988	0.4669	0.2679	0.1271			0.1147	0.3179	0.2339	0.4486	0.9301	0.9492	0.8647
1989	0.6511	0.6595	0.1307	0.0343	0.1571	0.1733	0.5550	0.9373	0.8120	0.9620	0.9373	0.5706
1990	0.7064	0.7667	0.5665		0.0660	0.1171	0.1376	0.8211	0.8794	0.9712	0.9155	0.8232
1991	0.5529	0.4768	0.1090	0.1348	0.1489	0.2523	0.5246	0.8703	0.3080	0.9481	0.9347	0.5908
1992	0.6760	0.7608	0.3383	0.0347	0.0011	0.1187	0.2522	0.9194	0.5196	0.6570	0.5620	0.3143
1993	0.2016	0.2181	0.0104	0.0114	0.1223	0.0989	0.2015	0.7880	0.7850	0.9492	0.9418	0.3703
1994	0.1733	0.4556	0.0639		0.1738	0.2711	0.5402	0.8855	0.9101	0.9659	0.9706	0.9613
1995	0.5792	0.7075	0.1897	0.3461	0.1712	0.6637	0.3481	0.1075	0.0086	0.1206	0.7272	0.4653
1996	0.3178			0.2036	0.0872	0.0875	0.5276	0.7070	0.3280	0.9049	0.8225	0.1313
1997	0.1887	0.3422	0.0845	0.0689	0.1955	0.2038	0.4518	0.8259	0.0372	0.5837	0.2052	0.5415
1998	0.1648	0.0058		0.0055	0.2032	0.0615	0.0977	0.2789	0.3407	0.8069	0.8091	0.6580
1999	0.0816	0.1483	0.2135	0.1287	0.0573	0.1231	0.4821	0.0954	0.1224	0.5921	0.2007	0.2492
2000	0.1590	0.0066	0.0003	0.0006	0.0421	0.1314	0.3365	0.7731	0.9162	0.9659	0.9630	0.8959
2001	0.7505	0.7428	0.4761	0.2376	0.0817	0.5135	0.3079	0.4361	0.7464	0.8913	0.9326	0.8160
2002	0.7861	0.4456	0.2192	0.3295	0.2292	0.4346	0.7828	0.9477	0.9173	0.9352	0.9551	0.9644
2003	0.9696	0.9596	0.8747	0.7990	0.8137	0.8544	0.6580	0.8422	0.9318	0.9622	0.9733	0.8953
2004	0.9163	0.9238	0.8725	0.7878	0.8363	0.8739	0.9496	0.9515	0.9411	0.9456	0.9570	0.9467
2005	0.8978	0.9147	0.7064	0.7308	0.8617	0.9360	0.6399	0.8437	0.3378	0.8964	0.9067	0.8803
2006	0.8417	0.8362	0.6503	0.7572	0.7303	0.7523	0.7164	0.9068	0.9408	0.9405	0.9607	0.9196
Avg	0.4872	0.3651	0.2046	0.1636	0.1659	0.2593	0.4083	0.5870	0.4871	0.8217	0.8219	0.6649
Max	0.9696	0.9596	0.8747	0.7990	0.8617	0.9360	0.9496	0.9515	0.9411	0.9712	0.9733	0.9686
Min	0.0799						0.0071	0.0211	0.0086	0.1206	0.2007	0.1313
Std	0.2714	0.3299	0.2630	0.2483	0.2535	0.2731	0.2646	0.3282	0.3292	0.2121	0.2223	0.2595

% EVAP PER MILE

Reach **10** **Julesburg Gage to S. Platte Gage at North Platte** Length 85.6 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0187	0.0066	0.0031	0.0023	0.0027	0.0057	0.0111	0.0179	0.0160	0.0331	0.0316	0.0266
1976	0.0218	0.0074	0.0026	0.0020	0.0040	0.0052	0.0156	0.0211	0.0363	0.0575	0.0523	0.0356
1977	0.0198	0.0100	0.0054	0.0028	0.0049	0.0059	0.0138	0.0222	0.0218	0.0433	0.0295	0.0318
1978	0.0192	0.0071	0.0040	0.0032	0.0048	0.0066	0.0204	0.0224	0.0268	0.0582	0.0480	0.0465
1979	0.0307	0.0097	0.0049	0.0046	0.0042	0.0059	0.0176	0.0144	0.0100	0.0186	0.0194	0.0190
1980	0.0177	0.0038	0.0022	0.0019	0.0028	0.0041	0.0105	0.0037	0.0115	0.0359	0.0493	0.0346
1981	0.0178	0.0060	0.0033	0.0021	0.0034	0.0067	0.0173	0.0116	0.0192	0.0416	0.0293	0.0341
1982	0.0147	0.0071	0.0034	0.0022	0.0039	0.0073	0.0242	0.0225	0.0220	0.0242	0.0311	0.0204
1983	0.0138	0.0050	0.0022	0.0016	0.0027	0.0044	0.0059	0.0050	0.0031	0.0112	0.0198	0.0193
1984	0.0107	0.0040	0.0022	0.0014	0.0026	0.0050	0.0071	0.0073	0.0120	0.0259	0.0244	0.0103
1985	0.0056	0.0032	0.0019	0.0014	0.0021	0.0058	0.0214	0.0124	0.0155	0.0335	0.0249	0.0135
1986	0.0080	0.0031	0.0015	0.0018	0.0025	0.0081	0.0121	0.0157	0.0133	0.0292	0.0362	0.0157
1987	0.0103	0.0044	0.0028	0.0023	0.0038	0.0041	0.0151	0.0110	0.0136	0.0305	0.0385	0.0198
1988	0.0213	0.0034	0.0031	0.0018	0.0026	0.0059	0.0127	0.0170	0.0230	0.0366	0.0373	0.0269
1989	0.0147	0.0075	0.0034	0.0023	0.0025	0.0054	0.0220	0.0253	0.0240	0.0487	0.0304	0.0193
1990	0.0177	0.0099	0.0035	0.0021	0.0032	0.0049	0.0113	0.0147	0.0319	0.0467	0.0355	0.0404
1991	0.0171	0.0074	0.0022	0.0016	0.0041	0.0068	0.0159	0.0194	0.0183	0.0405	0.0430	0.0245
1992	0.0200	0.0065	0.0047	0.0020	0.0040	0.0053	0.0136	0.0315	0.0165	0.0189	0.0250	0.0195
1993	0.0132	0.0049	0.0016	0.0013	0.0023	0.0046	0.0115	0.0188	0.0253	0.0339	0.0255	0.0170
1994	0.0099	0.0057	0.0032	0.0022	0.0033	0.0064	0.0144	0.0277	0.0410	0.0461	0.0437	0.0410
1995	0.0204	0.0082	0.0044	0.0023	0.0057	0.0084	0.0141	0.0113	0.0038	0.0099	0.0215	0.0204
1996	0.0093	0.0063	0.0030	0.0012	0.0027	0.0038	0.0161	0.0195	0.0196	0.0301	0.0293	0.0124
1997	0.0106	0.0044	0.0017	0.0012	0.0025	0.0070	0.0130	0.0215	0.0092	0.0215	0.0161	0.0188
1998	0.0077	0.0029	0.0014	0.0015	0.0027	0.0030	0.0098	0.0121	0.0124	0.0317	0.0221	0.0241
1999	0.0102	0.0051	0.0021	0.0022	0.0047	0.0072	0.0172	0.0082	0.0100	0.0227	0.0098	0.0124
2000	0.0112	0.0068	0.0028	0.0021	0.0045	0.0065	0.0173	0.0297	0.0394	0.0505	0.0468	0.0309
2001	0.0265	0.0039	0.0024	0.0036	0.0021	0.0080	0.0211	0.0198	0.0341	0.0425	0.0381	0.0310
2002	0.0188	0.0108	0.0031	0.0032	0.0045	0.0050	0.0374	0.0307	0.0528	0.0473	0.0494	0.0374
2003	0.0212	0.0128	0.0079	0.0087	0.0047	0.0154	0.0304	0.0255	0.0339	0.0639	0.0540	0.0343
2004	0.0325	0.0099	0.0071	0.0063	0.0076	0.0185	0.0363	0.0425	0.0396	0.0539	0.0387	0.0388
2005	0.0271	0.0110	0.0057	0.0029	0.0066	0.0206	0.0341	0.0390	0.0193	0.0503	0.0376	0.0376
2006	0.0270	0.0208	0.0031	0.0108	0.0055	0.0159	0.0373	0.0398	0.0526	0.0393	0.0373	0.0310
Avg	0.0170	0.0071	0.0033	0.0028	0.0038	0.0073	0.0180	0.0200	0.0227	0.0368	0.0336	0.0264
Max	0.0325	0.0208	0.0079	0.0108	0.0076	0.0206	0.0374	0.0425	0.0528	0.0639	0.0540	0.0465
Min	0.0056	0.0029	0.0014	0.0012	0.0021	0.0030	0.0059	0.0037	0.0031	0.0099	0.0098	0.0103
Std	0.0068	0.0036	0.0015	0.0021	0.0013	0.0042	0.0084	0.0096	0.0127	0.0134	0.0110	0.0097

% SEEP PER MILE

Reach **10** **Julesburg Gage to S. Platte Gage at North Platte** Length 85.6 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979					0.0983							
1980				0.0839			0.0125	0.0995				
1981												
1982												
1983							0.0553	0.0192	0.0777			
1984							0.0453	0.0300			0.1233	
1985			0.3295									
1986												
1987			0.1103					0.0657				
1988												
1989			0.0861									
1990				0.1756								
1991			0.3290	0.2874								
1992				0.1527								
1993			0.2467									0.0063
1994			0.0150	0.0061								
1995								0.3288				
1996												
1997									0.0201			
1998												
1999												
2000			0.0891									
2001												
2002												
2003												
2004												
2005			0.4705	0.3314					0.3433			
2006	0.3747		0.6260		0.0740							

% DIVERSION PER MILE

Reach 10 Julesburg Gage to S. Platte Gage at North Platte Length 85.6 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.6171	0.6136	0.7098	0.8536	0.9068	0.7356	0.8608	0.7039	0.5772	0.4861	0.4888	0.3993
1976	0.4468	0.2973	0.8055	0.8063	0.8133	0.8618	0.6731	0.5409	0.4397	0.1830	0.0813	0.1945
1977	0.2177	0.1585	0.4181	0.5169	0.7925	0.7425	0.7946	0.6151	0.5476	0.3894	0.3429	0.2427
1978	0.4951	0.4780	0.4632	0.5296	0.6944	0.7061	0.5364	0.5403	0.7011	0.2414	0.1159	0.0764
1979	0.3543	0.2447	0.3428	0.3325	0.7071	0.7140	0.7619	0.9017	0.3370	0.6435	0.7235	0.8085
1980	0.7636	0.8917	0.9198	0.6379	0.4538	0.5001	0.1062	0.1164	0.1671	0.4425	0.2234	0.3412
1981	0.5202	0.7451	0.8951	0.9646	0.8798	0.8222	0.8528	0.8502	0.8633	0.2688	0.1881	0.1903
1982	0.5226	0.4735	0.6552	0.6827	0.7778	0.6907	0.5491	0.5115	0.6602	0.7428	0.3140	0.6006
1983	0.6106	0.7440	0.9142	0.5460	0.6592	0.8187	0.4573	0.1633	0.0203	0.1403	0.4196	0.1466
1984	0.0653	0.8295	0.2788	0.1656	0.1385	0.1626	0.2875	0.0356	0.0515	0.3521	0.4181	0.2536
1985	0.1852	0.1991	0.0020	0.2463	0.1982	0.3812	0.5571	0.6541	0.6895	0.4729	0.6111	0.8267
1986	0.9189	0.7689	0.4042	0.3871	0.3642	0.5719	0.2849	0.4752	0.1433	0.4922	0.2764	0.4761
1987	0.4211	0.5333	0.4284	0.4903	0.7113	0.5899	0.5639	0.2997	0.3826	0.4843	0.3057	0.4838
1988	0.6489	0.7049	0.6325	0.5303	0.3342	0.7694	0.8395	0.4875	0.8125	0.3606	0.2823	0.3209
1989	0.4739	0.4959	0.6004	0.7436	0.6758	0.6447	0.5899	0.4615	0.6008	0.2573	0.4596	0.7245
1990	0.6232	0.4070	0.4810	0.7316	0.8741	0.9533	0.9633	0.6379	0.5602	0.3257	0.4338	0.4066
1991	0.5224	0.5208	0.4156	0.6309	0.7106	0.7400	0.6942	0.5452	0.6016	0.3357	0.3952	0.7066
1992	0.2664	0.3744	0.4480	0.6375	0.7699	0.7216	0.7882	0.3862	0.7729	0.7369	0.5860	0.5923
1993	0.5264	0.6393	0.6329	0.6794	0.6705	0.6617	0.7249	0.4733	0.4619	0.2593	0.1853	0.6112
1994	0.7036	0.3418	0.6135	0.6626	0.6233	0.7280	0.6130	0.3786	0.2110	0.1638	0.1400	0.1236
1995	0.4324	0.1501	0.2921	0.4000	0.5086	0.4652	0.5494	0.3776	0.1105	0.2325	0.5325	0.5499
1996	0.6873	0.7169	0.7063	0.6854	0.6121	0.7142	0.7517	0.5992	0.7454	0.4010	0.2692	0.4647
1997	0.4117	0.5216	0.7688	0.6825	0.6457	0.7601	0.5785	0.3946	0.1003	0.3485	0.2055	0.6666
1998	0.7056	0.3837	0.5115	0.5098	0.5768	0.5929	0.4835	0.6167	0.5519	0.2461	0.1814	0.5079
1999	0.7981	0.8073	0.5020	0.5537	0.7834	0.7128	0.5135	0.2804	0.2707	0.3160	0.2084	0.2619
2000	0.3328	0.6063	0.3782	0.5436	0.4863	0.7357	0.6534	0.2326	0.2594	0.3329	0.3552	0.4804
2001	0.2141			0.2043	0.5996	0.3785	0.3457	0.4463	0.2597	0.3476	0.3463	0.4780
2002	0.5539	0.3122	0.4751	0.5810	0.6461	0.4367	0.1113	0.2802	0.2657	0.1049	0.2232	0.3140
2003	0.2169				0.1001	0.2658	0.4321	0.4999	0.3554	0.2064	0.1904	0.3672
2004	0.3498	0.1721				0.1664	0.2093	0.2759	0.2633	0.1445	0.2076	0.2995
2005	0.4630	0.2263		0.3688	0.5993		0.3981	0.3221	0.4808	0.4304	0.5319	0.5346
2006	0.0800			0.2843	0.3344	0.1659	0.4818	0.4471	0.3721	0.6388	0.5241	0.3857
Avg	0.4734	0.4487	0.4592	0.5184	0.5827	0.5909	0.5627	0.4547	0.4261	0.3603	0.3365	0.4324
Max	0.9189	0.8917	0.9198	0.9646	0.9068	0.9533	0.9633	0.9017	0.8633	0.7428	0.7235	0.8267
Min	0.0653						0.1062	0.0356	0.0203	0.1049	0.0813	0.0764
Std	0.2057	0.2541	0.2766	0.2268	0.2307	0.2309	0.2141	0.1915	0.2341	0.1633	0.1577	0.1948

% EVAP PER MILE

Reach **11** **Cache la Poudre River, Canyon Mouth Gage to Greeley Gage** Length 51.8 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0041	0.0037	0.0019	0.0021	0.0026	0.0051	0.0078	0.0043	0.0049	0.0043	0.0030	0.0035
1976	0.0052	0.0030	0.0023	0.0012	0.0038	0.0044	0.0129	0.0058	0.0037	0.0041	0.0033	0.0037
1977	0.0041	0.0032	0.0024	0.0012	0.0045	0.0065	0.0101	0.0053	0.0050	0.0046	0.0032	0.0041
1978	0.0073	0.0040	0.0028	0.0007	0.0017	0.0073	0.0109	0.0053	0.0044	0.0044	0.0032	0.0046
1979	0.0040	0.0029	0.0004		0.0023	0.0051	0.0096	0.0060	0.0042	0.0045	0.0039	0.0054
1980	0.0056	0.0018	0.0017	0.0005	0.0014	0.0029	0.0066	0.0035	0.0043	0.0047	0.0034	0.0042
1981	0.0042	0.0032	0.0037	0.0028	0.0032	0.0058	0.0159	0.0046	0.0058	0.0040	0.0029	0.0045
1982	0.0036	0.0044	0.0023	0.0016	0.0025	0.0071	0.0105	0.0052	0.0044	0.0053	0.0041	0.0047
1983	0.0040	0.0024	0.0016	0.0026	0.0037	0.0041	0.0047	0.0032	0.0096	0.0038	0.0047	0.0048
1984	0.0053	0.0029	0.0000	0.0007	0.0023	0.0043	0.0062	0.0046	0.0042	0.0047	0.0043	0.0045
1985	0.0038	0.0036	0.0018	0.0007	0.0011	0.0058	0.0054	0.0048	0.0042	0.0048	0.0032	0.0042
1986	0.0057	0.0011	0.0006	0.0025	0.0030	0.0071	0.0099	0.0036	0.0042	0.0045	0.0035	0.0038
1987	0.0054	0.0028	0.0014	0.0019	0.0039	0.0038	0.0121	0.0052	0.0059	0.0044	0.0040	0.0052
1988	0.0068	0.0035	0.0013	0.0006	0.0024	0.0039	0.0105	0.0056	0.0043	0.0051	0.0040	0.0041
1989	0.0086	0.0038	0.0012	0.0023	0.0003	0.0060	0.0092	0.0042	0.0051	0.0043	0.0035	0.0053
1990	0.0049	0.0046	0.0010	0.0031	0.0022	0.0030	0.0105	0.0043	0.0050	0.0050	0.0041	0.0060
1991	0.0063	0.0041	0.0006	0.0008	0.0038	0.0073	0.0088	0.0053	0.0049	0.0048	0.0041	0.0048
1992	0.0062	0.0025	0.0020	0.0019	0.0040	0.0046	0.0104	0.0037	0.0046	0.0048	0.0041	0.0059
1993	0.0060	0.0020	0.0006	0.0006	0.0013	0.0049	0.0083	0.0045	0.0047	0.0042	0.0040	0.0050
1994	0.0045	0.0020	0.0017	0.0023	0.0015	0.0068	0.0094	0.0043	0.0052	0.0039	0.0042	0.0061
1995	0.0056	0.0031	0.0022	0.0020	0.0038	0.0063	0.0083	0.0066	0.0037	0.0046	0.0041	0.0041
1996	0.0068	0.0045	0.0023	0.0012	0.0029	0.0047	0.0057	0.0036	0.0050	0.0047	0.0044	0.0053
1997	0.0066	0.0030	0.0021	0.0009	0.0023	0.0071	0.0080	0.0039	0.0048	0.0047	0.0060	0.0053
1998	0.0063	0.0028	0.0017	0.0021	0.0029	0.0039	0.0071	0.0038	0.0040	0.0043	0.0048	0.0058
1999	0.0048	0.0036	0.0012	0.0026	0.0048	0.0072	0.0073	0.0040	0.0041	0.0050	0.0051	0.0053
2000	0.0066	0.0055	0.0027	0.0023	0.0038	0.0052	0.0052	0.0047	0.0044	0.0057	0.0031	0.0047
2001	0.0052	0.0016	0.0014	0.0021	0.0017	0.0051	0.0112	0.0057	0.0050	0.0058	0.0039	0.0053
2002	0.0076	0.0045	0.0025	0.0019	0.0035	0.0038	0.0117	0.0048	0.0062	0.0059	0.0058	0.0087
2003	0.0051	0.0042	0.0034	0.0044	0.0027	0.0060	0.0077	0.0057	0.0033	0.0071	0.0053	0.0050
2004	0.0073	0.0036	0.0025	0.0024	0.0026	0.0115	0.0081	0.0053	0.0049	0.0062	0.0039	0.0055
2005	0.0041	0.0031	0.0026	0.0023	0.0043	0.0083	0.0097	0.0046	0.0050	0.0054	0.0035	0.0041
2006	0.0045	0.0045	0.0015	0.0038	0.0025	0.0048	0.0103	0.0048	0.0055	0.0051	0.0044	0.0055
Avg	0.0055	0.0033	0.0018	0.0018	0.0028	0.0056	0.0091	0.0047	0.0048	0.0048	0.0040	0.0050
Max	0.0086	0.0055	0.0037	0.0044	0.0048	0.0115	0.0159	0.0066	0.0096	0.0071	0.0060	0.0087
Min	0.0036	0.0011	0.0000		0.0003	0.0029	0.0047	0.0032	0.0033	0.0038	0.0029	0.0035
Std	0.0013	0.0010	0.0008	0.0010	0.0011	0.0017	0.0024	0.0008	0.0011	0.0007	0.0008	0.0010

