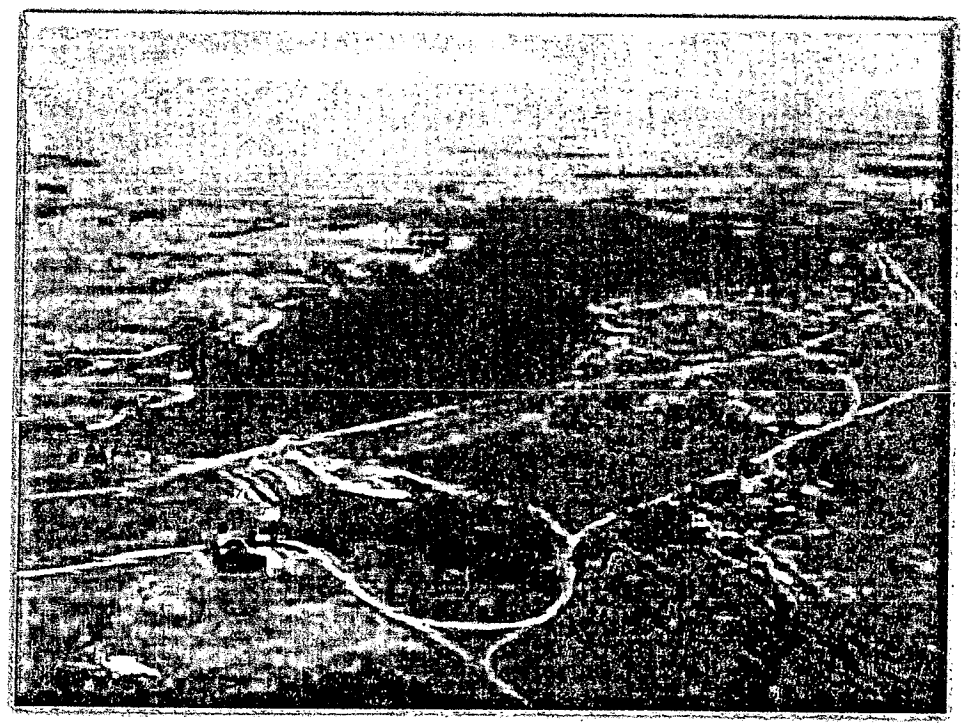
RECLAMATION
Managing Water in the West

Draft Appraisal Report:
The Frenchman Unit



September 2008

Bureau of Reclamation
Nebraska-Kansas Area Office
Grand Island, Nebraska

Glossary

Abbreviations, acronyms, and some terms used in this report are defined here.

BOD – Biochemical oxygen demand

CS—Candidate species

Compact—Republican River Compact

Council – Republican River Basin Irrigation District Council

CREP – Conservation Reserve Enhancement Program

DNR—Nebraska Department of Natural Resources

DPR – Definite Plan Report

E – Endangered

EOM—End-of-month

EQIP – Environmental Quality Incentives Program

ESA – Endangered Species Act

FVID—Frenchman Valley Irrigation District

FSS—Final Settlement Stipulation

FWS – U.S. Fish and Wildlife Service

H&RWID—Hitchcock and Red Willow Irrigation District

IMP's—Integrated Water Management Plans

ITA's—Indian Trust Assets

NGPC—Nebraska Game and Parks Commission

NRD's—Natural Resource District

O&M—Operations and Maintenance

P – Proposed

(Glossary continued on back cover)

Dave Heineman
Governor

STATE OF NEBRASKA

DEPARTMENT OF NATURAL RESOURCES
Brian P. Dunnigan, P.E. [redacted]
Acting Director

September 26, 2008

IN REPLY TO:

Aaron M. Thompson, Area Manager
Bureau of Reclamation
Great Plains Region
Nebraska-Kansas Area Office
P.O. Box 1607
Grand Island, Nebraska 68802-1607

Dear Mr. Thompson:

Thank you for the opportunity to review the Draft Appraisal Report, the Frenchman Unit, Frenchman-Cambridge Division, Pick-Sloan Missouri Basin Project, Nebraska. We have several general and a number of page specific comments. They include the following:

1. We believe the report provides useful information and would like to thank the Bureau of Reclamation for providing the assistance to help Nebraskans better understand the physical environment and water management alternatives in this important basin.