% SEEP PER MILE

Reach **11** **Cache la Poudre River, Canyon Mouth Gage to Greeley Gage** Length 51.8 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976	0.1133											
1977												
1978												
1979												
1980												
1981												
1982												
1983	0.0876											
1984												
1985												
1986												
1987												
1988												
1989												
1990	0.1966											
1991												
1992												
1993												
1994												
1995												
1996												
1997												
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												
2006												

% DIVERSION PER MILE

Reach 11 Cache la Poudre River, Canyon Mouth Gage to Greeley Gage Length 51.8 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	1.3400	0.5483	0.2021	0.2075	0.3488	0.5515	0.9941	1.7195	1.3414	1.7898	1.8650	1.7415
1976	1.1750	0.6932	0.7119	0.8537	0.7723	0.7105	0.9075	1.7613	1.8623	1.8883	1.7707	1.7039
1977	1.3926	0.7736	0.3592	0.5484	0.6403	0.6673	1.4826	1.8412	1.9116	1.7448	1.8755	1.8497
1978	1.2936	0.9212	0.7695	0.7017	0.6633	0.6605	1.1970	1.6194	1.3556	1.8850	1.8751	1.7367
1979	1.4169	0.8457	0.9081	0.8967	0.8373	0.7495	1.0584	0.6172	0.7809	1.8212	1.6487	1.5923
1980	1.0783	0.3921	0.4849	0.5803	0.1781	0.1760	0.1607	0.0574	1.2592	1.8503	1.8603	1.6878
1981	1.3709	1.0351	0.8835	0.9313	0.6505	0.6555	1.2222	1.7580	1.5018	1.8894	1.8762	1.7532
1982	1.5292	0.9724	0.7506	0.6628	0.9303	0.7329	1.3907	1.8664	1.3537	1.3870	1.8378	1.4350
1983	1.2123	0.9508	0.1402	0.4025	0.7105	0.5097	0.1034	0.2288	0.2298	1.1012	1.5606	1.4888
1984	1.3143	0.5618	0.5138	0.1361	0.1022	0.1310	0.1051	0.5958	1.1468	1.5049	1.6699	1.4594
1985	0.9505	0.3231	0.1229	0.1447	0.2275	0.6123	1.5954	1.7744	1.4980	1.8025	1.8549	1.6447
1986	1.0528	0.7270	0.5894	0.4431	0.2907	0.4320	0.3439	1.6989	0.9559	1.7041	1.8474	1.6460
1987	1.0763	0.9064	0.3967	0.5757	0.3587	0.3553	1.2786	1.4300	1.5374	1.8701	1.8569	1.7572
1988	1.1943	0.9616	0.7345	0.7696	0.7761	0.8430	1.1981	1.7571	1.7492	1.8357	1.8377	1.6946
1989	1.0397	0.9435	0.7459	0.6928	0.4410	0.7106	1.4602	1.8924	1.7435	1.8664	1.8082	1.5638
1990	1.1802	0.8890	1.0257	0.6251	0.6288	0.8306	0.4921	1.8127	1.6172	1.8457	1.8455	1.6761
1991	1.1711	0.8649	0.7144	0.6218	0.5848	0.6650	1.4818	1.8627	1.3894	1.8430	1.8416	1.7291
1992	1.2668	0.9780	0.9413	0.8038	0.7642	0.7470	1.3523	1.8816	1.7357	1.8076	1.7552	1.6211
1993	1.1785	0.9264	0.8137	0.8063	0.6557	0.4858	0.8466	1.8017	1.3613	1.8182	1.8459	1.6117
1994	1.2079	0.6990	0.5126	0.4458	0.5512	0.4222	1.2787	1.8990	1.7769	1.8820	1.7917	1.6602
1995	1.1659	0.9071	0.8232	0.8322	0.8975	0.8100	1.1113	0.9998	0.3327	1.5632	1.8206	1.6545
1996	1.0857	0.9466	0.6913	0.6096	0.2700	0.5306	1.4673	1.7022	1.1328	1.7478	1.7851	1.3547
1997	1.0509	0.4488	0.5171	0.6570	0.7002	0.7471	1.2976	1.7886	0.5536	1.7639	1.2493	1.4310
1998	0.6963	0.1580	0.4091	0.6168	0.8181	0.7447	1.1212	1.8078	1.6011	1.8411	1.8046	1.6073
1999	1.3266	0.6191	0.5895	0.5777	0.6115	0.7094	1.0220	0.2890	0.9220	1.7789	1.6859	1.1699
2000	0.7798	0.4718	0.4863	0.3094	0.4946	0.9478	1.7502	1.7910	1.8488	1.8528	1.8594	1.6648
2001	1.3796	1.0990	0.8426	0.7850	0.7680	0.8636	1.1947	1.5625	1.8191	1.7760	1.8338	1.6924
2002	1.2535	1.1999	0.8236	0.7840	0.8772	0.9796	1.4801	1.8331	1.8626	1.8560	1.8370	1.6656
2003	1.2598	0.8854	0.7593	0.7053	0.6802	1.1051	1.5760	1.7258	1.8206	1.8620	1.8072	1.6687
2004	1.3743	1.0994	1.0437	0.8290	0.9501	0.8783	1.7255	1.8612	1.8650	1.8730	1.8557	1.7234
2005	1.0774	1.1207	1.0979	1.0147	0.7340	0.6512	1.2644	1.8536	1.3903	1.8711	1.8511	1.7866
2006	1.2190	0.9216	0.8852	0.9989	1.0040	0.8328	1.4677	1.8548	1.8642	1.8377	1.7984	1.5814
Avg	1.1909	0.8060	0.6653	0.6428	0.6224	0.6703	1.1384	1.5295	1.4100	1.7738	1.7910	1.6267
Max	1.5292	1.1999	1.0979	1.0147	1.0040	1.1051	1.7502	1.8990	1.9116	1.8894	1.8762	1.8497
Min	0.6963	0.1580	0.1229	0.1361	0.1022	0.1310	0.1034	0.0574	0.2298	1.1012	1.2493	1.1699
Std	0.1745	0.2472	0.2499	0.2245	0.2340	0.2111	0.4445	0.5375	0.4504	0.1647	0.1210	0.1363

% EVAP PER MILE

Reach **12** **WY/NE Stateline Gage to Bridgeport Gage** Length 57.5 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0100	0.0070	0.0048	0.0043	0.0079	0.0122	0.0164	0.0167	0.0174	0.0163	0.0127	0.0133
1976	0.0126	0.0072	0.0049	0.0042	0.0074	0.0124	0.0250	0.0178	0.0204	0.0153	0.0126	0.0118
1977	0.0101	0.0071	0.0047	0.0046	0.0081	0.0124	0.0217	0.0218	0.0219	0.0147	0.0133	0.0162
1978	0.0147	0.0076	0.0051	0.0048	0.0080	0.0120	0.0272	0.0169	0.0188	0.0139	0.0127	0.0154
1979	0.0168	0.0078	0.0053	0.0027	0.0069	0.0144	0.0232	0.0227	0.0179	0.0188	0.0125	0.0137
1980	0.0145	0.0052	0.0075	0.0029	0.0047	0.0102	0.0133	0.0089	0.0169	0.0152	0.0118	0.0131
1981	0.0134	0.0084	0.0091	0.0056	0.0148	0.0188	0.0374	0.0206	0.0202	0.0153	0.0120	0.0131
1982	0.0130	0.0088	0.0067	0.0049	0.0094	0.0163	0.0298	0.0150	0.0216	0.0221	0.0113	0.0104
1983	0.0114	0.0047	0.0049	0.0056	0.0085	0.0105	0.0129	0.0093	0.0068	0.0094	0.0105	0.0078
1984	0.0084	0.0073	0.0047	0.0070	0.0049	0.0043	0.0052	0.0081	0.0080	0.0120	0.0131	0.0093
1985	0.0068	0.0057	0.0020	0.0023	0.0074	0.0079	0.0218	0.0201	0.0195	0.0180	0.0132	0.0111
1986	0.0116	0.0052	0.0027	0.0012	0.0078	0.0128	0.0099	0.0124	0.0149	0.0111	0.0141	0.0091
1987	0.0058	0.0039	0.0043	0.0075	0.0079	0.0051	0.0222	0.0219	0.0201	0.0160	0.0228	0.0109
1988	0.0149	0.0058	0.0046	0.0030	0.0072	0.0106	0.0262	0.0211	0.0220	0.0166	0.0137	0.0112
1989	0.0116	0.0117	0.0058	0.0044	0.0094	0.0116	0.0260	0.0238	0.0170	0.0170	0.0148	0.0131
1990	0.0160	0.0155	0.0038	0.0078	0.0096	0.0155	0.0219	0.0218	0.0207	0.0143	0.0135	0.0257
1991	0.0132	0.0085	0.0056	0.0051	0.0097	0.0154	0.0278	0.0258	0.0182	0.0146	0.0134	0.0122
1992	0.0128	0.0080	0.0059	0.0053	0.0090	0.0141	0.0285	0.0222	0.0270	0.0133	0.0115	0.0128
1993	0.0139	0.0087	0.0054	0.0050	0.0096	0.0121	0.0258	0.0194	0.0263	0.0131	0.0118	0.0141
1994	0.0114	0.0076	0.0049	0.0045	0.0086	0.0126	0.0258	0.0181	0.0205	0.0164	0.0131	0.0136
1995	0.0114	0.0078	0.0053	0.0044	0.0076	0.0134	0.0358	0.0248	0.0087	0.0114	0.0136	0.0096
1996	0.0119	0.0078	0.0052	0.0045	0.0077	0.0129	0.0223	0.0160	0.0134	0.0148	0.0129	0.0126
1997	0.0116	0.0076	0.0056	0.0046	0.0084	0.0123	0.0103	0.0110	0.0109	0.0153	0.0124	0.0120
1998	0.0110	0.0074	0.0052	0.0048	0.0085	0.0064	0.0097	0.0160	0.0217	0.0156	0.0135	0.0125
1999	0.0107	0.0072	0.0048	0.0046	0.0085	0.0139	0.0192	0.0103	0.0117	0.0135	0.0129	0.0116
2000	0.0111	0.0076	0.0055	0.0050	0.0085	0.0128	0.0213	0.0155	0.0170	0.0154	0.0127	0.0127
2001	0.0108	0.0074	0.0050	0.0047	0.0084	0.0131	0.0241	0.0198	0.0198	0.0154	0.0128	0.0131
2002	0.0119	0.0078	0.0051	0.0044	0.0079	0.0136	0.0267	0.0317	0.0138	0.0173	0.0185	0.0217
2003	0.0148	0.0095	0.0065	0.0059	0.0095	0.0149	0.0284	0.0333	0.0288	0.0163	0.0138	0.0229
2004	0.0153	0.0096	0.0064	0.0060	0.0107	0.0157	0.0306	0.0309	0.0382	0.0159	0.0152	0.0233
2005	0.0162	0.0106	0.0069	0.0063	0.0108	0.0171	0.0296	0.0311	0.0309	0.0147	0.0136	0.0182
2006	0.0158	0.0099	0.0065	0.0058	0.0111	0.0156	0.0286	0.0198	0.0249	0.0140	0.0139	0.0170
Avg	0.0124	0.0079	0.0053	0.0048	0.0086	0.0126	0.0230	0.0195	0.0192	0.0151	0.0134	0.0139
Max	0.0168	0.0155	0.0091	0.0078	0.0148	0.0188	0.0374	0.0333	0.0382	0.0221	0.0228	0.0257
Min	0.0058	0.0039	0.0020	0.0012	0.0047	0.0043	0.0052	0.0081	0.0068	0.0094	0.0105	0.0078
Std	0.0026	0.0021	0.0013	0.0014	0.0018	0.0032	0.0075	0.0065	0.0066	0.0023	0.0022	0.0042

% SEEP PER MILE

Reach **12** **WY/NE Stateline Gage to Bridgeport Gage** Length 57.5 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
1982												
1983												
1984												
1985												
1986												
1987												
1988												
1989												
1990												
1991												
1992												
1993												
1994												
1995												
1996												
1997												
1998						0.0278						
1999												
2000												
2001												
2002												
2003												
2004												
2005												
2006												

% DIVERSION PER MILE

Reach **12** **WY/NE Stateline Gage to Bridgeport Gage** Length 57.5 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0666						0.0250	0.6794	0.8034	1.1136	1.2219	0.8401
1976	0.0834						0.2031	0.8368	0.9400	1.3619	1.0963	0.8450
1977	0.0849						0.0579	0.8457	0.9060	1.2884	1.1215	0.8855
1978	0.1052	0.0026					0.0487	0.4456	0.6942	1.1545	1.1049	0.8030
1979							0.0033	0.6616	0.9874	1.1779	1.0339	0.7196
1980	0.0877						0.0175	0.2577	0.6202	1.2217	1.1839	0.8295
1981	0.1595						0.1648	0.7703	1.2391	1.2153	1.1535	0.8826
1982	0.1323						0.1697	0.9015	0.8416	1.1150	1.0006	0.6760
1983	0.0975						0.1256	0.2268	0.2330	0.3839	0.4311	0.3216
1984	0.0454							0.1889	0.2360	0.6171	0.6751	0.4502
1985	0.0479						0.1210	0.9007	0.9236	1.3093	1.1920	0.6955
1986	0.0162						0.0050	0.3598	0.3262	0.5170	0.9172	0.4461
1987	0.0429						0.0158	0.4873	0.7436	1.2067	0.7525	0.6021
1988	0.0631						0.1541	0.4800	0.8800	1.2562	1.2154	0.7738
1989	0.0509						0.1942	0.9187	1.2842	1.5135	1.2885	0.7920
1990	0.0520						0.0258	0.4186	0.9858	1.4318	1.1864	0.9648
1991	0.0627						0.1008	0.5301	0.4411	1.3361	1.4182	0.8242
1992	0.0738						0.1311	1.1971	0.8251	1.1820	1.3793	1.0006
1993	0.1164	0.0004					0.0352	0.9821	0.7358	1.2208	0.9099	0.6368
1994	0.0381						0.0321	0.9022	1.0271	1.0136	1.1704	0.7638
1995	0.0844	0.0057					0.0476	0.1368	0.2165	0.9289	1.2378	0.7760
1996	0.0488						0.3047	0.6941	0.3644	1.2591	1.1105	0.5101
1997	0.0596						0.0185	0.3656	0.1430	0.9034	0.6910	0.6670
1998	0.1131						0.0607	0.7881	0.6837	1.2256	1.1191	0.7129
1999	0.0813	0.0017					0.1179	0.2288	0.2419	0.6592	0.8970	0.4169
2000	0.1168	0.0009					0.2211	0.6746	0.9440	1.2662	1.2587	0.6735
2001	0.1031	0.0005				0.0059	0.1420	0.6094	0.9572	1.0243	1.1542	0.5366
2002	0.0700	0.0005				0.0321	0.2584	1.0721	1.5294	1.4714	1.2833	0.8600
2003	0.2930	0.0031					0.1670	0.7501	1.3275	1.4805	1.4782	0.7821
2004	0.4425	0.0000					0.2915	1.2368	1.3069	1.4617	1.3942	0.8244
2005	0.2415	0.0142					0.3096	1.0204	0.7445	1.4195	1.2109	0.8901
2006	0.2375	0.0355				0.0243	0.2720	1.1632	1.1554	1.4992	1.3965	0.9115
Avg	0.1037	0.0020				0.0019	0.1201	0.6791	0.7902	1.1636	1.1151	0.7286
Max	0.4425	0.0355				0.0321	0.3096	1.2368	1.5294	1.5135	1.4782	1.0006
Min								0.1368	0.1430	0.3839	0.4311	0.3216
Std	0.0873	0.0066				0.0069	0.0963	0.3065	0.3611	0.2826	0.2318	0.1647

% EVAP PER MILE

Reach **13** **Bridgeport Gage to Lewellen Gage** Length 60 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0099	0.0068	0.0044	0.0038	0.0067	0.0113	0.0172	0.0276	0.0308	0.0397	0.0431	0.0246
1976	0.0125	0.0067	0.0043	0.0037	0.0065	0.0117	0.0247	0.0323	0.0409	0.0622	0.0368	0.0219
1977	0.0107	0.0073	0.0048	0.0048	0.0071	0.0113	0.0231	0.0349	0.0381	0.0550	0.0335	0.0268
1978	0.0132	0.0079	0.0053	0.0046	0.0077	0.0100	0.0266	0.0241	0.0267	0.0352	0.0306	0.0253
1979	0.0128	0.0075	0.0043	0.0037	0.0053	0.0104	0.0225	0.0313	0.0338	0.0456	0.0261	0.0176
1980	0.0121	0.0064	0.0054	0.0035	0.0046	0.0099	0.0152	0.0126	0.0211	0.0476	0.0354	0.0239
1981	0.0119	0.0075	0.0065	0.0049	0.0110	0.0142	0.0355	0.0272	0.0512	0.0493	0.0297	0.0250
1982	0.0110	0.0084	0.0059	0.0045	0.0078	0.0143	0.0365	0.0324	0.0357	0.0496	0.0238	0.0153
1983	0.0102	0.0059	0.0048	0.0046	0.0088	0.0106	0.0156	0.0118	0.0076	0.0112	0.0125	0.0087
1984	0.0074	0.0073	0.0044	0.0050	0.0049	0.0048	0.0065	0.0095	0.0095	0.0158	0.0203	0.0126
1985	0.0073	0.0059	0.0032	0.0031	0.0071	0.0077	0.0237	0.0371	0.0390	0.0540	0.0389	0.0179
1986	0.0097	0.0063	0.0035	0.0026	0.0066	0.0115	0.0133	0.0163	0.0191	0.0140	0.0262	0.0120
1987	0.0075	0.0046	0.0041	0.0057	0.0077	0.0075	0.0244	0.0260	0.0358	0.0535	0.0399	0.0217
1988	0.0161	0.0066	0.0049	0.0040	0.0070	0.0102	0.0282	0.0264	0.0517	0.0671	0.0563	0.0254
1989	0.0138	0.0093	0.0054	0.0037	0.0083	0.0121	0.0330	0.0480	0.0611	0.1074	0.0602	0.0291
1990	0.0214	0.0118	0.0053	0.0057	0.0094	0.0142	0.0264	0.0306	0.0644	0.0959	0.0523	0.0608
1991	0.0183	0.0086	0.0062	0.0057	0.0096	0.0144	0.0307	0.0348	0.0264	0.0674	0.0789	0.0362
1992	0.0188	0.0087	0.0057	0.0050	0.0090	0.0126	0.0308	0.0780	0.0502	0.0417	0.0544	0.0401
1993	0.0175	0.0092	0.0060	0.0051	0.0096	0.0113	0.0234	0.0372	0.0432	0.0502	0.0303	0.0243
1994	0.0152	0.0077	0.0050	0.0046	0.0085	0.0122	0.0291	0.0434	0.0565	0.0441	0.0474	0.0311
1995	0.0144	0.0076	0.0056	0.0049	0.0087	0.0137	0.0280	0.0245	0.0132	0.0293	0.0530	0.0250
1996	0.0130	0.0076	0.0053	0.0045	0.0082	0.0120	0.0272	0.0265	0.0176	0.0481	0.0383	0.0193
1997	0.0125	0.0074	0.0053	0.0049	0.0078	0.0126	0.0119	0.0155	0.0128	0.0310	0.0229	0.0219
1998	0.0127	0.0073	0.0051	0.0047	0.0078	0.0069	0.0113	0.0255	0.0320	0.0475	0.0384	0.0245
1999	0.0122	0.0069	0.0052	0.0048	0.0083	0.0123	0.0199	0.0131	0.0144	0.0221	0.0274	0.0165
2000	0.0130	0.0079	0.0054	0.0046	0.0081	0.0118	0.0258	0.0260	0.0381	0.0558	0.0515	0.0234
2001	0.0123	0.0076	0.0056	0.0049	0.0094	0.0130	0.0269	0.0316	0.0427	0.0373	0.0426	0.0206
2002	0.0127	0.0081	0.0054	0.0049	0.0089	0.0139	0.0334	0.0641	0.1061	0.0964	0.0734	0.0423
2003	0.0207	0.0100	0.0073	0.0060	0.0110	0.0154	0.0308	0.0437	0.0809	0.0947	0.0867	0.0460
2004	0.0206	0.0105	0.0070	0.0064	0.0102	0.0154	0.0355	0.0727	0.1041	0.0868	0.0621	0.0434
2005	0.0186	0.0098	0.0070	0.0064	0.0108	0.0160	0.0333	0.0519	0.0490	0.0762	0.0429	0.0388
2006	0.0184	0.0100	0.0066	0.0055	0.0105	0.0152	0.0354	0.0565	0.0777	0.0970	0.0696	0.0386
Avg	0.0137	0.0078	0.0053	0.0047	0.0082	0.0119	0.0252	0.0335	0.0416	0.0540	0.0433	0.0269
Max	0.0214	0.0118	0.0073	0.0064	0.0110	0.0160	0.0365	0.0780	0.1061	0.1074	0.0867	0.0608
Min	0.0073	0.0046	0.0032	0.0026	0.0046	0.0048	0.0065	0.0095	0.0076	0.0112	0.0125	0.0087
Std	0.0038	0.0015	0.0009	0.0009	0.0016	0.0026	0.0078	0.0166	0.0245	0.0252	0.0175	0.0112

% SEEP PER MILE

Reach **13** **Bridgeport Gage to Lewellen Gage** Length 60 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												0.0001
1976												
1977												
1978												
1979												
1980							0.0651	0.0068				
1981												
1982												
1983								0.0243	0.0225			
1984						0.0240		0.0525				
1985						0.0398						
1986									0.0135			0.0564
1987												
1988												
1989												
1990			0.0344									
1991				0.0028								
1992												
1993			0.2191									
1994										0.0312		
1995												
1996				0.0233	0.0324							0.0383
1997									0.0897			
1998							0.2250	0.0391	0.0644			0.0365
1999						0.1241						0.0527
2000								0.1523	0.0223	0.0062		
2001											0.0864	
2002			0.1204									
2003				0.1210						0.1443	0.1993	
2004	0.0121		0.0066							0.0702		0.0544
2005												
2006												

% DIVERSION PER MILE

Reach **13** **Bridgeport Gage to Lewellen Gage** Length 60 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0203								0.0720	0.2278	0.3121	0.1013
1976	0.0212	0.0006						0.0280	0.1437	0.4039	0.2206	0.0966
1977	0.0186							0.0233	0.1260	0.3958	0.2003	0.1086
1978	0.0225							0.0001	0.0708	0.1827	0.1699	0.0780
1979								0.0221	0.1192	0.2081	0.1679	0.0697
1980	0.0187							0.0071	0.0401	0.2902	0.2381	0.0608
1981	0.0112							0.0716	0.2736	0.1166	0.0911	0.0576
1982	0.0229							0.0369	0.1520	0.2024	0.1262	0.0604
1983	0.0129							0.0000	0.0089	0.0410	0.0432	0.0250
1984	0.0239							0.0016	0.0198	0.0755	0.0926	0.0515
1985	0.0137						0.0008	0.0471	0.1343	0.3126	0.2296	0.0707
1986	0.0035							0.0193	0.0357	0.0689	0.1536	0.0420
1987	0.0050							0.0308	0.1034	0.2684	0.1139	0.0465
1988	0.0170						0.0000	0.0130	0.1254	0.3783	0.2922	0.0713
1989	0.0235							0.1116	0.3838	0.7368	0.4613	0.0735
1990	0.0228							0.0253	0.2525	0.5096	0.3001	0.1690
1991	0.0342						0.0544	0.0900	0.0261	0.3566	0.4720	0.1010
1992	0.0235							0.2302	0.1454	0.2096	0.3514	0.1192
1993	0.0281							0.0400	0.1058	0.2783	0.1650	0.0495
1994	0.0045							0.1084	0.2642	0.1902	0.2806	0.1322
1995	0.0255							0.0097	0.0043	0.1276	0.2803	0.1090
1996	0.0151						0.0026	0.0970	0.0492	0.3173	0.2071	0.0517
1997	0.0100						0.0024	0.0432	0.0237	0.1650	0.0988	0.1055
1998	0.0112							0.0122	0.0310	0.0887	0.1236	0.0350
1999	0.0112							0.0122	0.0310	0.0887	0.1236	0.0350
2000	0.0005							0.0428	0.1733	0.3473	0.3547	0.0915
2001	0.0098							0.0669	0.1773	0.1943	0.2802	0.0614
2002	0.0091						0.0004	0.2273	0.7788	0.5323	0.5297	0.2483
2003	0.0360						0.0456	0.0931	0.4843	0.4850	0.6699	0.1315
2004	0.1327	0.0115						0.3412	0.6110	0.4503	0.3933	0.2346
2005	0.0289							0.1244	0.1006	0.4331	0.2017	0.2131
2006	0.0404						0.0167	0.2050	0.3499	0.4858	0.3623	0.1229
Avg	0.0212	0.0004					0.0038	0.0682	0.1693	0.2865	0.2533	0.0945
Max	0.1327	0.0115					0.0544	0.3412	0.7788	0.7368	0.6699	0.2483
Min									0.0043	0.0410	0.0432	0.0250
Std	0.0223	0.0020					0.0123	0.0797	0.1783	0.1616	0.1406	0.0552

% EVAP PER MILE

Reach **14** **Keystone Gage to N. Platte Gage at North Platte** Length 51.5 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0355	0.0103	0.0065	0.0055	0.0098	0.0139	0.0254	0.0348	0.0313	0.0185	0.0167	0.0202
1976	0.0200	0.0097	0.0055	0.0054	0.0083	0.0139	0.0250	0.0348	0.0273	0.0156	0.0156	0.0129
1977	0.0137	0.0071	0.0063	0.0058	0.0090	0.0118	0.0221	0.0373	0.0330	0.0163	0.0175	0.0250
1978	0.0260	0.0108	0.0068	0.0058	0.0100	0.0119	0.0309	0.0360	0.0319	0.0171	0.0203	0.0310
1979	0.0204	0.0099	0.0064	0.0060	0.0102	0.0108	0.0308	0.0391	0.0361	0.0206	0.0181	0.0277
1980	0.0250	0.0109	0.0061	0.0055	0.0090	0.0151	0.0201	0.0184	0.0291	0.0170	0.0185	0.0283
1981	0.0182	0.0101	0.0068	0.0060	0.0116	0.0148	0.0373	0.0252	0.0361	0.0172	0.0236	0.0253
1982	0.0159	0.0109	0.0064	0.0058	0.0100	0.0140	0.0378	0.0271	0.0366	0.0167	0.0143	0.0158
1983	0.0164	0.0094	0.0064	0.0066	0.0102	0.0138	0.0206	0.0313	0.0052	0.0084	0.0067	0.0053
1984	0.0123	0.0100	0.0026	0.0024	0.0032	0.0035	0.0045	0.0069	0.0086	0.0144	0.0151	0.0141
1985	0.0172	0.0048	0.0027	0.0031	0.0072	0.0064	0.0342	0.0309	0.0324	0.0166	0.0207	0.0211
1986	0.0176	0.0103	0.0063	0.0053	0.0088	0.0133	0.0177	0.0216	0.0258	0.0131	0.0093	0.0072
1987	0.0085	0.0059	0.0064	0.0063	0.0097	0.0118	0.0399	0.0333	0.0376	0.0276	0.0174	0.0351
1988	0.0208	0.0090	0.0060	0.0054	0.0084	0.0124	0.0374	0.0351	0.0296	0.0205	0.0236	0.0301
1989	0.0298	0.0109	0.0066	0.0053	0.0104	0.0142	0.0497	0.0362	0.0330	0.0224	0.0172	0.0351
1990	0.0348	0.0111	0.0070	0.0054	0.0102	0.0139	0.0357	0.0269	0.0395	0.0177	0.0226	0.0353
1991	0.0375	0.0120	0.0077	0.0060	0.0111	0.0164	0.0369	0.0340	0.0363	0.0164	0.0223	0.0420
1992	0.0234	0.0097	0.0063	0.0053	0.0089	0.0108	0.0342	0.0509	0.0349	0.0218	0.0253	0.0389
1993	0.0304	0.0118	0.0070	0.0056	0.0105	0.0119	0.0241	0.0362	0.0434	0.0310	0.0264	0.0327
1994	0.0283	0.0103	0.0065	0.0057	0.0108	0.0145	0.0308	0.0450	0.0433	0.0205	0.0196	0.0372
1995	0.0279	0.0118	0.0074	0.0064	0.0121	0.0166	0.0335	0.0366	0.0336	0.0169	0.0160	0.0211
1996	0.0266	0.0125	0.0082	0.0074	0.0120	0.0177	0.0413	0.0331	0.0421	0.0191	0.0241	0.0267
1997	0.0241	0.0119	0.0078	0.0058	0.0091	0.0153	0.0336	0.0346	0.0265	0.0184	0.0208	0.0204
1998	0.0129	0.0100	0.0071	0.0063	0.0103	0.0100	0.0157	0.0332	0.0347	0.0166	0.0206	0.0306
1999	0.0261	0.0109	0.0062	0.0059	0.0099	0.0151	0.0323	0.0391	0.0410	0.0177	0.0208	0.0209
2000	0.0251	0.0122	0.0081	0.0066	0.0120	0.0164	0.0323	0.0290	0.0172	0.0168	0.0164	0.0345
2001	0.0263	0.0108	0.0067	0.0062	0.0101	0.0162	0.0307	0.0423	0.0315	0.0155	0.0165	0.0343
2002	0.0343	0.0144	0.0084	0.0063	0.0120	0.0160	0.0415	0.0372	0.0325	0.0134	0.0223	0.0388
2003	0.0277	0.0123	0.0078	0.0064	0.0106	0.0149	0.0352	0.0389	0.0482	0.0232	0.0247	0.0416
2004	0.0277	0.0120	0.0076	0.0062	0.0106	0.0157	0.0337	0.0459	0.0481	0.0330	0.0343	0.0365
2005	0.0264	0.0110	0.0072	0.0060	0.0112	0.0164	0.0361	0.0393	0.0427	0.0317	0.0328	0.0404
2006	0.0263	0.0124	0.0074	0.0059	0.0109	0.0157	0.0374	0.0398	0.0399	0.0261	0.0304	0.0383
Avg	0.0239	0.0105	0.0066	0.0057	0.0099	0.0136	0.0312	0.0341	0.0334	0.0193	0.0203	0.0283
Max	0.0375	0.0144	0.0084	0.0074	0.0121	0.0177	0.0497	0.0509	0.0482	0.0330	0.0343	0.0420
Min	0.0085	0.0048	0.0026	0.0024	0.0032	0.0035	0.0045	0.0069	0.0052	0.0084	0.0067	0.0053
Std	0.0071	0.0019	0.0012	0.0009	0.0017	0.0029	0.0088	0.0082	0.0094	0.0054	0.0058	0.0099

% SEEP PER MILE

Reach **14** **Keystone Gage to N. Platte Gage at North Platte** Length 51.5 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
1982												
1983												
1984												
1985												
1986												
1987												
1988												
1989												
1990												
1991										0.0463		
1992												
1993												
1994												
1995												
1996												
1997												
1998												
1999										0.1160		
2000									0.1971			
2001									0.2121			
2002									0.3150	0.1339		
2003										0.2168		
2004												
2005												
2006												

% DIVERSION PER MILE

Reach **14** **Keystone Gage to N. Platte Gage at North Platte** Length 51.5 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0832						0.1258	0.8420	0.7425	0.5025	0.5119	0.5932
1976	0.3640					0.0137	0.4201	0.6389	0.5103	0.4273	0.3636	0.3157
1977	0.1288	0.0050					0.0040	0.4167	0.7009	0.3878	0.6285	0.8284
1978	0.0248						0.0524	0.7571	0.7671	0.4510	0.7422	0.9823
1979	0.0601							0.6024	0.8796	0.6594	0.6556	0.8732
1980	0.1622						0.0106	0.2663	0.6162	0.5065	0.4701	0.7418
1981	0.0384						0.4483	0.5865	0.5496	0.4595	0.7777	0.8870
1982	0.0582						0.2941	0.6313	0.6115	0.4963	0.5984	0.5934
1983	0.0011						0.0580	0.2909	0.0785	0.1665	0.1472	0.1084
1984	0.0110							0.0341	0.1083	0.5156	0.4917	0.3645
1985	0.1782						0.4455	0.7407	0.8818	0.5404	0.7518	0.5533
1986							0.0478	0.3306	0.5119	0.4015	0.3120	0.1339
1987	0.0042						0.0955	0.7392	0.9634	0.6315	0.4951	0.4427
1988							0.0469	0.3810	0.5678	0.5504	0.6392	0.5543
1989							0.2593	0.9994	0.6167	0.6310	0.4619	0.2239
1990	0.0098						0.0818	0.4869	0.8857	0.4234	0.6519	0.5668
1991	0.0108						0.0786	0.3778	0.5692	0.4582	0.5504	0.5473
1992	0.0083						0.0204	0.5913	0.5378	0.7734	0.5521	0.6404
1993	0.0862						0.0008	0.4378	0.4614	0.8306	0.7818	0.6791
1994	0.0157						0.2183	0.7134	0.7795	0.5244	0.6206	0.7465
1995	0.0236						0.0003	0.1083	0.2736	0.4049	0.5381	0.5546
1996	0.0086						0.1571	0.6524	0.6453	0.4514	0.4806	0.1641
1997								0.6446	0.3634	0.4993	0.5344	0.2601
1998							0.0089	0.5909	0.4339	0.4045	0.4359	0.5041
1999							0.0099	0.4818	0.6343	0.5017	0.4116	0.1096
2000							0.5850	0.4423	0.4399	0.4481	0.4993	0.6282
2001	0.0021							0.3222	0.6979	0.3889	0.4894	0.4545
2002							0.2200	1.0020	0.7297	0.3538	0.7291	0.4091
2003	0.0390						0.1375	0.6158	0.8011	0.5929	0.7057	0.6077
2004	0.1302	0.0319					0.1964	0.9476	0.9375	0.7420	1.1011	0.8614
2005	0.0716	0.0032						0.4454	0.5079	0.9167	1.0699	0.6310
2006	0.0779	0.0181					0.0409	0.9793	1.3167	0.6657	0.8899	0.6111
Avg	0.0499	0.0018				0.0004	0.1270	0.5655	0.6288	0.5221	0.5965	0.5366
Max	0.3640	0.0319				0.0137	0.5850	1.0020	1.3167	0.9167	1.1011	0.9823
Min								0.0341	0.0785	0.1665	0.1472	0.1084
Std	0.0754	0.0063				0.0024	0.1566	0.2399	0.2446	0.1489	0.1954	0.2326