2. Our comments on the preliminary draft probably should have included a suggestion that a limited description of study partners and timing be added to the report summary so that readers can more easily learn about the genesis of the effort. Both the Reclamation role in leading the study and writing the draft and the NDNR role in providing modeling for the effort would also ideally be mentioned at some point in the text and summary.

3. The purpose and scope section of the report and its summary indicate that the report's purpose "is to determine whether alternative plans analyzed in this report have sufficient potential to justify further federal involvement, including a detailed feasibility report on the unit". We were unable to find any wording in the current draft of the report that makes that determination. That may be because the determination is actually made after the report is issued or only with the issuing of the final report; but if so, the report should indicate that is the case. Third sentence – insert the word "that" between "flows" and "could".

4. Page ii paragraph 1– Second Sentence – It would be better to indicate that the passage of state legislation in 2004 provided the state with additional options for compliance. It was statewide legislation and to state only that it was passed "to try to comply" might mislead about a broad legislative bill.

301 Cenntenial Mall South, 4th Floor • P.O. Box 94676 • Lincoln, Nebraska 68509-4676 • Phone (402) 471-2363 • Telefax (402) 471-2900

5. Page ii paragraph 2 - We would suggest that the second sentence be removed and that the incentive based irrigation reductions from CREP and EQIP acres be mentioned.

6. Page 4 paragraph 2 - Same comment as #4.

7. Page 5 paragraph 2 - Should state that ruling was that "a portion" of LB 701 taxing authority is unconstitutional.

8. Page 6 paragraph 2 – Needs to be rewritten. Nebraska's Ground Water Management and Protection Act allows restriction of ground water use under prescribed conditions and does allow Natural Resources Districts to address depletion of streamflows by ground water development. (LB 962 was incorporated into the Ground Water Management and Protection Act).

9. Page 20 last paragraph second sentence - Remove "(including groundwater management plans)" replace with "(including ground water management area rules)".

10. Page 51 next to last paragraph - You may wish to reexamine the delivery system efficiency estimate of 40%.

11. Page 53 First Bullet – We suggest deletion of the current wording and replacing it with the words "The Districts would need to work with DNR to transfer permitted uses to ground water recharge".

12. Page 53 Sixth Bullet – We suggest removing the words "It is DNR's preliminary opinion that".

Again, thank you for the opportunity to review this report.

Sincerely,

Brian P. Dunnigan P.E.
Acting Director
Nebraska Department of Natural Resources

sg

Gaul, Steve

From: Gaul, Steve
Sent: Friday, August 08, 2008 6:09 PM
To: 'JWERGIN@gp.usbr.gov'
Cc: Jim Schneider (jschneider@dnr.ne.gov)
Subject: RE: ***OLD ADDRESS*** Preliminary Draft Report - Frenchman Valley Appraisal Study

Jack -

Staff working on Republican issues have been pretty busy preparing for meetings next week and I am leaving on vacation tomorrow but wanted to get you at least some comments on the draft report. I am intentionally not making any comments regarding the portions of the report that are related to the compact since I have been out of the loop on that but I do have a few items on other topics that you may want to consider. Most of these are not major.

Page 10 2nd paragraph under "Irrigation", 4th sentence "That was the (first) year H&RWID"

Page 11 "Recreation Fish and Wildlife" Do the visitation numbers actually show a declining trend in recreation use or a change in the nature of recreation use? The final sentence of the section says recreation benefits are diminishing but is that based on declining surface acres or declining visitation?