% EVAP PER MILE

Reach **15** **N. Platte Gage at North Platte to Brady Gage** Length 23.8 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0163	0.0055	0.0032	0.0026	0.0044	0.0064	0.0122	0.0170	0.0167	0.0194	0.0173	0.0148
1976	0.0092	0.0050	0.0032	0.0023	0.0041	0.0064	0.0136	0.0193	0.0253	0.0192	0.0203	0.0181
1977	0.0131	0.0061	0.0034	0.0026	0.0049	0.0072	0.0158	0.0211	0.0186	0.0183	0.0141	0.0155
1978	0.0173	0.0053	0.0036	0.0035	0.0062	0.0074	0.0171	0.0164	0.0224	0.0185	0.0155	0.0184
1979	0.0148	0.0051	0.0032	0.0029	0.0048	0.0074	0.0178	0.0163	0.0111	0.0148	0.0144	0.0170
1980	0.0148	0.0064	0.0023	0.0020	0.0033	0.0048	0.0084	0.0050	0.0090	0.0185	0.0172	0.0162
1981	0.0098	0.0054	0.0030	0.0022	0.0040	0.0071	0.0204	0.0156	0.0210	0.0166	0.0128	0.0181
1982	0.0131	0.0060	0.0029	0.0024	0.0042	0.0068	0.0222	0.0207	0.0210	0.0187	0.0140	0.0140
1983	0.0120	0.0049	0.0028	0.0018	0.0034	0.0048	0.0062	0.0056	0.0031	0.0072	0.0092	0.0076
1984	0.0082	0.0057	0.0023	0.0017	0.0021	0.0033	0.0051	0.0052	0.0075	0.0140	0.0146	0.0085
1985	0.0050	0.0024	0.0019	0.0019	0.0029	0.0046	0.0166	0.0148	0.0185	0.0177	0.0159	0.0135
1986	0.0069	0.0044	0.0027	0.0019	0.0034	0.0051	0.0089	0.0138	0.0128	0.0145	0.0108	0.0077
1987	0.0112	0.0037	0.0023	0.0019	0.0036	0.0052	0.0131	0.0099	0.0153	0.0221	0.0178	0.0146
1988	0.0075	0.0039	0.0025	0.0026	0.0032	0.0050	0.0125	0.0179	0.0251	0.0199	0.0192	0.0168
1989	0.0149	0.0057	0.0032	0.0022	0.0042	0.0062	0.0219	0.0195	0.0206	0.0230	0.0160	0.0206
1990	0.0158	0.0069	0.0043	0.0026	0.0045	0.0057	0.0127	0.0157	0.0236	0.0193	0.0185	0.0256
1991	0.0215	0.0085	0.0052	0.0037	0.0047	0.0084	0.0179	0.0211	0.0217	0.0190	0.0203	0.0248
1992	0.0146	0.0065	0.0040	0.0030	0.0040	0.0052	0.0159	0.0263	0.0192	0.0162	0.0172	0.0232
1993	0.0172	0.0064	0.0033	0.0027	0.0044	0.0049	0.0142	0.0212	0.0273	0.0222	0.0175	0.0154
1994	0.0093	0.0044	0.0025	0.0023	0.0039	0.0061	0.0186	0.0194	0.0237	0.0193	0.0181	0.0269
1995	0.0132	0.0066	0.0037	0.0031	0.0055	0.0083	0.0192	0.0190	0.0054	0.0089	0.0148	0.0129
1996	0.0079	0.0033	0.0025	0.0023	0.0037	0.0051	0.0102	0.0169	0.0163	0.0179	0.0157	0.0114
1997	0.0087	0.0033	0.0026	0.0023	0.0035	0.0046	0.0107	0.0129	0.0071	0.0145	0.0117	0.0126
1998	0.0081	0.0033	0.0021	0.0017	0.0031	0.0048	0.0089	0.0130	0.0157	0.0163	0.0147	0.0118
1999	0.0071	0.0034	0.0027	0.0021	0.0030	0.0043	0.0107	0.0084	0.0095	0.0165	0.0124	0.0106
2000	0.0075	0.0034	0.0021	0.0017	0.0031	0.0048	0.0107	0.0152	0.0179	0.0177	0.0160	0.0165
2001	0.0131	0.0057	0.0040	0.0026	0.0043	0.0075	0.0164	0.0179	0.0213	0.0173	0.0167	0.0177
2002	0.0172	0.0070	0.0034	0.0031	0.0056	0.0084	0.0186	0.0230	0.0197	0.0165	0.0186	0.0231
2003	0.0167	0.0077	0.0051	0.0043	0.0079	0.0117	0.0217	0.0258	0.0304	0.0187	0.0159	0.0271
2004	0.0287	0.0135	0.0083	0.0061	0.0097	0.0144	0.0342	0.0177	0.0226	0.0208	0.0144	0.0290
2005	0.0307	0.0117	0.0070	0.0058	0.0104	0.0148	0.0304	0.0361	0.0214	0.0165	0.0147	0.0365
2006	0.0240	0.0110	0.0064	0.0052	0.0101	0.0126	0.0300	0.0241	0.0128	0.0187	0.0204	0.0383
Avg	0.0136	0.0059	0.0035	0.0028	0.0047	0.0069	0.0160	0.0172	0.0176	0.0175	0.0158	0.0183
Max	0.0307	0.0135	0.0083	0.0061	0.0104	0.0148	0.0342	0.0361	0.0304	0.0230	0.0204	0.0383
Min	0.0050	0.0024	0.0019	0.0017	0.0021	0.0033	0.0051	0.0050	0.0031	0.0072	0.0092	0.0076
Std	0.0061	0.0024	0.0015	0.0011	0.0020	0.0028	0.0067	0.0064	0.0066	0.0032	0.0027	0.0074

% SEEP PER MILE

Reach **15** **N. Platte Gage at North Platte to Brady Gage** Length 23.8 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976											0.0390	
1977												
1978				0.1109								
1979												
1980												
1981												
1982												
1983												
1984			0.6091									
1985												
1986												
1987												
1988												
1989												
1990												
1991	0.3839		0.1120									
1992												
1993												
1994												
1995												
1996												
1997												
1998												
1999												
2000												
2001			0.0704							0.0715		
2002												
2003												
2004				0.1944								
2005												
2006												

% DIVERSION PER MILE

Reach **15** **N. Platte Gage at North Platte to Brady Gage** Length 23.8 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	3.7552	3.7164	3.7362	3.7711	3.7927	3.7746	3.7227	3.7913	3.2405	2.5880	2.8234	3.7745
1976	3.8815	3.8631	3.7905	3.8164	3.7251	3.7338	3.7169	3.7253	3.4740	2.4970	2.7358	3.5133
1977	3.7284	3.8025	3.7636	3.8544	3.7411	3.5746	3.3223	3.4268	3.5887	2.2888	3.1089	3.7633
1978	3.6775	3.7316	3.6977	3.5521	3.6579	3.5652	3.5849	3.6733	3.5330	2.3182	3.2506	3.7779
1979	3.7879	3.7907	3.8086	3.8082	3.7694	3.4565	3.5866	3.7356	1.8794	3.0223	3.0515	3.8518
1980	3.7011	3.5964	3.8266	3.6580	3.0307	3.2393	1.7560	0.7617	1.4098	2.2364	2.5809	3.7365
1981	3.6619	3.8224	3.8471	3.8741	3.8106	3.7283	3.6699	3.5807	3.7125	2.7429	3.7374	3.7869
1982	3.6821	3.5891	3.7840	3.8631	3.7745	3.7131	3.6669	3.4685	3.4666	2.6729	2.8911	3.4458
1983	3.2486	3.5732	3.3934	2.7807	3.2839	3.4287	2.1497	0.9573	0.3050	0.2784	0.8802	0.8877
1984	2.7842	3.2742	0.9371	1.4787	1.3485	1.3200	0.9001	0.6241	0.8340	2.2051	2.5497	1.7702
1985	1.9748	1.3816	1.2790	1.3584	1.5159	1.8964	3.4537	3.2996	3.4416	2.7788	3.2535	3.4300
1986	3.7018	3.5717	3.2123	3.0922	2.8297	3.3964	1.8112	2.6115	1.5878	1.9609	1.8432	1.8772
1987	2.3116	2.8694	3.0034	2.8388	3.3781	2.9452	3.0614	2.1120	2.2960	3.0516	2.9208	3.7146
1988	3.8751	3.7979	3.6630	2.7160	2.4338	3.6893	3.7044	3.0699	3.1059	2.7330	3.0375	3.8197
1989	3.7775	3.7312	3.7697	3.8316	3.4615	3.5763	3.7007	3.7827	3.6168	2.9294	2.8615	3.6074
1990	3.6727	3.5741	3.6351	3.8061	3.7222	3.7524	3.4880	3.3319	3.7184	2.3925	3.1227	3.5206
1991	3.2871	3.4879	3.3975	3.5954	3.7435	3.6345	3.6021	3.3957	3.6023	2.4844	2.8452	3.7880
1992	3.7214	3.6683	3.6531	3.6966	3.8057	3.6268	3.7606	3.7977	3.7541	3.3723	2.9832	3.7308
1993	3.5825	3.6438	3.7438	3.3272	3.3710	3.1816	3.5195	3.5605	3.5201	3.3989	3.7179	3.7918
1994	3.8999	3.7962	3.7711	3.5708	3.6062	3.7471	3.5573	3.7618	3.5974	2.9903	2.9954	3.7052
1995	3.7952	3.7291	3.7689	3.7303	3.7277	3.7200	3.5799	3.0455	0.6807	1.0622	2.4872	3.0297
1996	3.4842	3.8352	3.8695	3.6318	3.3881	3.5899	3.8938	3.6418	3.5179	2.5828	3.0696	2.4710
1997	3.0580	3.8447	3.4934	3.3879	3.7157	3.5385	3.5434	3.7560	0.9305	1.9785	1.9310	2.7669
1998	2.6386	2.6512	2.8240	2.5334	2.9265	2.5907	1.8586	3.0422	2.7414	2.2487	2.6220	3.8237
1999	3.8857	3.7965	3.5453	2.8519	3.9142	3.9234	3.8456	1.5998	1.4580	2.3691	2.0532	2.1125
2000	2.8208	3.2448	3.2291	3.1060	3.1731	3.4337	3.5035	3.4177	2.9518	2.5362	2.7305	3.9344
2001	3.8591	3.7691	3.6381	3.8087	3.8511	3.7041	3.5401	3.6834	3.6962	2.4889	2.8921	3.8705
2002	3.6802	3.6898	3.7746	3.7682	3.7247	3.6707	3.7107	3.7477	3.8376	2.3218	3.4093	3.9359
2003	3.8457	3.7568	3.7408	3.7382	3.6703	3.5911	3.6067	3.5228	3.6991	3.5928	3.6697	4.0321
2004	3.6372	3.4833	3.4223	3.3295	3.4329	3.4327	3.3831	3.8663	3.7998	3.6652	3.8899	3.7786
2005	3.3814	3.4312	3.3594	3.3312	3.3398	3.3098	3.3285	3.3528	3.3327	3.8425	3.9794	3.6549
2006	3.6270	3.5609	3.4845	3.4596	3.4413	3.4547	3.4399	3.7538	4.0574	3.5893	3.7756	3.6924
Avg	3.4821	3.5336	3.4332	3.3427	3.3784	3.4044	3.2803	3.1531	2.8871	2.6006	2.9281	3.3874
Max	3.8999	3.8631	3.8695	3.8741	3.9142	3.9234	3.8938	3.8663	4.0574	3.8425	3.9794	4.0321
Min	1.9748	1.3816	0.9371	1.3584	1.3485	1.3200	0.9001	0.6241	0.3050	0.2784	0.8802	0.8877
Std	0.4775	0.4699	0.6508	0.6243	0.6023	0.5349	0.7196	0.9061	1.0903	0.7060	0.6356	0.7447

% EVAP PER MILE

Reach **16** **Brady Gage to Cozad Gage** Length 25.5 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0808	0.0246	0.0149	0.0123	0.0227	0.0319	0.0535	0.0686	0.0448	0.0380	0.0311	0.0407
1976	0.0566	0.0265	0.0157	0.0121	0.0190	0.0307	0.0560	0.0645	0.0583	0.0345	0.0366	0.0480
1977	0.0451	0.0240	0.0159	0.0129	0.0222	0.0288	0.0447	0.0518	0.0561	0.0319	0.0268	0.0603
1978	0.0709	0.0241	0.0159	0.0151	0.0242	0.0206	0.0578	0.0650	0.0595	0.0320	0.0306	0.0542
1979	0.0672	0.0247	0.0167	0.0160	0.0239	0.0231	0.0648	0.0628	0.0297	0.0282	0.0259	0.0373
1980	0.0677	0.0253	0.0135	0.0098	0.0106	0.0172	0.0222	0.0149	0.0235	0.0298	0.0322	0.0549
1981	0.0471	0.0294	0.0170	0.0140	0.0254	0.0352	0.0710	0.0366	0.0524	0.0316	0.0236	0.0498
1982	0.0513	0.0228	0.0135	0.0136	0.0239	0.0308	0.0903	0.0590	0.0479	0.0328	0.0225	0.0390
1983	0.0331	0.0201	0.0115	0.0060	0.0131	0.0204	0.0191	0.0163	0.0112	0.0179	0.0205	0.0177
1984	0.0182	0.0187	0.0049	0.0038	0.0053	0.0080	0.0122	0.0138	0.0184	0.0281	0.0278	0.0207
1985	0.0120	0.0054	0.0038	0.0040	0.0066	0.0111	0.0579	0.0523	0.0555	0.0301	0.0267	0.0352
1986	0.0341	0.0191	0.0108	0.0072	0.0095	0.0201	0.0235	0.0347	0.0309	0.0263	0.0202	0.0181
1987	0.0251	0.0107	0.0083	0.0066	0.0142	0.0158	0.0401	0.0291	0.0387	0.0389	0.0334	0.0657
1988	0.0490	0.0185	0.0131	0.0082	0.0096	0.0235	0.0636	0.0541	0.0580	0.0366	0.0345	0.0495
1989	0.0234	0.0224	0.0149	0.0120	0.0194	0.0249	0.0800	0.0618	0.0446	0.0357	0.0264	0.0603
1990	0.0584	0.0237	0.0162	0.0113	0.0221	0.0270	0.0571	0.0445	0.0508	0.0327	0.0351	0.0674
1991	0.0770	0.0230	0.0162	0.0148	0.0227	0.0345	0.0663	0.0461	0.0596	0.0337	0.0356	0.0674
1992	0.0562	0.0227	0.0151	0.0109	0.0209	0.0230	0.0641	0.0779	0.0443	0.0286	0.0316	0.0477
1993	0.0653	0.0249	0.0152	0.0112	0.0212	0.0184	0.0461	0.0592	0.0560	0.0370	0.0289	0.0596
1994	0.0589	0.0223	0.0145	0.0127	0.0199	0.0267	0.0586	0.0701	0.0556	0.0349	0.0306	0.0816
1995	0.0507	0.0229	0.0142	0.0114	0.0217	0.0288	0.0618	0.0505	0.0174	0.0220	0.0264	0.0343
1996	0.0371	0.0207	0.0153	0.0124	0.0130	0.0220	0.0692	0.0626	0.0565	0.0319	0.0334	0.0318
1997	0.0270	0.0202	0.0116	0.0090	0.0203	0.0234	0.0535	0.0655	0.0166	0.0269	0.0265	0.0388
1998	0.0241	0.0098	0.0066	0.0050	0.0102	0.0146	0.0222	0.0447	0.0435	0.0295	0.0291	0.0687
1999	0.0530	0.0192	0.0142	0.0065	0.0208	0.0317	0.0710	0.0233	0.0259	0.0315	0.0279	0.0275
2000	0.0257	0.0140	0.0089	0.0064	0.0125	0.0223	0.0523	0.0544	0.0404	0.0311	0.0315	0.0916
2001	0.0569	0.0209	0.0148	0.0134	0.0240	0.0263	0.0482	0.0510	0.0477	0.0311	0.0287	0.0634
2002	0.0564	0.0253	0.0155	0.0126	0.0225	0.0344	0.0717	0.0606	0.0349	0.0302	0.0335	0.1013
2003	0.0731	0.0287	0.0174	0.0144	0.0253	0.0359	0.0660	0.0572	0.0389	0.0311	0.0264	0.0615
2004	0.0750	0.0327	0.0188	0.0151	0.0260	0.0373	0.0802	0.0415	0.0493	0.0331	0.0202	0.0561
2005	0.0658	0.0299	0.0189	0.0157	0.0257	0.0350	0.0684	0.0565	0.0588	0.0246	0.0161	0.0776
2006	0.0786	0.0316	0.0184	0.0150	0.0290	0.0377	0.0676	0.0406	0.0202	0.0296	0.0218	0.0644
Avg	0.0506	0.0222	0.0138	0.0110	0.0190	0.0257	0.0557	0.0497	0.0421	0.0310	0.0282	0.0529
Max	0.0808	0.0327	0.0189	0.0160	0.0290	0.0377	0.0903	0.0779	0.0596	0.0389	0.0366	0.1013
Min	0.0120	0.0054	0.0038	0.0038	0.0053	0.0080	0.0122	0.0138	0.0112	0.0179	0.0161	0.0177
Std	0.0192	0.0059	0.0037	0.0036	0.0063	0.0076	0.0187	0.0164	0.0147	0.0044	0.0050	0.0199

% SEEP PER MILE

Reach **16** **Brady Gage to Cozad Gage** Length 25.5 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976										0.0686		
1977										0.3565		
1978										0.4303		
1979												
1980								0.1300		0.6240	0.2221	
1981												
1982										0.0314		
1983							0.0340	0.3006	0.2304	0.1365		
1984					0.0074			0.2906	0.3975			0.3979
1985		0.1463		0.3037	0.4728							
1986				0.2566			0.0251		0.2980	0.4294	0.6461	0.2831
1987												
1988									0.0035			
1989												
1990										0.2835		
1991												
1992												
1993					0.1060							
1994												
1995									0.1540	0.0393		
1996												
1997									1.4097	0.5093		0.4407
1998						0.2447	0.4888			0.2653		
1999								0.5421	0.3941			0.5126
2000												
2001												
2002										0.1648		
2003												
2004												
2005												
2006												

% DIVERSION PER MILE

Reach **16** **Brady Gage to Cozad Gage** Length 25.5 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.2741							2.5461	1.7921	3.3378	3.2795	3.1947
1976							0.1097	2.4910	3.1344	3.4725	3.6077	2.8532
1977	0.2034							0.9469	2.6079	3.1139	3.5635	2.2043
1978	0.0083						0.0036	1.8613	3.4466	3.0289	3.4210	3.3659
1979							0.0613	2.3027	0.7180	2.6943	3.6480	3.1402
1980							0.0106	0.0931	0.4022	3.0769	3.1501	2.6326
1981							2.4215	2.7718	3.6149	2.8573	3.5639	1.6091
1982	0.0096							2.4273	3.2288	3.6500	3.6679	2.4304
1983	0.0240						0.0547	0.0919	0.0753	0.3208	0.5976	0.2420
1984	0.0096							0.0331	0.0851	1.9145	3.0345	0.4223
1985							0.5416	1.3738	2.7522	3.4745	3.5089	2.0561
1986	0.2628						0.1149	0.6129	0.5387	2.1935	1.6279	0.3066
1987	0.0336						0.1354	0.3843	0.6574	3.5355	3.4162	1.4230
1988	0.2393	0.0352					0.4582	0.6298	3.2542	2.7712	3.5887	2.9552
1989	2.5058	0.0520					1.1025	3.4515	3.0246	3.6388	3.4092	1.2251
1990	0.0496						0.3601	1.4668	3.4592	3.3255	3.2792	3.0904
1991	0.2547						0.6595	0.7976	2.4025	3.6066	3.6350	2.5687
1992	0.1661						0.6999	2.8832	3.2831	3.5032	2.8441	3.0668
1993	0.0555						0.4998	2.0557	3.0378	3.2513	3.3254	1.7479
1994						0.1045	1.0278	2.3627	3.3817	3.1050	3.4661	1.5702
1995	1.3842	0.0010					0.2023	0.8380	0.1262	0.7292	2.5893	1.9906
1996	0.0435						0.1627	1.8607	2.7298	3.3521	2.9576	0.2902
1997							0.0142	1.8832	0.2525	2.2525	1.6512	0.4491
1998							0.0430	1.0340	1.6985	2.9543	3.2018	1.7442
1999	0.2860							0.2164	0.4152	2.2054	1.5434	0.2229
2000						0.0082	0.2903	1.8892	3.1798	3.2782	3.2952	0.0647
2001							0.5016	2.4215	3.6539	3.3271	3.3155	2.1003
2002							1.2735	3.7333	3.7704	3.1134	3.6511	
2003							0.4187	2.5460	3.7513	3.7906	3.8018	2.2947
2004							0.9795	3.5313	3.5793	3.7305	3.6596	1.8007
2005							0.7790	3.1531	2.7522	3.8097	3.6319	1.5232
2006							1.7170	3.6710	3.6514	3.7593	3.6951	1.6091
Avg	0.1816	0.0028				0.0035	0.4576	1.8238	2.3268	3.0054	3.1446	1.7561
Max	2.5058	0.0520				0.1045	2.4215	3.7333	3.7704	3.8097	3.8018	3.3659
Min								0.0331	0.0753	0.3208	0.5976	
Std	0.4863	0.0108				0.0182	0.5593	1.1139	1.3220	0.8049	0.7423	1.0339

% EVAP PER MILE

Reach **17** **Cozad Gage to Overton Gage** Length 28.1 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0146	0.0047	0.0027	0.0021	0.0037	0.0053	0.0102	0.0233	0.0155	0.0470	0.0368	0.0154
1976	0.0091	0.0039	0.0023	0.0018	0.0031	0.0049	0.0107	0.0222	0.0550	0.0620	0.0789	0.0204
1977	0.0103	0.0049	0.0026	0.0024	0.0041	0.0055	0.0093	0.0159	0.0292	0.0630	0.0333	0.0164
1978	0.0144	0.0048	0.0028	0.0026	0.0047	0.0053	0.0126	0.0226	0.0498	0.0578	0.0402	0.0301
1979	0.0135	0.0048	0.0029	0.0028	0.0046	0.0049	0.0162	0.0234	0.0135	0.0164	0.0336	0.0265
1980	0.0167	0.0065	0.0019	0.0015	0.0026	0.0035	0.0073	0.0067	0.0103	0.0735	0.0511	0.0191
1981	0.0098	0.0053	0.0028	0.0021	0.0038	0.0059	0.0241	0.0212	0.0500	0.0254	0.0236	0.0197
1982	0.0102	0.0055	0.0027	0.0024	0.0036	0.0051	0.0212	0.0271	0.0350	0.0606	0.0377	0.0142
1983	0.0103	0.0035	0.0021	0.0016	0.0023	0.0034	0.0055	0.0071	0.0052	0.0088	0.0108	0.0075
1984	0.0047	0.0040	0.0019	0.0014	0.0018	0.0026	0.0045	0.0056	0.0078	0.0184	0.0296	0.0080
1985	0.0048	0.0023	0.0015	0.0015	0.0027	0.0033	0.0124	0.0129	0.0221	0.0357	0.0328	0.0117
1986	0.0056	0.0036	0.0021	0.0013	0.0024	0.0039	0.0080	0.0113	0.0150	0.0224	0.0115	0.0065
1987	0.0080	0.0027	0.0016	0.0014	0.0025	0.0036	0.0103	0.0102	0.0148	0.0335	0.0282	0.0124
1988	0.0067	0.0030	0.0018	0.0017	0.0024	0.0036	0.0113	0.0160	0.0528	0.0279	0.0304	0.0178
1989	0.0139	0.0060	0.0028	0.0020	0.0034	0.0042	0.0273	0.0385	0.0300	0.0419	0.0317	0.0180
1990	0.0174	0.0064	0.0036	0.0023	0.0039	0.0052	0.0113	0.0155	0.0502	0.0734	0.0300	0.0366
1991	0.0200	0.0058	0.0040	0.0027	0.0038	0.0064	0.0197	0.0170	0.0277	0.0577	0.0509	0.0359
1992	0.0178	0.0055	0.0032	0.0024	0.0036	0.0040	0.0152	0.0402	0.0245	0.0200	0.0181	0.0314
1993	0.0123	0.0053	0.0027	0.0018	0.0035	0.0038	0.0110	0.0251	0.0294	0.0199	0.0249	0.0144
1994	0.0084	0.0035	0.0021	0.0019	0.0032	0.0046	0.0142	0.0254	0.0446	0.0270	0.0410	0.0256
1995	0.0146	0.0055	0.0028	0.0021	0.0043	0.0074	0.0175	0.0154	0.0079	0.0114	0.0235	0.0132
1996	0.0069	0.0030	0.0022	0.0020	0.0028	0.0044	0.0111	0.0172	0.0179	0.0251	0.0146	0.0097
1997	0.0070	0.0029	0.0020	0.0019	0.0030	0.0042	0.0100	0.0149	0.0113	0.0283	0.0152	0.0104
1998	0.0063	0.0026	0.0015	0.0014	0.0024	0.0038	0.0073	0.0118	0.0162	0.0267	0.0180	0.0117
1999	0.0069	0.0028	0.0020	0.0016	0.0027	0.0046	0.0108	0.0098	0.0107	0.0181	0.0122	0.0089
2000	0.0059	0.0027	0.0016	0.0013	0.0023	0.0039	0.0098	0.0154	0.0228	0.0269	0.0283	0.0214
2001	0.0116	0.0045	0.0032	0.0023	0.0039	0.0057	0.0128	0.0213	0.0391	0.0293	0.0239	0.0166
2002	0.0129	0.0084	0.0028	0.0025	0.0047	0.0068	0.0222	0.0429	0.0552	0.0435	0.0730	0.0231
2003	0.0179	0.0086	0.0043	0.0039	0.0068	0.0101	0.0232	0.0356	0.0601	0.0901	0.0901	0.0564
2004	0.0443	0.0088	0.0053	0.0044	0.0061	0.0104	0.0419	0.0723	0.0995	0.0785	0.0797	0.0674
2005	0.0250	0.0078	0.0047	0.0042	0.0070	0.0109	0.0241	0.0406	0.0229	0.0926	0.0744	0.0463
2006	0.0194	0.0082	0.0049	0.0039	0.0079	0.0085	0.0297	0.0750	0.1064	0.1096	0.0858	0.0582
Avg	0.0127	0.0049	0.0027	0.0022	0.0037	0.0053	0.0151	0.0237	0.0329	0.0429	0.0379	0.0228
Max	0.0443	0.0088	0.0053	0.0044	0.0079	0.0109	0.0419	0.0750	0.1064	0.1096	0.0901	0.0674
Min	0.0047	0.0023	0.0015	0.0013	0.0018	0.0026	0.0045	0.0056	0.0052	0.0088	0.0108	0.0065
Std	0.0076	0.0019	0.0010	0.0008	0.0014	0.0021	0.0080	0.0163	0.0242	0.0259	0.0227	0.0153

% SEEP PER MILE

Reach **17** **Cozad Gage to Overton Gage** Length 28.1 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980								0.1567				
1981												
1982		0.0327		0.4881								
1983												
1984												
1985					0.0264							
1986							0.3403					
1987												
1988												
1989												
1990												
1991												
1992								0.4002	0.8725	0.5847	1.6785	0.9150
1993												0.1053
1994				0.0403								
1995									0.2250			
1996	0.0392											
1997	0.0135				0.0550	0.0306	0.1928	0.0246	0.0578		0.3394	
1998	0.2496					0.4485						
1999	0.0686	0.0103	0.3280	0.1025		0.2331		0.2120				
2000		0.0246										
2001				0.1303	0.4448							
2002			0.3277									
2003					0.1921							
2004												
2005												
2006												

% DIVERSION PER MILE

Reach 17 Cozad Gage to Overton Gage Length 28.1 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
1981												
1982												
1983												
1984												
1985												
1986												
1987												
1988												
1989												
1990												
1991												
1992												
1993												
1994												
1995												
1996												
1997												
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												
2006												
Avg												
Max												
Min												
Std												

% EVAP PER MILE

Reach **18** **Overton Gage to Odessa Gage** Length 15.7 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0316	0.0102	0.0058	0.0047	0.0081	0.0115	0.0216	0.0522	0.0309	0.0893	0.0711	0.0348
1976	0.0197	0.0085	0.0051	0.0038	0.0065	0.0105	0.0222	0.0484	0.1061	0.0953	0.1406	0.0454
1977	0.0225	0.0107	0.0058	0.0054	0.0088	0.0114	0.0180	0.0295	0.0583	0.1211	0.0643	0.0363
1978	0.0306	0.0106	0.0061	0.0058	0.0105	0.0095	0.0254	0.0449	0.1127	0.1241	0.0798	0.0683
1979	0.0287	0.0104	0.0065	0.0059	0.0096	0.0092	0.0308	0.0454	0.0201	0.0306	0.0578	0.0570
1980	0.0355	0.0125	0.0041	0.0031	0.0043	0.0062	0.0098	0.0063	0.0120	0.1222	0.0871	0.0420
1981	0.0209	0.0116	0.0061	0.0046	0.0083	0.0130	0.0481	0.0417	0.0937	0.0470	0.0415	0.0421
1982	0.0218	0.0114	0.0059	0.0058	0.0077	0.0109	0.0448	0.0536	0.0611	0.1035	0.0572	0.0300
1983	0.0186	0.0073	0.0042	0.0028	0.0042	0.0062	0.0083	0.0075	0.0032	0.0076	0.0115	0.0079
1984	0.0084	0.0083	0.0027	0.0019	0.0022	0.0031	0.0045	0.0051	0.0080	0.0250	0.0533	0.0117
1985	0.0064	0.0027	0.0019	0.0022	0.0038	0.0049	0.0254	0.0265	0.0428	0.0583	0.0466	0.0213
1986	0.0113	0.0074	0.0040	0.0025	0.0041	0.0072	0.0110	0.0164	0.0210	0.0356	0.0189	0.0092
1987	0.0112	0.0047	0.0031	0.0026	0.0048	0.0063	0.0158	0.0152	0.0217	0.0486	0.0493	0.0237
1988	0.0126	0.0060	0.0037	0.0032	0.0040	0.0072	0.0208	0.0279	0.1127	0.0451	0.0557	0.0389
1989	0.0302	0.0132	0.0063	0.0040	0.0069	0.0084	0.0552	0.0809	0.0499	0.0792	0.0566	0.0345
1990	0.0374	0.0142	0.0079	0.0050	0.0084	0.0103	0.0231	0.0249	0.0884	0.1264	0.0656	0.0807
1991	0.0439	0.0111	0.0068	0.0059	0.0082	0.0141	0.0402	0.0307	0.0504	0.1058	0.1059	0.0818
1992	0.0408	0.0121	0.0070	0.0050	0.0078	0.0080	0.0329	0.0984	0.0691	0.0423	0.0596	0.0773
1993	0.0272	0.0117	0.0058	0.0038	0.0061	0.0059	0.0214	0.0488	0.0519	0.0262	0.0395	0.0278
1994	0.0183	0.0076	0.0045	0.0039	0.0062	0.0095	0.0306	0.0566	0.0858	0.0434	0.0728	0.0513
1995	0.0292	0.0116	0.0060	0.0045	0.0091	0.0140	0.0366	0.0229	0.0071	0.0128	0.0329	0.0265
1996	0.0137	0.0063	0.0047	0.0042	0.0055	0.0087	0.0222	0.0319	0.0317	0.0450	0.0267	0.0150
1997	0.0114	0.0057	0.0039	0.0034	0.0053	0.0086	0.0194	0.0291	0.0135	0.0416	0.0219	0.0192
1998	0.0098	0.0038	0.0025	0.0022	0.0041	0.0067	0.0108	0.0202	0.0303	0.0478	0.0344	0.0256
1999	0.0152	0.0059	0.0043	0.0029	0.0057	0.0090	0.0207	0.0130	0.0131	0.0287	0.0195	0.0141
2000	0.0091	0.0048	0.0031	0.0023	0.0040	0.0066	0.0175	0.0284	0.0428	0.0478	0.0568	0.0479
2001	0.0256	0.0095	0.0069	0.0051	0.0086	0.0108	0.0230	0.0340	0.0754	0.0529	0.0424	0.0339
2002	0.0257	0.0164	0.0063	0.0054	0.0093	0.0135	0.0446	0.0906	0.1180	0.0921	0.1207	0.0505
2003	0.0401	0.0194	0.0097	0.0089	0.0148	0.0221	0.0515	0.0609	0.0963	0.1151	0.1044	0.1214
2004	0.1026	0.0206	0.0123	0.0101	0.0138	0.0236	0.0927	0.1439	0.1783	0.1273	0.1216	0.1296
2005	0.0591	0.0181	0.0105	0.0075	0.0144	0.0214	0.0469	0.0571	0.0385	0.1192	0.0894	0.0907
2006	0.0416	0.0178	0.0108	0.0088	0.0178	0.0189	0.0570	0.1165	0.1354	0.1417	0.0834	0.0993
Avg	0.0269	0.0104	0.0058	0.0046	0.0076	0.0105	0.0298	0.0440	0.0588	0.0703	0.0622	0.0467
Max	0.1026	0.0206	0.0123	0.0101	0.0178	0.0236	0.0927	0.1439	0.1783	0.1417	0.1406	0.1296
Min	0.0064	0.0027	0.0019	0.0019	0.0022	0.0031	0.0045	0.0051	0.0032	0.0076	0.0115	0.0079
Std	0.0184	0.0045	0.0024	0.0020	0.0036	0.0049	0.0180	0.0318	0.0428	0.0394	0.0316	0.0313

% SEEP PER MILE

Reach **18** **Overton Gage to Odessa Gage** Length 15.7 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975		0.6520	0.2095		0.1043	0.2063	0.0101		0.0727			0.7529
1976	0.9291	1.2195	1.0255	1.0021	0.4467	0.2985	0.3650					0.1641
1977	0.0442	1.0920	0.2384	0.2338	0.4978		0.7329					0.4988
1978		0.0852	0.7870		0.2519				0.0484			0.1233
1979	0.8301	0.7010	0.0945						0.3565			
1980	0.2184		0.0302	0.3549								0.3941
1981	0.4626	0.6857			0.1404	0.4152						0.7824
1982			0.0851			0.4052						
1983		0.8729	0.6962	0.0280					0.2305		0.0520	0.4428
1984	0.0512	0.2084	0.0723	0.0373		0.0964		0.1652	0.0261			0.0664
1985	0.3171	0.4734	0.1676		0.2002	0.1289		0.0126				
1986		0.7581		0.1517					0.4130			
1987		0.3657	0.2644	0.1085								
1988			0.0758		0.2064							
1989	0.9034		0.0976									
1990		0.5384		0.1001	0.1468						0.0933	0.5019
1991	0.6422			0.7588	0.1905	0.1990						
1992	0.3265	0.0040			0.0498	0.2267						
1993	0.3415	0.6201	0.7018	0.4682								
1994	0.1684		0.0179									
1995				0.5383								0.0876
1996		0.5316	0.6363	0.0886	0.2454	0.5839						
1997						0.0178						0.1590
1998			0.2119		0.2216		0.2838					0.4979
1999	0.4043	0.4258										
2000			0.0886									0.1328
2001	0.5901											
2002												0.9425
2003	0.0659	1.6610	0.9319	0.5700								
2004		0.6694	0.5649	0.1843	0.4490	0.1676						
2005	0.3528	0.3272										
2006	1.0871	1.6665	1.7019	0.8770	1.4576	0.0197						

% DIVERSION PER MILE

Reach **18** **Overton Gage to Odessa Gage** Length 15.7 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	1.2674	0.9841	0.0731			0.0892	0.6847	1.4358	1.1315	3.3059	2.9789	0.9157
1976	1.5850	0.7045				0.1737	0.9803	0.8138	2.3990	3.1585	4.6572	1.9518
1977	1.5700	0.7032				0.4412	0.7411	0.9215	2.0181	4.0427	3.7402	1.8480
1978	1.2261	0.3029					0.3983	1.4686	3.6300	2.7367	3.7627	2.8313
1979	1.7728	0.9125					0.3934	2.0227	0.6398	1.1498	3.0292	3.1102
1980	3.3932	0.3212					0.1443	0.1904	0.3315	4.2102	3.1347	2.3311
1981	2.3957	1.7283				0.2061	2.2264	2.2170	3.7660	1.4802	2.2482	2.3065
1982	0.7610						0.4728	1.2879	3.1227	4.3368	3.5652	1.9485
1983	0.1269						0.4101	0.2078	0.0984	0.1672	0.3332	0.2459
1984	0.3525	0.0065					0.0001	0.0419	0.1456	0.7626	2.4035	0.5357
1985	0.4204	0.2120					0.3800	0.4999	0.7683	2.4355	1.9968	1.1154
1986	1.0119	0.6720					0.1070	0.5460	0.6161	1.2897	0.7878	0.4329
1987	0.3849	0.1699					0.0806	0.4161	0.4929	1.2763	1.8659	0.7654
1988	0.7830	0.8018	0.3094			0.0621	0.4531	0.7486	2.6651	1.0236	1.4331	1.3857
1989	0.3496						0.6335	3.2836	1.2605	2.1594	2.2670	1.3525
1990	1.2909						0.1375	0.9571	3.3263	4.8582	2.1522	3.2321
1991	1.6186	0.0337					0.3252	0.4887	0.6111	2.3150	2.2409	1.2364
1992							0.1242	2.4719	2.3700	0.9176	1.0576	1.4867
1993	0.1704							0.1395	0.6948	0.2060	0.6141	0.4282
1994								0.0336	1.3136	0.9816	2.2136	0.7555
1995		0.4262						0.5434	0.1614	0.3146	1.1517	0.6122
1996								0.3813	0.6625	0.9540	0.5652	0.3753
1997	0.5674	0.5321					0.4302	0.9418	0.2624	1.3886	0.7966	0.8074
1998	0.2737	0.0017					0.2424	0.5851	0.7237	1.6690	1.3821	0.7138
1999	0.4581					0.2263	0.6394	0.1005	0.1394	0.4795	0.4091	0.3317
2000	0.2380	0.1363			0.0131		0.1623	0.5058	0.7834	0.8502	1.4461	1.3050
2001	0.7702							0.0512	1.5916	1.8806	1.8329	1.7126
2002	2.0328	1.9948					0.3044	2.9033	1.5254	2.2503	4.7793	2.5244
2003	2.4690							1.7854	4.5031	5.6744	6.0816	4.5512
2004								1.0973	5.6378	4.7396	5.5632	4.3365
2005	0.0011					0.2585	2.3655	2.8818	1.1514	5.0985	5.0904	5.4614
2006	3.3099	1.9225				0.6455	3.4599	5.7222	6.0631	6.1520	4.4899	5.8723
Avg	0.9563	0.3927	0.0120		0.0004	0.0657	0.5093	1.1779	1.7064	2.3208	2.5022	1.8381
Max	3.3932	1.9948	0.3094		0.0131	0.6455	3.4599	5.7222	6.0631	6.1520	6.0816	5.8723
Min								0.0336	0.0984	0.1672	0.3332	0.2459
Std	0.9483	0.5692	0.0549		0.0023	0.1453	0.7626	1.2150	1.5954	1.7008	1.5713	1.4776