Page 11 "Other Needs" The second sentence of the first paragraph states "Reduced streamflows and a lessened water supply from the Frenchman Unit have caused adverse effects on water quality for towns in the project area". Is this a reference to municipal wells and if so is there evidence of the relationship? More specifics on what is being referred to on this point would be good.

Page 15 top line - this may need to add the word "or" between the words "fully overappropriated"

Page 20 Graph legend needs more specifics spelled out

Page 20 2nd sentence under "Updated Modeling" currently says "updates of each NRD's IMP". I would suggest instead "updates of the IMP for each NRD".

Page 22 Clean up graph axis

Page 44 Bottom Paragraph - Are these two sentences entirely compatible in regard to how they characterize the impact on recreational benefits? One says it won't change recreation while the other talks about "perhaps expanded at the expense of recreation benefits".

Page 51 2nd to last paragraph mentions "NDNR computer model". I believe this needs to be "RRCA groundwater model".

Jack, I will be out of the office next week but let me know if you have questions and I will respond when I return. Sorry I didn't have more, but the short fuse and a busy schedule made this a tough week to get things out.

Steve

-----Original Message-----
From: Jack Wergin [mailto:JWERGIN@gp.usbr.gov]
Sent: Thursday, July 31, 2008 2:38 PM
To: Schneider, Jim
Cc: Edgerton, Brad; Steve Gaul; Jill Manring; Michael Kube
Subject: ***OLD ADDRESS*** Preliminary Draft Report - Frenchman Valley Appraisal Study

Jim:

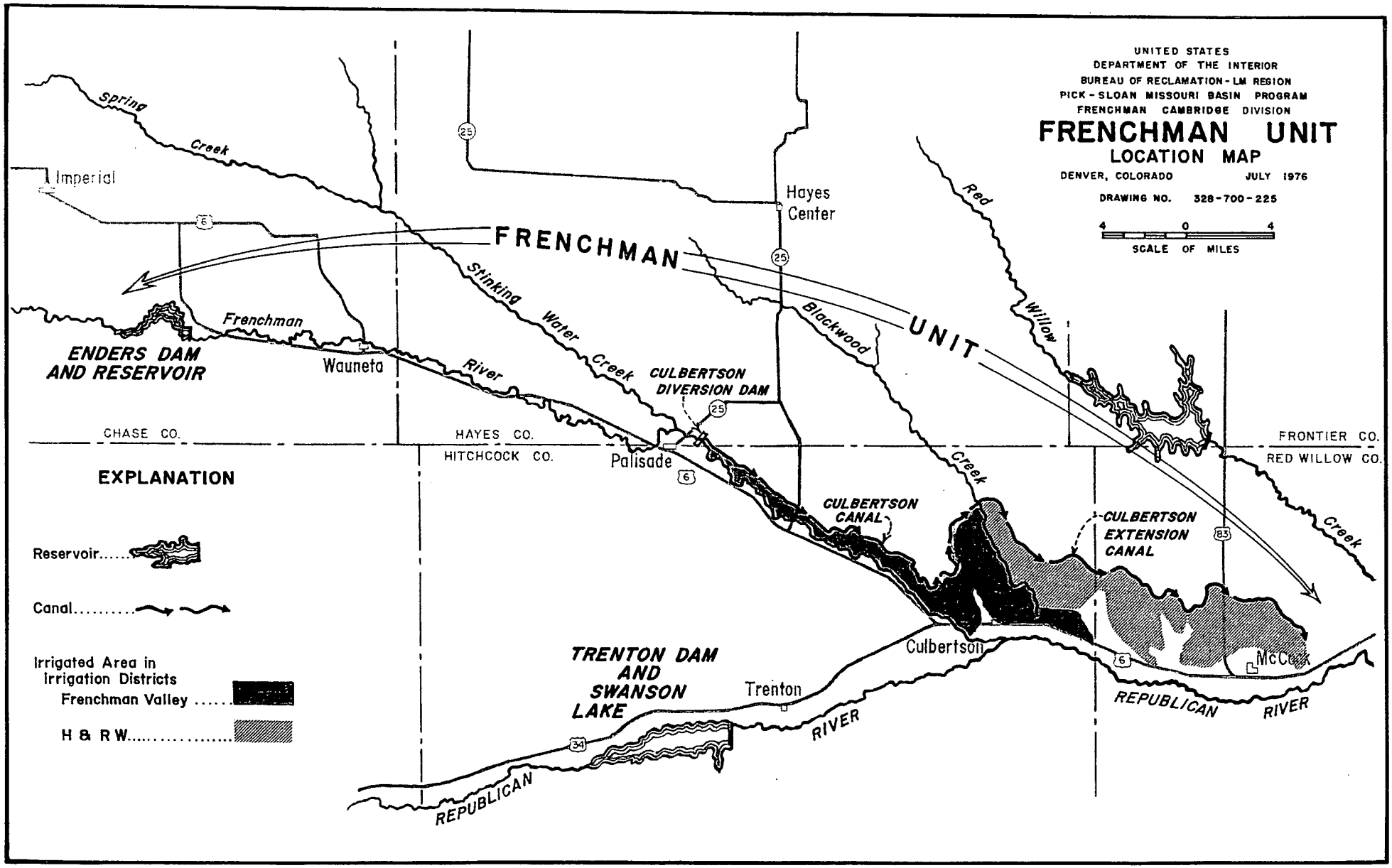
Reclamation has put together a preliminary draft report for the Frenchman Valley Appraisal Study. At this point, the draft is for review by the FVAS Team only, meaning Reclamation and Nebraska Department of Natural Resources. We will be sending you two copies of the draft report and we will also send one copy to Brad Edgerton in Cambridge. For this internal review we are looking for a quick turnaround - we would like your comments back by August 8th.

After we get comments back from the study team, we are hoping to distribute a revised draft to the study partners by August 15th. This version will be sent to all study partners including: Department of Natural Resources, Upper Republican NRD, Middle Republican NRD, Nebraska Game and Parks Commission, Frenchman Valley Irrigation District, H & RW Irrigation District, and Riverside Irrigation District.

NOTE - there were some problems with printing the preliminary draft report so Chapter 7 is included as an insert.

Let me know if you have any questions.

Jack Wergin
308-389-5322


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION - LM REGION
PICK - SLOAN MISSOURI BASIN PROGRAM
FRENCHMAN CAMBRIDGE DIVISION
FRENCHMAN UNIT
LOCATION MAP
DENVER, COLORADO JULY 1976
DRAWING NO. 328-700-225
4 0 4
SCALE OF MILES
Spring Creek
Imperial
Hayes Center
FRENCHMAN UNIT
Red Willow Creek
Stinking Water Creek
Blackwood Creek
Frenchman River
ENDERS DAM AND RESERVOIR
Wauneta
CULBERTSON DIVERSION DAM
CHASE CO.
HAYES CO.
HITCHCOCK CO.
FRONTIER CO.
RED WILLOW CO.
Palisade
CULBERTSON CANAL
CULBERTSON EXTENSION CANAL
EXPLANATION
Reservoir.....
Canal.....
Irrigated Area in Irrigation Districts
Frenchman Valley .....
H & R W.....
TRENTON DAM AND SWANSON LAKE
Trenton
Culbertson
McCook
REPUBLICAN RIVER
REPUBLICAN RIVER

Summary

The Bureau of Reclamation's Frenchman Unit (Unit) in south-central Nebraska lacks the water supply to meet all authorized purposes. The Unit supplies the Frenchman Valley Irrigation District (FVID) and the Hitchcock and Red Willow Irrigation District (H&RWID). It also provides fishing, flat-water recreation, hunting, and camping around the Unit's Enders Reservoir and lands surrounding.

Reclamation studies in 1977 and 1997 showed that surface water inflows into the reservoir had dropped drastically due to intensive drilling of irrigation wells upstream in Frenchman Creek, and to soil and water conservation practices in the area. FVID and H&RWID have not received a full water supply since the early 1970's. The last time the reservoir reached the top of conservation pool at elevation 3112.3 feet was in 1968.