% EVAP PER MILE

Reach **19** **Odessa Gage to Grand Island Gage** Length 56.2 miles

% Evap = Evap divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.0280	0.0100	0.0050	0.0039	0.0069	0.0087	0.0177	0.0406	0.0252	0.0727	0.0747	0.0314
1976	0.0205	0.0090	0.0041	0.0037	0.0051	0.0084	0.0192	0.0375	0.1104	0.1076	0.1817	0.0391
1977	0.0204	0.0111	0.0050	0.0047	0.0075	0.0095	0.0140	0.0228	0.0416	0.1527	0.0688	0.0358
1978	0.0270	0.0091	0.0059	0.0049	0.0092	0.0043	0.0179	0.0371	0.1138	0.1469	0.0927	0.0657
1979	0.0295	0.0102	0.0055	0.0050	0.0080	0.0057	0.0196	0.0290	0.0172	0.0248	0.0596	0.0526
1980	0.0340	0.0109	0.0033	0.0026	0.0035	0.0043	0.0077	0.0048	0.0090	0.1112	0.1016	0.0400
1981	0.0202	0.0112	0.0051	0.0038	0.0070	0.0105	0.0415	0.0375	0.1026	0.0422	0.0310	0.0434
1982	0.0190	0.0094	0.0048	0.0047	0.0054	0.0077	0.0358	0.0338	0.0465	0.1002	0.0662	0.0271
1983	0.0161	0.0069	0.0034	0.0022	0.0034	0.0050	0.0066	0.0058	0.0025	0.0058	0.0091	0.0065
1984	0.0066	0.0066	0.0021	0.0013	0.0016	0.0024	0.0034	0.0040	0.0061	0.0172	0.0519	0.0093
1985	0.0052	0.0022	0.0015	0.0018	0.0029	0.0036	0.0170	0.0180	0.0358	0.0585	0.0433	0.0179
1986	0.0082	0.0068	0.0032	0.0021	0.0032	0.0055	0.0087	0.0134	0.0184	0.0317	0.0157	0.0073
1987	0.0090	0.0039	0.0026	0.0021	0.0038	0.0044	0.0116	0.0123	0.0157	0.0447	0.0462	0.0196
1988	0.0105	0.0050	0.0032	0.0026	0.0031	0.0059	0.0183	0.0230	0.0994	0.0412	0.0520	0.0340
1989	0.0269	0.0105	0.0051	0.0034	0.0057	0.0068	0.0491	0.0820	0.0451	0.0438	0.0552	0.0220
1990	0.0275	0.0103	0.0067	0.0028	0.0060	0.0073	0.0192	0.0199	0.0674	0.1602	0.0664	0.0920
1991	0.0448	0.0096	0.0058	0.0057	0.0064	0.0114	0.0365	0.0262	0.0353	0.1173	0.1131	0.0757
1992	0.0379	0.0104	0.0059	0.0041	0.0062	0.0066	0.0258	0.0986	0.0592	0.0385	0.0563	0.0762
1993	0.0246	0.0111	0.0053	0.0034	0.0050	0.0036	0.0158	0.0297	0.0399	0.0172	0.0306	0.0218
1994	0.0142	0.0057	0.0036	0.0032	0.0050	0.0056	0.0216	0.0483	0.0621	0.0354	0.0724	0.0463
1995	0.0257	0.0107	0.0051	0.0036	0.0073	0.0107	0.0225	0.0177	0.0054	0.0089	0.0265	0.0228
1996	0.0111	0.0052	0.0042	0.0035	0.0046	0.0067	0.0171	0.0196	0.0172	0.0310	0.0208	0.0123
1997	0.0091	0.0044	0.0032	0.0028	0.0044	0.0062	0.0145	0.0225	0.0107	0.0345	0.0187	0.0164
1998	0.0080	0.0030	0.0021	0.0017	0.0030	0.0053	0.0084	0.0138	0.0196	0.0394	0.0262	0.0233
1999	0.0122	0.0040	0.0033	0.0023	0.0043	0.0071	0.0146	0.0092	0.0096	0.0209	0.0143	0.0112
2000	0.0073	0.0038	0.0024	0.0019	0.0032	0.0054	0.0145	0.0224	0.0343	0.0434	0.0548	0.0436
2001	0.0233	0.0079	0.0059	0.0036	0.0060	0.0076	0.0182	0.0246	0.0600	0.0485	0.0390	0.0299
2002	0.0214	0.0142	0.0049	0.0041	0.0080	0.0115	0.0372	0.0722	0.1235	0.0933	0.1461	0.0536
2003	0.0382	0.0236	0.0100	0.0066	0.0130	0.0184	0.0412	0.0408	0.0910	0.1695	0.0008	0.0006
2004	0.0004	0.0200	0.0086	0.0092	0.0120	0.0177	0.0830	0.1592	0.2387	0.1761	0.1466	0.0008
2005	0.1014	0.0260	0.0150	0.0106	0.0191	0.0314	0.0615	0.0513	0.0411	0.3598	0.1323	0.1931
2006	0.0461	0.0215	0.0093	0.0078	0.0173	0.0174	0.0439	0.1448	0.2205	0.0936	0.1034	0.1187
Avg	0.0229	0.0098	0.0050	0.0039	0.0065	0.0085	0.0245	0.0382	0.0570	0.0778	0.0631	0.0403
Max	0.1014	0.0260	0.0150	0.0106	0.0191	0.0314	0.0830	0.1592	0.2387	0.3598	0.1817	0.1931
Min	0.0004	0.0022	0.0015	0.0013	0.0016	0.0024	0.0034	0.0040	0.0025	0.0058	0.0008	0.0006
Std	0.0182	0.0057	0.0027	0.0021	0.0039	0.0057	0.0171	0.0362	0.0563	0.0709	0.0437	0.0383

% SEEP PER MILE

Reach **19** **Odessa Gage to Grand Island Gage** Length 56.2 miles

% Seep = Seep divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975	0.2666	0.2434	0.4072	0.2251	0.1382						0.4637	
1976	0.3405	0.1561		0.2015					0.2759	0.9518	1.3683	0.9573
1977	0.2292	0.1427	0.3839	0.3205						0.4382	0.5168	
1978	0.1870	0.2600	0.1442	0.4968						0.9512	0.7961	0.9156
1979	0.4337	0.2415	0.2297	0.3410	0.4217				0.4159		0.3587	0.7015
1980	0.4552	0.2993		0.3853	0.0936		0.0395	0.2426			0.1920	0.6221
1981	0.3152	0.3176	0.2023	0.3026	0.2667				0.2928	0.6775		0.5441
1982	0.2859										0.0336	0.4714
1983		0.0709		0.2305	0.0916	0.0447	0.1619		0.1185	0.1095	0.1612	0.1976
1984						0.0082	0.0324		0.0649		0.5319	0.2977
1985	0.1862	0.0245	0.0975	0.2854								
1986				0.0411			0.3029	0.0051	0.0337	0.1491	0.3720	0.2638
1987	0.1225		0.0998	0.1676	0.0975			0.0638			0.3941	0.4372
1988	0.3702	0.1445	0.3227	0.2900		0.0814	0.1259	0.1497		0.2006	0.1922	0.2818
1989				0.0945	0.0826	0.1559		0.0912			0.2422	
1990			0.3194				0.0024			0.5663	0.1041	0.4685
1991	0.2442	0.3462	0.5582	0.2007			0.1698	0.1611		1.0087	0.8704	0.8192
1992	0.5798	0.1019	0.1310					0.1482		0.3107	0.5846	0.4392
1993	0.1312			0.4136	0.6159							
1994				0.2924	0.3213							0.4433
1995			0.0716									0.1210
1996				0.2765	0.3808							0.1342
1997			0.2363	0.2142	0.1418				0.1282		0.1305	0.0844
1998	0.0044	0.1742	0.0916									0.0587
1999												0.2318
2000	0.1953			0.0995	0.1229	0.0259	0.0078			0.0123	0.2863	0.5477
2001			0.1187							0.5008	0.3010	0.2038
2002					0.1073	0.0745			0.7163	1.1980	1.5880	0.9414
2003	0.2637	0.1180	0.0774							0.6972	1.7785	1.7787
2004	1.7789	1.0083							1.2403	0.7771	1.6320	1.7786
2005	1.1056	0.3734	0.2468	0.4955		0.0369			0.3815	0.1872	1.0703	0.7566
2006	0.9444					0.1563			0.5671	1.6377	1.1215	0.6409

% DIVERSION PER MILE

Reach 19 Odessa Gage to Grand Island Gage Length 56.2 miles

% Div = Diversions divided by Total Inflow to the Reach multiplied by 100

Wtr Yr	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1975												
1976												
1977												
1978												
1979												
1980												
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2004												
2005												
2006												
Avg												
Max												
Min												
Std												

WATER MANAGEMENT STUDY, PHASE I
EVALUATION OF PULSE FLOWS FOR THE PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

Phase I Report
April 8, 2008

APPENDIX 3

Routing Tool Analysis Results

WY	Year Class	Scenario	Total McConaughy Release (af)	Total EA at Overton (af)*	Peak EA Flow at Overton (cfs)	Peak 3-Day Total (af)	# Days > 5,000 EA (cfs)	# Days > 6,000 total (cfs)	# Days > 800 EA (cfs)	Total EA Irr Season (af)	Shortage on Peak Day (cfs)	Target Vol Short (af)	Days of Year	Typical reasons for short to target flow
1947	Average	5000-I	85493	82274	5221	22495	1	8	14		-221	7258	4/9-4/27	North Platte River, North Platte Hydro
1947	Average	5000-II	38115	42264	2521	14339	0	8	8		2479	15413	12/6-12/20	North Platte River
1947	Average	800-I	343483	246608	816	4792	0	11	135	239531	-16	3250		Sutherland Canal
1947	Average	800-II	343606	248033	800	4760	0	11	131	236966	0	5814		North Platte River
1948	Average	5000-I	107431	101159	5651	25682	1	1	20		-651	4070	1/26-2/15	North Platte River, Sutherland Canal
1948	Average	5000-II	37427	41710	2636	14151	0	0	9		2364	15601	2/1-2/15	North Platte River
1948	Average	800-I	338503	242499	800	4760	0	0	141	235281	0	7500		Korty Div, North Platte River
1948	Average	800-II	339031	243024	800	4760	0	0	141	234952	0	7828		North Platte River
1949	Average	5000-I	94511	90561	3942	21483	0	15	16		1058	8269	1/28-2/17	Sutherland Canal, North Platte Hydro, North Platte River
1949	Average	5000-II	44782	47980	2619	15424	0	15	9		2381	14328	12/25-1/9	North Platte River
1949	Average	800-I	345177	248485	812	4785	0	15	141	238791	-12	3989		North Platte River, North Platte Hydro, Keystone Ramp
1949	Average	800-II	343109	247390	800	4760	0	15	141	238012	0	4769		North Platte River
1950	Average	5000-I	115729	104939	4724	21847	0	0	21		276	7905	4/9-4/30	North Platte River, CNPPID Div
1950	Average	5000-II	39923	43814	2494	14528	0	0	9		2506	15225	12/2-12/16	North Platte River
1950	Average	800-I	351213	252924	807	4775	0	0	151	242746	-7	35		Keystone Ramp, North Platte Ramp
1950	Average	800-II	351999	253949	800	4760	0	0	155	242780	0	0		
1951	Average	5000-I	109990	93122	3833	20356	0	1	19		1167	9397	4/18-4/30	North Platte Hydro, North Platte Hydro, North Platte River
1951	Average	5000-II	32351	37321	2483	13461	0	1	7		2517	16291	1/16-1/29	North Platte River
1951	Average	800-I	348532	251083	808	4775	0	1	149	242294	-8	487		Sutherland Canal, Keystone Div, North Platte Ramp
1951	Average	800-II	345537	249375	800	4760	0	1	148	238390	0	4391		North Platte River, North Platte Ramp
1952	Wet	5000-I	90863	87766	3419	17659	0	0	18		1581	12094	4/3-4/14	North Platte River
1952	Wet	5000-II	44207	47910	2543	15081	0	0	9		2457	14672	12/3-12/18	North Platte River
1952	Wet	800-I	345088	247631	800	4760	0	0	131	237998	0	4783		Sutherland Canal
1952	Wet	800-II	310210	223450	800	4760	0	0	113	213824	0	28956		North Platte River
1953	Average	5000-I	119308	111815	4517	20922	0	1	20		483	8831	2/10-2/24	North Platte River, North Platte Hydro
1953	Average	5000-II	38505	42598	2594	14814	0	0	8		2406	14939	2/10-2/24	North Platte River
1953	Average	800-I	348159	251099	808	4775	0	0	146	240769	-8	2011		Sutherland Canal, North Platte River
1953	Average	800-II	348813	251648	800	4760	0	0	148	240822	0	1958		North Platte Ramp, North Platte River
1954	Dry	5000-I	70905	68161	4695	21810	0	0	12		305	7943	4/10-4/27	Keystone Div, North Platte Hydro, North Platte River
1954	Dry	5000-II	55370	55373	2514	14927	0	0	11		2486	14825	4/3-4/20	North Platte River
1954	Dry	800-I	574306	240193	800	4760	0	0	110	229125	0	13655		Sutherland Canal, North Platte River
1954	Dry	800-II	575394	241423	800	4760	0	0	111	229223	0	13557		North Platte River
1955	Dry	5000-I	98171	89551	5094	22404	1	0	15		-94	7349	4/8-4/30	North Platte Hydro, North Platte River
1955	Dry	5000-II	38240	40686	2645	14586	0	0	8		2355	15166	2/7-2/21	North Platte River
1955	Dry	800-I	576248	241193	807	4774	0	0	105	229995	-7	12786		Sutherland Canal, North Platte River
1955	Dry	800-II	576880	241188	800	4760	0	0	113	230576	0	12205		North Platte River
1956	Dry	5000-I	120006	110601	4975	26191	0	1	20		25	3562	3/10-3/30	Keystone Div, North Platte River
1956	Dry	5000-II	32632	35917	2530	13701	0	0	7		2470	16052	12/8-12/21	North Platte Ramp
1956	Dry	800-I	589632	245281	806	4772	0	0	115	235289	-6	7491		Sutherland Canal, North Platte River
1956	Dry	800-II	588888	245322	800	4760	0	0	110	234204	0	8577		North Platte River
1957	Dry	5000-I	51304	51743	5000	22499	0	2	7		0	7253	3/29-4/10	Sutherland Canal, North Platte River
1957	Dry	5000-II	44302	45884	2555	15031	0	2	9		2445	14722	12/30-1/14	North Platte River
1957	Dry	800-I	582428	243547	808	4775	0	4	114	232360	-8	10420		Sutherland Canal, North Platte River
1957	Dry	800-II	582963	243630	800	4760	0	4	118	233038	0	9742		North Platte Ramp
1958	Average	5000-I	95143	91076	4586	21732	0	1	15		414	8021	2/17-3/8	Sutherland Canal, North Platte River
1958	Average	5000-II	38136	42281	2631	14493	0	0	8		2369	15259	2/16-3/2	North Platte River
1958	Average	800-I	342493	245504	815	4790	0	1	130	235565	-15	7215		Ramp rates in Keystone Div, North Platte River
1958	Average	800-II	340350	245746	800	4760	0	1	142	234681	0	8100		North Platte River
1959	Dry	5000-I	59166	58203	4588	21581	0	0	9		412	8171	2/22-3/8	Sutherland Canal, North Platte River
1959	Dry	5000-II	43556	45244	2429	14406	0	0	9		2571	15347	12/13-12/28	North Platte River
1959	Dry	800-I	589619	246433	818	4784	0	0	113	235268	-18	7513		Sutherland Canal, North Platte River
1959	Dry	800-II	589566	247105	800	4760	0	0	127	234982	0	7799		North Platte River
1960	Average	5000-I	47938	50671	5173	21794	1	2	7		-173	7959	2/25-3/9	North Platte River, Sutherland Canal
1960	Average	5000-II	44217	47531	2585	15218	0	2	9		2415	14535	11/2-11/17	North Platte River
1960	Average	800-I	350584	251140	839	4838	0	2	145	242615	-39	165		North Platte Hydro
1960	Average	800-II	351760	252230	800	4760	0	2	152	242697	0	84		North Platte River

WY	Year Class	Scenario	Total McConaughy Release (af)	Total EA at Overton (af)*	Peak EA Flow at Overton (cfs)	Peak 3-Day Total (af)	# Days > 5,000 EA (cfs)	# Days > 6,000 total (cfs)	# Days > 800 EA (cfs)	Total EA Irr Season (af)	Shortage on Peak Day (cfs)	Target Vol Short (af)	Days of Year	Typical reasons for short to target flow
1961	Dry	5000-I	64278	57406	4827	21982	0	0	9		173	7770	4/14-4/28	North Platte River, Sutherland Canal
1961	Dry	5000-II	32647	35891	2537	13712	0	0	7		2463	16040	1/15-1/28	North Platte River
1961	Dry	800-I	580674	242817	803	4760	0	0	117	231671	-3	11110		Sutherland Canal, North Platte River
1961	Dry	800-II	581083	243681	800	4760	0	0	121	231556	0	11224		North Platte River
1962	Average	5000-I	56384	57271	4837	21663	0	1	11		163	8090	4/13-4/27	North Platte River, Sutherland Canal
1962	Average	5000-II	32661	37587	2546	13729	0	1	7		2454	16023	12/31-1/13	North Platte River
1962	Average	800-I	348557	251036	808	4775	0	2	143	240980	-8	1800		North Platte River, North Platte Hydro
1962	Average	800-II	345200	249153	800	4760	0	2	147	238089	0	4692		North Platte River
1963	Average	5000-I	66688	65335	4572	21301	0	0	11		428	8452	4/15-4/30	Keystone Div, North Platte River
1963	Average	5000-II	32474	37427	2492	13720	0	0	7		2508	16033	2/10-2/23	North Platte River
1963	Average	800-I	340209	245163	800	4760	0	0	140	235152	0	7629		System Full
1963	Average	800-II	340827	246093	800	4760	0	0	140	234961	0	7819		North Platte River
1964	Dry	5000-I	53755	53780	5262	23133	1	1	10		-262	6619	4/11-4/24	North Platte River, Sutherland Canal
1964	Dry	5000-II	43498	45234	2559	14495	0	0	9		2441	15257	1/25-2/9	North Platte River
1964	Dry	800-I	589712	245752	803	4766	0	0	116	235354	-3	7427		System Full, North Platte River
1964	Dry	800-II	585471	243451	800	4760	0	0	121	233267	0	9514		North Platte River
1965	Average	5000-I	78430	76739	4803	23328	0	6	14		197	6425	3/5-3/20	Sutherland Canal, North Platte River
1965	Average	5000-II	32626	37557	2530	13704	0	6	7		2470	16049	12/6-12/19	North Platte River
1965	Average	800-I	346389	249401	845	4850	0	7	132	239307	-45	3474		North Platte Hydro
1965	Average	800-II	349248	251999	800	4760	0	7	151	240924	0	1856		North Platte Ramp
1966	Average	5000-I	54001	55853	4304	21803	0	1	9		696	7949	1/23-2/6	Sutherland Canal, North Platte River
1966	Average	5000-II	43546	46920	2483	14540	0	0	10		2517	15213	2/9-2/22	North Platte River
1966	Average	800-I	342975	247628	838	4835	0	0	132	238232	-38	4548		Keystone Div, North Platte River
1966	Average	800-II	344676	248793	800	4760	0	0	139	237683	0	5098		North Platte River
1967	Average	5000-I	51280	53427	5003	21951	1	0	9		-3	7801	4/8-4/22	North Platte Hydro, North Platte River
1967	Average	5000-II	32803	37709	2537	13742	0	0	7		2463	16010	1/8-1/21	North Platte River
1967	Average	800-I	347865	248945	825	4816	0	1	132	238600	-25	4180		Sutherland Canal
1967	Average	800-II	350373	252844	800	4760	0	1	148	241462	0	1318		North Platte Ramp
1968	Average	5000-I	68363	66751	4631	23420	0	0	8		369	6333	4/15-4/30	North Platte Hydro, North Platte River
1968	Average	5000-II	32460	37451	2481	13686	0	0	7		2519	16067	4/17-4/30	North Platte River
1968	Average	800-I	345174	248093	845	4850	0	0	126	237974	-45	4806		North Platte Hydro, North Platte Ramp
1968	Average	800-II	344276	246973	800	4760	0	0	142	237437	0	5344		North Platte Ramp
1969	Average	5000-I	56265	57161	4796	21769	0	3	9		204	7984	4/14-4/27	North Platte Hydro, North Platte River
1969	Average	5000-II	44108	47401	2512	14875	0	3	9		2488	14878	12/20-1/4	North Platte River
1969	Average	800-I	347375	250207	826	4812	0	4	140	240143	-26	2637		Sutherland Canal, North Platte Ramp
1969	Average	800-II	351071	253193	800	4760	0	4	149	242595	0	185		North Platte Ramp
1970	Average	5000-I	59088	59852	3340	16596	0	7	12		1660	13156	4/6-4/24	Sutherland Canal, North Platte River - no Keystone Div.
1970	Average	5000-II	44354	47613	2542	15072	0	7	9		2458	14681	12/28-1/10	North Platte River
1970	Average	800-I	325529	235011	826	4812	0	9	128	223939	-26	18841		North Platte Ramp, Sutherland Canal, North Platte River
1970	Average	800-II	325105	235036	800	4760	0	9	136	223970	0	18811		North Platte Ramp, North Platte River
1971	Wet	5000-I	43750	47340	3985	18732	0	59	9		1015	11021	4/3-4/17	Sutherland Canal, North Platte River
1971	Wet	5000-II	38387	42886	2528	14571	0	59	8		2472	15181	12/26-1/9	North Platte River
1971	Wet	800-I	214579	156444	844	4912	0	59	66	148698	-44	94082		Keystone Div, North Platte River
1971	Wet	800-II	212115	155176	800	4760	0	59	84	148699	0	94082		North Platte River
1972	Average	5000-I	58555	59626	4294	21374	0	0	11		706	8378	4/13-4/26	Sutherland Canal, North Platte River
1972	Average	5000-II	43735	47118	2483	14633	0	0	9		2517	15119	1/14-1/29	North Platte River
1972	Average	800-I	344388	246665	865	4895	0	0	116	238193	-65	4588		North Platte Hydro
1972	Average	800-II	319091	228974	800	4760	0	0	125	221023	0	21757		North Platte River
1973	Wet	5000-I	56936	57906	3535	20366	0	65	10		1465	9386	4/9-4/24	North Platte Hydro, North Platte River
1973	Wet	5000-II	43573	47333	2458	14427	0	62	9		2542	15325	12/19-1/3	North Platte River
1973	Wet	800-I	172416	131880	800	4760	0	62	27	118932	0	123848		Sutherland Canal, North Platte River
1973	Wet	800-II	110171	88166	800	4760	0	62	29	75219	0	167562		North Platte River
1974	Wet	5000-I	40737	38483	2316	12849	0	66	8		2684	16903	5/17-5/31	Keystone Div, North Platte River
1974	Wet	5000-II	54045	47797	2239	13244	0	66	10		2761	16508	5/15-5/31	North Platte River
1974	Wet	800-I	343699	247414	897	4962	0	66	122	238878	-97	3902		Keystone Div, North Platte River
1974	Wet	800-II	342044	246862	800	4760	0	66	137	238326	0	4454		North Platte River
1975	Average	5000-I	48514	51076	4365	20303	0	0	9		635	9449	4/5-4/18	Sutherland Canal, North Platte River
1975	Average	5000-II	43835	47168	2501	14790	0	0	9		2499	14962	1/26-2/10	North Platte River
1975	Average	800-I	339835	244910	826	4812	0	0	138	234847	-26	7933		North Platte Ramp, Keystone Div, North Platte Hydro
1975	Average	800-II	343001	247608	800	4760	0	0	144	236542	0	6238		North Platte River
1976	Average	5000-I	60926	61774	4471	21366	0	0	11		529	8386	3/17-4/2	North Platte Hydro, North Platte River
1976	Average	5000-II	43706	47093	2481	14651	0	0	9		2519	15101	4/2-4/17	North Platte River
1976	Average	800-I	329869	236812	819	4799	0	0	119	227151	-19	15629		North Platte River, Sutherland Canal
1976	Average	800-II	316188	227237	800	4760	0	0	112	217719	0	25061		North Platte River