By existing Nebraska water right law, inflows to Enders Reservoir, and natural flows to Frenchman Creek below the dam, are held by the irrigation districts. These water rights are needed to meet irrigation obligations to the FVID and H&RWID. See Appendix A for a description of the natural flow and storage water rights for Frenchman River and Enders Reservoir.

Purpose and Scope

The purpose is to determine whether the alternative plans analyzed in this report have sufficient potential to justify further Federal involvement, including a detailed feasibility report on the Unit.

Background

The Unit is one of four in Reclamation's Frenchman-Cambridge Division. It is located on Frenchman Creek, a tributary to the Republican River near the Kansas border. The study area encompasses Chase, Dundy, Hays, Hitchcock, Perkins, and Red Willow counties.

Water stored in Enders Reservoir—along with flows from the Frenchman and Stinking Water Creeks—supplies the Culbertson Canal and the Culbertson Extension Canal Systems (see map at front).

Kansas claimed in a 1998 suit that Nebraska had violated the Republican River Compact which divides the basin's water supply among the three states. The states negotiated a settlement, called the *Final Settlement Stipulation* (FSS), approved by the Supreme Court in May 2003. It called for accounting for stream depletions caused by groundwater pumping.

Under the division of water in the FSS, Nebraska exceeded its allocation from 2003-2006. To try to comply, the state enacted legislation in 2004 by which the Nebraska Department of Natural Resources (DNR) and the natural resource districts (NRD's) developed integrated surface water/groundwater management plans. These *Integrated Water Management Plans* (IMP's) include limiting groundwater depletions by the NRD's. The IMP's provide target stream flows could be met with a 20 percent reduction in groundwater pumping in the Republican River Basin from average pumping from 1998-2002.

The DNR and/or NRD's have tried to improve streamflows through other means as well: buying or leasing surface water from willing irrigation districts or taxing property in the basin to pay for surface water. Generally these methods have not resulted in reduced groundwater pumping in the basin.

Alternatives

Three alternative plans were developed by Reclamation and the study partners to meet planning objectives and avoid constraints.

- Flow-through Alternative
- Recreation Alternative, and
- Groundwater Recharge Alternative.

These alternatives were compared to the *Future-Without-the-Project Condition*, which represents no change in present conditions of the Unit. Table S.1 describes the salient characteristics of the alternatives; summarizes irrigation, flat-water recreation, fish and wildlife, and flood benefits of each; and concludes whether or not the alternatives would meet the three planning objectives.

Conclusions

Because of the severe decline in streamflows in the Frenchman River Basin, due to intensive groundwater pumping and soil and water conservation measures, the Unit no longer operates as authorized.

Study modeling results using DNR/NRD developed IMP's show only a small increase in streamflows in the basin. The surface water supply of the Unit will not return to levels necessary to sustain all project irrigation requirements.

Table S.1: Summary of the Alternatives

	Future-Without-the-Project Condition	Flow through Alternative	Recreation Alternative	Groundwater Recharge Alternative
Description	No change from present conditions in the Unit.	Would pass inflows through the reservoir.	Would establish a target minimum pool at Enders 7 feet higher than top of dead pool to benefit recreation.	Would operate the Unit to recharge groundwater to benefit groundwater irrigation
Reservoir Minimum Pool	Same	Decrease	Increase	No Change/ Increase
Elevation (ft)	3082.4	3080.0	3089.4	3082.4
Surface Area (ac)	627	567	825	627
Content (AF)	8,948	7,516	14,426	8,948
Water Supply (in/ac)	3.5 from reservoir every 5th year for both districts; 3.5 yearly from natural flows for FVID.	4.5 for FVID yearly from natural flows or 1.75 yearly from natural flows for FVID and H&RWID.	1.5 from reservoir every 5th year for both districts; 4 yearly from natural flows for FVID.	No project deliveries from canal system. All irrigation is from groundwater.
Irrigation Benefits	Authorized project acres continue to be irrigated by reservoir storage and natural flows.	Inflows would pass through reservoir for diversion by both FVID and H&RWID; yearly evaporation and seepage losses would drop by 219 AF.	Initial storage loss of 525 AF for irrigation; following this, minor drop in yearly irrigation water supply due to increased annual evaporation losses of 722 AF.	FVID and H&RWID would irrigate from groundwater recharged by Unit canals and laterals.