WY	Year Class	Scenario	Total McConaughy Release (af)	Total EA at Overton (af)*	Peak EA Flow at Overton (cfs)	Peak 3-Day Total (af)	# Days > 5,000 EA (cfs)	# Days > 6,000 total (cfs)	# Days > 800 EA (cfs)	Total EA Irr Season (af)	Shortage on Peak Day (cfs)	Target Vol Short (af)	Days of Year	Typical reasons for short to target flow
1977	Average	5000-I	76449	74155	4471	22485	0	1	13		529	7267	4/1-4/17	Sutherland Canal, North Platte River
1977	Average	5000-II	37937	42111	2538	14317	0	0	8		2462	15435	3/1-3/15	North Platte River
1977	Average	800-I	339498	244672	819	4792	0	0	136	234616	-19	8164		North Platte River, Keystone Div.
1977	Average	800-II	337067	243148	800	4760	0	0	134	233756	0	9025		North Platte River
1978	Dry	5000-I	108058	100466	4869	25230	0	1	18		131	4523	3/25-4/13	Sutherland Canal, North Platte Hydro, North Platte River
1978	Dry	5000-II	43636	45313	2465	14630	0	0	9		2535	15123	4/14-4/29	North Platte River
1978	Dry	800-I	564306	236168	826	4811	0	0	103	225166	-26	17614		Keystone Div, North Platte River
1978	Dry	800-II	564855	237129	800	4760	0	0	114	225005	0	17776		North Platte River
1979	Average	5000-I	87459	84386	4947	24282	0	6	15		53	5471	4/5-4/22	Sutherland Canal, North Platte River
1979	Average	5000-II	43773	47114	2483	14737	0	5	9		2517	15016	1/23-2/7	North Platte River
1979	Average	800-I	348972	251324	851	4895	0	8	140	241287	-51	1493		North Platte Hydro, North Platte Ramp
1979	Average	800-II	351757	253760	800	4760	0	8	151	242694	0	86		North Platte Ramp
1980	Wet	5000-I	57770	58868	3689	21200	0	41	10		1311	8552	1/22-2/6	Sutherland Canal, North Platte Hydro, North Platte River
1980	Wet	5000-II	44003	47735	2510	14759	0	40	9		2490	14994	12/27-1/11	North Platte River
1980	Wet	800-I	342203	246144	817	4804	0	47	125	237724	-17	5056		North Platte Ramp, Sutherland Canal
1980	Wet	800-II	340298	244206	800	4760	0	46	121	236322	0	6459		North Platte River, North Platte Ramp
1981	Average	5000-I	71793	69469	5358	22344	1	0	11		-358	7408	4/17-4/30	Sutherland Canal, North Platte River
1981	Average	5000-II	44211	47490	2555	15113	0	0	9		2445	14640	1/30-2/14	North Platte River
1981	Average	800-I	348427	250941	808	4775	0	0	139	240904	-8	1877		North Platte Ramp
1981	Average	800-II	350385	252796	800	4760	0	0	147	241729	0	1051		North Platte River, North Platte Ramp
1982	Dry	5000-I	108102	95601	5427	25205	1	1	16		-427	4547	4/9-4/28	Keystone Div, North Platte River
1982	Dry	5000-II	44188	45786	2537	15065	0	0	9		2463	14688	4/13-4/28	North Platte River
1982	Dry	800-I	575589	240781	800	4760	0	0	114	229595	0	13186		System Full
1982	Dry	800-II	558222	234451	800	4760	0	0	113	222327	0	20454		North Platte River, North Platte Ramp
1983	Wet	5000-I	48924	51871	3934	19017	0	142	10		1066	10736	1/25-2/9	North Platte Hydro, North Platte River
1983	Wet	5000-II	44044	47737	2492	14812	0	140	9		2508	14940	1/6-1/21	North Platte River
1983	Wet	800-I	98185	75923	800	4760	0	142	35	64857	0	177923		System Full
1983	Wet	800-II	84853	69229	800	4760	0	141	36	58163	0	184617		North Platte River
1984	Wet	5000-I	148940	137705	3864	22921	0	146	26		1136	6832	10/9-11/1	Keystone Div, North Platte River
1984	Wet	5000-II	43169	47020	2371	14088	0	146	9		2629	15664	11/4-11/19	North Platte River
1984	Wet	800-I	246672	179573	800	4760	0	148	73	165369	0	77411		System Full
1984	Wet	800-II	197551	143410	800	4760	0	148	72	136937	0	105844		North Platte River
1985	Wet	5000-I	72341	71377	4759	23440	0	17	11		241	6313	4/10-4/25	Keystone Div, North Platte River
1985	Wet	5000-II	42958	46805	2433	14392	0	17	10		2567	15361	4/6-4/21	North Platte River
1985	Wet	800-I	347130	249482	821	4803	0	17	134	239209	-21	3572		North Platte River
1985	Wet	800-II	345956	249848	800	4760	0	17	140	240052	0	2728		North Platte River
1986	Wet	5000-I	53636	54921	3921	17162	0	6	10		1079	12591	1/29-2/13	North Platte Hydro, North Platte River
1986	Wet	5000-II	43919	47629	2495	14774	0	4	9		2505	14979	11/11-11/26	North Platte River
1986	Wet	800-I	229243	167762	800	4760	0	10	62	159200	0	83580		System Full
1986	Wet	800-II	201360	151136	800	4760	0	10	57	142574	0	100206		North Platte River, North Platte Ramp
1987	Wet	5000-I	64103	64563	3671	17947	0	3	13		1329	11805	4/5-4/24	Sutherland Canal, North Platte River
1987	Wet	5000-II	40959	45092	2420	14365	0	3	9		2580	15388	1/12-1/26	North Platte River
1987	Wet	800-I	351120	253383	829	4818	0	6	145	242324	-29	456		System Full
1987	Wet	800-II	351140	253718	800	4760	0	6	152	242659	0	121		North Platte River, North Platte Ramp
1988	Average	5000-I	64142	64571	4011	21616	0	1	11		989	8136	1/23-2/7	Sutherland Canal, North Platte River
1988	Average	5000-II	43627	47025	2458	14463	0	0	9		2542	15289	12/15-12/30	North Platte River
1988	Average	800-I	342698	246212	800	4760	0	0	130	236175	0	6606		North Platte River
1988	Average	800-II	346062	248497	800	4760	0	0	136	237429	0	5352		Keystone Div, North Platte River
1989	Average	5000-I	89268	85119	5271	24501	1	0	13		-271	5252	4/12-4/30	Sutherland Canal, North Platte River
1989	Average	5000-II	42940	46401	2518	14875	0	0	9		2482	14877	4/15-4/30	North Platte River
1989	Average	800-I	339826	244861	806	4773	0	0	137	235035	-6	7746		Keystone Div, North Platte Ramp
1989	Average	800-II	344953	248982	800	4760	0	0	143	237904	0	4876		North Platte River, North Platte Ramp
1990	Average	5000-I	86891	84011	4588	24245	0	0	14		412	5507	1/21-2/7	Sutherland Canal, North Platte River
1990	Average	5000-II	43877	47204	2476	14678	0	0	9		2524	15075	12/11-12/26	North Platte River
1990	Average	800-I	334958	241272	813	4786	0	0	124	232538	-13	10242		Keystone Div, North Platte Ramp
1990	Average	800-II	335502	241947	800	4760	0	0	128	233214	0	9566		North Platte River, North Platte Ramp
1991	Dry	5000-I	109356	97048	5404	24257	1	0	17		-404	5496	4/8-4/28	Sutherland Canal, North Platte River
1991	Dry	5000-II	43505	45201	2445	14480	0	0	9		2555	15273	3/28-4/12	North Platte River
1991	Dry	800-I	551509	230209	807	4774	0	0	97	220687	-7	22093		Keystone Div, North Platte River
1991	Dry	800-II	557579	234123	800	4760	0	0	97	222127	0	20653		North Platte River
1992	Average	5000-I	98554	93598	5267	25086	1	0	17		-267	4667	4/6-4/24	Sutherland Canal, North Platte River
1992	Average	5000-II	54636	56464	2432	14471	0	0	11		2568	15282	4/7-4/24	North Platte River
1992	Average	800-I	345816	248360	808	4775	0	0	146	240167	-8	2613		Keystone Div, Sutherland Canal, North Platte Ramp
1992	Average	800-II	353678	253856	800	4760	0	0	154	242780	0	0		N/A

WY	Year Class	Scenario	Total McConaughy Release (af)	Total EA at Overton (af)*	Peak EA Flow at Overton (cfs)	Peak 3-Day Total (af)	# Days > 5,000 EA (cfs)	# Days > 6,000 total (cfs)	# Days > 800 EA (cfs)	Total EA Irr Season (af)	Shortage on Peak Day (cfs)	Target Vol Short (af)	Days of Year	Typical reasons for short to target flow
1993	Average	5000-I	82787	79471	5183	21576	1	0	13		-183	8177	4/12-4/29	Sutherland Canal, North Platte River
1993	Average	5000-II	43814	47150	2510	14773	0	0	9		2490	14980	1/31-2/15	North Platte River
1993	Average	800-I	348871	247193	800	4760	0	0	138	237076	0	5704		System Full
1993	Average	800-II	351706	253724	800	4760	0	0	153	242658	0	123		North Platte Ramp
1994	Average	5000-I	119264	110173	5299	26002	1	1	19		-299	3750	4/7-4/27	Keystone Div, North Platte River
1994	Average	5000-II	43879	47206	2494	14800	0	0	9		2506	14952	4/12-4/27	North Platte
1994	Average	800-I	341670	246174	800	4760	0	0	137	236249	0	6532		Keystone Div, North Platte Ramp
1994	Average	800-II	344427	248592	800	4760	0	0	142	237630	0	5151		North Platte Ramp
1995	Wet	5000-I	98610	94489	4907	23631	0	36	16		93	6121	1/28-2/15	Keystone Div, North Platte River
1995	Wet	5000-II	43516	47284	2465	14558	0	36	9		2535	15195	1/31-2/15	North Platte River
1995	Wet	800-I	330876	239299	818	4844	0	38	118	229254	-18	13526		North Platte River
1995	Wet	800-II	330381	238844	800	4760	0	38	132	229457	0	13324		North Platte River
1996	Average	5000-I	119825	111490	4125	17466	0	0	21		875	12286	4/15-4/30	Sutherland Canal, North Platte River
1996	Average	5000-II	49709	52240	2519	14934	0	0	10		2481	14819	1/23-2/7	North Platte River
1996	Average	800-I	350426	251142	800	4760	0	4	149	242443	0	337		Keystone Div, North Platte Ramp, North Platte River
1996	Average	800-II	350747	251421	800	4760	0	4	148	242429	0	351		North Platte River, North Platte Ramp
1997	Wet	5000-I	64952	65394	3101	15610	0	15	13		1899	14142	3/30-4/18	North Platte River, Sutherland Canal, CNPPID Div.
1997	Wet	5000-II	43727	47465	2474	14669	0	15	9		2526	15083	4/15-4/30	North Platte River
1997	Wet	800-I	343076	247761	817	4794	0	17	130	236695	-17	6085		North Platte Ramp, North Platte Hydro Ramp
1997	Wet	800-II	342217	247470	800	4760	0	17	133	236405	0	6376		North Platte Ramp
1998	Wet	5000-I	69758	69603	4150	16736	0	0	15		850	13017	2/26-3/19	Sutherland Canal, North Platte River
1998	Wet	5000-II	43353	47144	2415	14272	0	0	9		2585	15480	1/21-2/5	North Platte River
1998	Wet	800-I	346007	249802	817	4760	0	0	137	238845	-17	3935		Keystone Div, North Platte Ramp, North Platte River
1998	Wet	800-II	344903	249318	800	4760	0	0	139	238361	0	4419		North Platte River
1999	Wet	5000-I	109505	103474	4814	20822	0	14	19		186	8930	2/27-3/23	Sutherland Canal, North Platte River
1999	Wet	5000-II	81377	79745	2453	14587	0	14	17		2547	15166	4/7-4/22	North Platte River
1999	Wet	800-I	344052	248321	856	4871	0	22	128	238259	-56	4521		Sutherland Canal, North Platte Ramp
1999	Wet	800-II	345044	249437	800	4760	0	22	141	238371	0	4410		North Platte River, North Platte Ramp
2000	Wet	5000-I	52845	55198	3117	17865	0	0	9		1883	11888	12/2-12/17	North Platte River, System Full
2000	Wet	5000-II	43597	47387	2458	14583	0	0	9		2542	15170	1/25-2/9	North Platte River
2000	Wet	800-I	345054	248385	814	4788	0	0	137	238938	-14	3842		Keystone Div, North Platte Ramp, North Platte River
2000	Wet	800-II	344619	247612	800	4760	0	0	136	238047	0	4734		North Platte River, North Platte Ramp
2001	Average	5000-I	109234	103088	5241	25170	1	1	18		-241	4582	3/19-4/8	Keystone Div, North Platte River
2001	Average	5000-II	43460	46847	2428	14450	0	0	9		2572	15302	1/30-2/14	North Platte River
2001	Average	800-I	318993	220585	806	4773	0	0	110	210560	-6	32221		Keystone Div, North Platte Ramp, North Platte River
2001	Average	800-II	322965	233521	800	4760	0	0	122	222519	0	20261		North Platte River, North Platte Ramp
2002	Dry	5000-I	103416	95639	5072	23771	1	0	16		-72	5981	2/18-3/9	Keystone Div, North Platte River
2002	Dry	5000-II	44136	45741	2544	15067	0	0	9		2456	14686	4/13/4/28	North Platte River
2002	Dry	800-I	536388	222403	808	4772	0	0	99	213135	-8	29645		Keystone Div, North Platte River
2002	Dry	800-II	523409	219509	800	4760	0	0	109	209133	0	33647		North Platte River, North Platte Ramp
2003	Dry	5000-I	114659	106115	5498	25600	1	0	18		-498	4153	3/16-4/5	Keystone Div, North Platte River
2003	Dry	5000-II	43608	45289	2485	14594	0	0	9		2515	15158	4/14-4/29	North Platte River
2003	Dry	800-I	604203	252344	800	4760	0	0	149	241136	0	1644		Keystone Div.
2003	Dry	800-II	608040	254564	800	4760	0	0	152	242441	0	340		North Platte Ramp
2004	Dry	5000-I	142512	130043	5438	27151	1	0	21		-438	2601	11/12-11/27	North Platte Hydro, North Platte River
2004	Dry	5000-II	44065	45720	2522	14899	0	0	9		2478	14853	10/18-11/02	North Platte River
2004	Dry	800-I	606289	251978	800	4760	0	0	151	242235	0	546		Keystone Div, North Platte Ramp
2004	Dry	800-II	605876	251342	800	4760	0	0	149	241808	0	972		North Platte Ramp
2005	Dry	5000-I	156886	138873	5575	26569	1	0	26		-575	3183	3/30-4/22	Keystone Div, North Platte River
2005	Dry	5000-II	43984	45611	2515	14903	0	0	9		2485	14849	3/21-4/5	North Platte River
2005	Dry	800-I	608089	253905	806	4772	0	0	150	242710	-6	71		North Platte Ramp
2005	Dry	800-II	608043	254566	800	4760	0	0	152	242442	0	338		North Platte Ramp
2006	Dry	5000-I	137885	119858	5535	26565	1	0	18		-535	3187	4/7-4/30	Sutherland Canal, North Platte River
2006	Dry	5000-II	44228	45820	2531	14979	0	0	9		2469	14774	12/4-12/19	North Platte River
2006	Dry	800-I	607169	253500	806	4772	0	0	149	242456	-6	325		Keystone Div, North Platte Ramp
2006	Dry	800-II	607851	254488	800	4760	0	0	149	242365	0	416		North Platte Ramp

WATER MANAGEMENT STUDY, PHASE I
EVALUATION OF PULSE FLOWS FOR THE PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

Phase I Report
April 8, 2008

APPENDIX 4

Request for Proposal – Engineering Services for the Platte River Recovery Implementation Program Water Management Study

April 2, 2007

TO: PROSPECTIVE CONSULTANTS

Subject: Request for Proposal –Engineering Services for the Platte River Recovery Implementation Program Water Management Study

The Governance Committee of the Platte River Recovery Implementation Program (Program) is soliciting proposals for the engineering services necessary to develop a water management study. The water management study will serve as a tool for the Governance Committee to assist in determining the timing and quantities of deliveries of Program water and define additional water supply and conservation projects necessary to meet certain Program water supply objectives. Attached to this RFP is a CD in pdf format of the Program Water Plan, which is Attachment 5 to the "Platte River Recovery Implementation Program," dated October 24, 2006. The sections of interest have been referenced in this RFP.

In responding to this RFP, the Governance Committee requests the following information:

1. **Scope of work** for completing this project. Prospective consultants should address each task outlined in the preliminary scope provided herein, but may offer a separate section in their proposal suggesting alternatives to the scope provided herein.

2. **Detailed schedule** for completing each task in the preliminary scope. The following are the critical dates for the Governance Committee's preferred schedule for the project:

December 31, 2007	Complete Phase I of the study as defined in the Preliminary Scope of Work, provided herein.
December 31, 2008	Complete Phase II of the study as defined in the Preliminary Scope of Work, provided herein.

   Prospective consultants should address their capability to comply with the above schedule. If it is deemed that the above critical dates should be revised, prospective consultants should offer alternative schedules describing the logic and reasons for the alternative.

3. **Detailed cost not to exceed proposal** to complete the project. The price proposal should identify the costs and hours allocated for each task in the scope of work and the total cost for the study. (See page 11 of this request for proposal.) Hourly rates and reimbursable expenses schedules for the proposing firm and any sub-consultants must be attached to the detailed price proposal. The contract will be awarded on a cost not to exceed basis for the total budget.

4. **Resumes** of key project participants and subcontractors proposed for this project. The resumes should address experience on projects similar to this water management study.

5. **Description of Insurance** shall be provided with the proposal. Proof of insurance will be required before a contract is issued. Minimum insurance requirements will include $1,000,000 general liability per occurrence. To the extent authorized by law, the contractor shall indemnify, save, and hold harmless the Nebraska Community Foundation, the Governance Committee, the states of Colorado, Wyoming, and

Nebraska, the Department of the Interior, and the Governance Committee Executive Director's Office, their employees, employers, and agents, against any and all claims, damages, liability and court awards including costs, expenses, and attorney fees incurred as a result of any act or omission by the contractor or its employees, agents, subcontractors, or assignees pursuant to the terms of this project.

Please submit one (1) bound and one (1) unbound copy of your proposal and an electronic copy in pdf format by **5:00 p.m. on May 15, 2007** to:

Dale Strickland
Executive Director's Office
2003 Central Avenue
Cheyenne, WY 82001
(307) 634-1756
dstrickland@west-inc.com

Terms and Conditions: The selected contractor will be retained by:

Nebraska Community Foundation
650 J Street, Suite 305
PO Box 83107
Lincoln, NE 68501

Terms and conditions will be negotiated as mutually agreeable. It is understood that the right is reserved by the Governance Committee to accept any proposal that, in its judgment, is the best proposal, and to waive any irregularities in any proposal.

Proposal Costs: Proposal costs incurred in response to this RFP will be the responsibility of the bidder. Neither Nebraska Community Foundation nor the Governance Committee will be liable for any costs incurred by the bidder in the completion and submission of the proposal.

Point of Contact: Questions regarding this RFP that could impact budget estimates or scope of services should be faxed to Dale Strickland at (307) 637-6981 or emailed to dstrickland@west-inc.com. Questions and responses will be provided by fax, email, or phone to all bidders.

April 2, 2007

PRELIMINARY SCOPE OF WORK
For
Engineering Services
Platte River Recovery Implementation Program
Water Management Study

1.0 INTRODUCTION

The Platte River Recovery Implementation Program (Program) was initiated on January 1, 2007 between Nebraska, Wyoming, and Colorado and the Department of the Interior (DOI) (the parties) to address endangered species issues in the Platte River Basin. The species, referred to as "target species," are the whooping crane, piping plover, interior least tern, and pallid sturgeon. A Governance Committee has been established that reviews, directs, and provides oversight for activities undertaken during the Program. The Governance Committee is comprised of one representative from each of the three states, three water user representatives, two representatives from environmental groups, and two members representing federal agencies. The Governance Committee has named Dale Strickland to serve as its interim Executive Director. Mr. Strickland will be the primary contact for prospective consultants responding to this RFP.

2.0 PROBLEM STATEMENT

One of the objectives of the Program is to complete a phased study to evaluate the feasibility of meeting the following water supply goals by December 31, 2011:

1. Provide 5,000 cubic feet per second of Program water for three days to the Overton gage on the Platte River in central Nebraska for pulse flows when other demands that may be competing for river channel and irrigation system capacity are low (normally September 1-May 31). Assuming this water-delivery availability, Program water may be used to supplement existing flows to achieve pulse flows in excess of 6,000 cfs two out of three years. If these flows are achieved by existing flows (without Program water), the deliveries of Program water would not be necessary.

2. Identify feasible measures and quantify the Program water necessary to ensure a yield of 800 cfs of Program water at the Overton gage during the irrigation season (May 1 through September 30).

3.0 DEFINITIONS AND ASSUMPTIONS

1. Program water

One of the long-term objectives of the Program is to reduce shortages to certain specified target flows by an average of 130,000-150,000 acre-feet per year in the Platte River in central Nebraska (Platte River valley area from Lexington to Chapman, Nebraska). The following list describes three initial Program projects and a reference to the description of the respective projects that can be found in the Program Document:

a. Nebraska's Environmental Account in Lake McConaughy (NEA) (Attachment 5, Section 5)
b. Wyoming's Pathfinder Modification Project (PMP) (Attachment 5, Section 4)
c. Colorado's Initial Water Project (Tamarack 1) (Attachment 5, Section 3)

The following table depicts estimated quantities of Program water that will be available in wet, average, and dry years. The following yields are based on model runs used in the FEIS for the Program for the 1947 through 1994 period of record. The yields of the NEA and PMP are achieved in Lake McConaughy. The yields of Tamarack I are based on increased flows at the CO/NE state line.

	Average yields (AF x 1,000)		
	Avg. Annual	Avg. Annual	Avg. Max Monthly
Project	NEA	PMP	Tamarack I
Wet year (25%)	74.8	29.5	3.4
Average year (50%)	56.9	22.7	3.2
Dry year (25%)	48.5	10.2	3.2

The above three projects will provide an average of 80,000 acre-feet per year toward the objective of reducing shortages to target flows by an average of 130,000-150,000 acre feet per year. Presently, it is envisioned that the remaining 50,000-70,000 acre feet of water per year will be obtained from projects selected from those identified in the "Reconnaissance Level Water Action Plan" (Attachment 5, Section 6). One of the purposes of this study is to assist the Governance Committee in the selection of these projects.

2. River channel capacity

The channel capacities for the reaches of the North Platte, South Platte, and Platte Rivers used to transport Program water will be based on discharge rates during flood stages as determined by the National Weather Service with one notable exception. The flood stage discharge of the North Platte River, north of the city of North Platte, Nebraska and extending approximately two miles upstream of the intersection of the North Platte River and Highway 83 will be assumed to be 3,000 cfs.

3. Irrigation system capacity

Throughout the year, the Districts (The Central Nebraska Public Power and Irrigation District (CNPPID) and Nebraska Public Power District (NPPD)) divert all available flows up to the diversion capacity including any available Program water.
However, Program water may be intentionally re-regulated using the Districts' systems and/or Program water may be intentionally bypassed to the river under the specific conditions and within the constraints described in the Program Document (Attachment 5, Section 1) and the agreement with the Districts.

The following are the known limitations and capacities within the Districts' system that affect the delivery of Program water; there may be others that are not identified herein. These limitations and capacities are provided in this RFP to provide background to prospective consultants. These limitations and capacities may be expanded or altered during the completion of Task I of Phase I. One of the purposes of this study is to test the sensitivity of these limitations in providing capacity for Program water. Attached to this RFP is a map of the Central Platte System

a. North Platte River Channel Limitations and Capacities below Keystone Diversion Dam

North Platte River Channel below Keystone Diversion Dam

- The initial ramp-up rate will be 300 cfs/day with no ramp down-rate limits (all seasons).
- Flows in the North Platte River at North Platte, Nebraska must not exceed flood stage as defined by the National Weather Service. Current flood stage is estimated to be approximately 1,600 cfs. However, the consultant should assume it will be 3,000 cfs due to planned Program improvements to the channel in the area. (See 2. above)

b. CNPPID System Limitations and Capacities

Central Diversion Dam at North Platte

- The maximum diversion is 2,250 cfs all year (barring icing conditions or hydro/system malfunctions)
- There are presently no specified maximum ramp-up/down rates. However, they may be provided in the future.
- A full diversion is generally possible all year long and is likely to occur in wet years.
- In average and dry years, the maximum diversion is being used for irrigation from July 1 to September 15.
- Diversion of the Districts' water reduces the available capacity for Program water. Program water in excess of available capacity must be bypassed down the river.
- The capacity available for Program water in mid-March could be reduced by 300 cfs for Elwood Reservoir filling.

Jeffrey Return

- The maximum return is 1,250 cfs.
- Capacity for Program water is limited during the irrigation season when the return is being used for NPPD irrigation flows.
- Use of the Jeffrey Return may be limited during the dry years from August through September due to CNPPID water conservation practices.
- Use of this return diminishes the flow continuing to Johnson Reservoir and could therefore reduce the capacity for regulation of Program water in Johnson Reservoir and/or the amount of water that can be released through the J-2 return.

J-2 Return

- The maximum return is 2,000 cfs.
- The capacity for return flows will decline from 2,000 cfs in mid April when irrigation deliveries begin. In dry years (when irrigation deliveries are reduced), available return flow capacity may be as high as approximately 800 cfs from July 1 to September 15. In some years, there may be no return flow capacity available.

c. NPPD System Limitations and Capacities

Keystone Diversion

- The maximum capacity of the diversion is 1,750 cfs all year barring icing conditions, summer weed growth, system maintenance and unplanned malfunctions.
- The ramp-up/down rate is 100 cfs/day all year, barring icing conditions and summer weed growth and system malfunctions. This ramp rate limitation is intended to avoid canal system damage that could result in a loss of the cooling water supply to Gerald Gentlemen power plant.
- The entire capacity is typically required for irrigation from July 1 to September 15.

Korty Diversion

- The maximum capacity of the diversion is 850 cfs all year, barring icing conditions, summer weed growth and system malfunctions.

Total NPPD Diversion

- The total diversion to NPPD can be no more than1,900 cfs below the confluence of the Keystone and Korty Diversions all year, barring icing conditions, summer weed growth and system malfunctions.

NPPD North Platte Hydro

- The maximum capacity is 1,750 cfs. As the hydro discharge rate increases to the maximum, a reduction in the storage level in Lake Maloney is required due to the fact that the system has no by-pass potential at the North Platte Hydro. When the outlet canal is flowing at a high rate, additional space is necessary in Lake Maloney to allow for the storage of the additional flow. The maximum hydro discharge rate may also decrease as the storage level in Lake Maloney is reduced, assuming inadequate replacement inflows in the Sutherland Outlet Canal.
- The ramp-up rate is 200 cfs per day and there is no maximum ramp-down rate, as long as adequate storage space exists in Sutherland and Maloney Reservoirs for flows in the canals.

4. Re-regulation within the Districts' system

Initially, there will be the opportunity to use a maximum of 4,000 acre feet of the capacity in Johnson Lake within the Districts' system as re-regulation space for Program water in February, March, and April. There may be additional opportunity for re-regulation in the Districts' system if this study identifies such additional re-regulation space would serve as a solution in the delivery of Program water and the Governance Committee determines such re-regulation is feasible. In any event, the total annual use of the re-regulation space cannot exceed 12,000 acre-feet.

5. Classification of water years

For purposes of this study, the classification of water years will be based on the flows at the Overton gage from 1947-2006. Provisional data for the most recent years can be used.

Wet-The 25% wettest years
Dry-The 25% driest years
Average-The remaining years

4.0 SCOPE OF WORK

The following scope of work is offered to assist the prospective consultants in the preparation of their proposals. The proposals should address each task in this scope. However, if prospective consultants believe scope alternatives would benefit the project, those alternatives should be thoroughly described and the corresponding cost increases or savings should be identified.

PHASE I

Task I. Research and Investigation

A. The consultant shall review the Program Water Plan. The consultant should prepare questions after reviewing the Program Water Plan. As a minimum, the consultant will hold interviews with the representatives of the Program or their designees. Interviews may be held in person or via conference calls.

Interview	Topic
Mark Butler, Fish and Wildlife Service	Yield of water supply projects
Don Anderson, Fish and Wildlife Service	Ramping rates for water deliveries
Sharon Whitmore, Fish and Wildlife Service	Environmental Account management
Don Kraus, CNPPID	Districts' system, including physical constraints and potential liabilities Environmental Account in Lake McConaughy
Brian Barels, NPPD	Districts' system, including physical constraints and potential liabilities
Jon Altenhofen, Northern Colorado Water Conservation District	Tamarack I
Mike Purcell, Wyoming	Pathfinder Modification Project
John Lawson, USBR	Pathfinder Modification Project
Ann Bleed, Nebraska	Conveyance losses

B. The consultant will need to contact the USGS and the Nebraska Department of Natural Resources regarding flow information at the Overton gage on the Platte River and other gages of interest.

C. The consultant will need to quantify and tabulate conveyance losses and lag times for the river reaches of interest during wet, average, and dry periods.

Task II. Determine Available Capacity for Program Water

The consultant will develop a working paper describing the methodology that will be used to determine the capacity available for delivery of Program water through the Districts' system and the river channels in wet, average, and dry years. A draft of the working paper will be circulated to parties interviewed under Task I.A. for review and comment.

After receipt of comments, the consultant will proceed in using the methodology to estimate the capacity available at critical points within the Districts' systems and within the river channels for delivery of Program water in wet, average, and dry years. Initially, the consultant will use the limitations and capacities described in section 3.0 of this RFP, as may be amended during the discussions conducted under Task I.A. of Phase I. The consultant will test the sensitivity of these limitations and capacities in delivery of Program water and may propose changes for consideration by the Governance Committee. The consultant will also estimate the amounts of water that would be required to achieve the water supply objectives described in Section 2.0 of this RFP given the available capacity.

Task III. Routing Studies

The consultant will build upon the methodologies and estimates developed in Task II to route Program water available in the NEA, PMP, and Tamarack I supplies through the available capacities as determined in Task II in order to determine the shortages to the water delivery objectives described in Section 2 of this RFP in wet, average, and dry years. The routing studies will be completed for the following scenarios:

Case I-No Program water will bypass the Districts' system when the Districts have the capacity within their system to divert it.

Case II-Program water can bypass the Districts' system even if the Districts have the capacity to divert it.

The consultant will quantify the shortages in wet, average, and dry years and identify the causes for those shortages under Case I and Case II. The consultant will identify the definitions and assumptions described in section 3.0 of this RFP that could be revised for the purposes of reducing shortages.

Task IV. Solutions

The consultant will review the projects identified in the "Reconnaissance Level Water Action Plan" (Attachment 5, Section 6) and identify those projects that would likely be the most cost-effective in reducing shortfalls to the Program water-delivery objectives described in Section 2.0. The consultant will describe the reasons for selecting the various projects and describe the operations of those projects that should be implemented to eliminate the shortages in wet, average, and dry years under Case I and Case II.

Task V. Draft Report

The consultant will provide the Executive Director's office a draft report describing the results of Task I through IV in pdf format, no later than October 1, 2007.

Task VI. Presentation

The consultant will work with the Executive Director's office to arrange one workshop to present the Phase I report to the Governance Committee and Water Advisory Committee in November, 2007.

Task VII. Final Report

The consultant will finalize the Phase I report incorporating comments received on the draft report and at the workshop. The consultant will provide one (1) bound and one (1) unbound copy of the final report and an electronic copy in pdf format no later than December 31, 2007.

PHASE II.

The Consultant shall not proceed to Phase II without written approval from the Executive Director.

Task I. Additional Solutions

The consultant will identify projects not previously analyzed that, if implemented, could reduce or eliminate shortfalls to the Program water-delivery objectives described in Section 2. The consultant will describe the reasons for selecting the various projects and describe the operations of those projects that should be implemented to eliminate the shortfalls in wet, average, and dry years under Case I and Case II.

Task II. Screening

The consultant will screen the projects identified above. The screening will be based on cost, technical feasibility, liability and risks, and environmental and permitting considerations. The consultant will select three (3) projects that are considered worthy of additional review.

Task III. Workshop

The consultant will work with the Executive Director's Office for purposes of arranging a workshop to review the results of Tasks I and II. The purpose of the workshop will be to determine the projects worthy of progressing to Task IV.

Task IV. Project Evaluations

The consultant will complete reconnaissance level designs and cost estimates on the projects selected in the Task III workshop. For purposes of proposal preparation, the consultant should assume that three (3) projects will be selected for the reconnaissance level designs and cost estimates.

Task V. Draft Report

The consultant will provide the Executive Director's office a draft Phase II report describing the results of Task I through IV in pdf format, no later than October 15, 2008.

Task VI. Final Report

The consultant will finalize the Phase II report incorporating comments received on the draft report. The consultant will provide one (1) bound and one (1) unbound copy of the final report and an electronic copy in pdf format no later than December 31, 2008.

Price Proposal

Water Management Study

Task		Proposal Price	Hours
PHASE I			
I.	Research and Investigation	$____________	_______
II.	Determine Available Capacity	$____________	_______
III.	Routing Studies	$____________	_______
IV.	Solutions	$____________	_______
V.	Draft Report	$____________	_______
VI.	Presentation	$____________	_______
VII.	Final Report		
Total Phase I		$____________	_______
PHASE II			
I.	Additional Solutions	$____________	_______
II.	Screening	$____________	_______
III.	Workshop	$____________	_______
IV.	Project Evaluations	$____________	_______
V.	Draft Report	$____________	_______
VI.	Final Report	$____________	_______
Total Phase II		$____________	_______
Grand Total		$____________	_______

Firm Name and Address: ____
____
____

Signature of Firm President or Authorized Agent:______________________________

If the consultant offers a revised scope of services, this form should be duplicated and the proposal prices for the revised scope should be provided.