	Future-Without-the-Project Condition	Flow through Alternative	Recreation Alternative	Groundwater Recharge Alternative
Flat-water Recreation Benefits	Continue to provide an average of 43,000 visitor-days of flat-water recreation and fishing on the reservoir and hunting on public lands surrounding.	Would result in loss in visitation for flat-water recreation and fishing, with consequent losses in economic value.	Recreation without storage deliveries—would result in largest gain in visitation and therefore economic value; Recreation with storage deliveries—gain in recreation visitation and economic value, but less than recreation without storage deliveries.	Would result in loss in visitation for flat-water recreation and fishing, with losses in economic value.
Fish and Wildlife Benefits	Continue to provide fishing and hunting on public lands around the reservoir.	Would result in significant decrease in fish benefits due to loss of reservoir surface area and crowding; slight increase in wildlife benefits due to exposed lands in upper end of reservoir from lower elevations.	Would result in increase in fish benefits due to additional reservoir storage; slight increase in wildlife benefits.	Would result in decrease in fish benefits due to loss of reservoir surface area and crowding; greater increase in wildlife benefits in the upper end of the reservoir from lower elevations.

	Future-Without-the-Project Condition	Flow through Alternative	Recreation Alternative	Groundwater Recharge Alternative
Flood Benefits	Flood control pool, surcharge pool, and freeboard remain the same.	Would result in no change—flood flows in excess of channel capacity would be stored for later release; might be considered an increase in flood protection as more flood storage would be available.	Flood control pool, surcharge pool, and freeboard remain the same.	Flood control pool, surcharge, pool, and freeboard remain the same.
Would maintain the viability of FVID and H&RWID?	Yes.	Yes—might not be much difference in district operations because of non-use of storage due to reduced supply.	Yes—with reduced irrigation supply from storage; payment for increased storage would serve as financial incentive for project landowners.	Yes—might be able to add more beneficiaries to the project (lands benefitting from recharge not currently in either district) which would increase repayment pool.
Would maintain recreation at the reservoir?	Yes	No – recreation benefits would basically be eliminated	Yes – but at a reduced level	Yes – but at a significantly lower level.
Would protect the Federal investment?	Yes.	Might be question for repayment—who pays?	Yes—might change who pays for benefits.	Might change areas of benefits—could add and/or eliminate some beneficiaries.

	Future-Without-the-Project Condition	Flow through Alternative	Recreation Alternative	Groundwater Recharge Alternative
Pumping Costs Over the Next 38 Years	$4.96 million	$4.96 million	$7.76 million	Rec. without deliveries - $5.34 million Rec. with deliveries- $5.07 million
Would result in changes to cultural resources or ITA's?	No.	No.	No.	No.

Contents

Chapter 4: Alternatives

Chapter 5: Potential Effects of the Alternatives

Chapter 1: *Introduction*

The Frenchman Unit (Unit) in south-central Nebraska lacks the water supply to meet all authorized purposes. The Unit, the uppermost project of the Bureau of Reclamation's (Reclamation) Frenchman-Cambridge Division of the Pick-Sloan Missouri Basin Program, includes Enders Dam and Reservoir, Culbertson Diversion Dam, Culbertson Canal, and Culbertson Extension Canal (see map at the front of this report).

The Unit supplies water to the Frenchman Valley Irrigation District (FVID) and the Hitchcock and Red Willow Irrigation District (H&RWID). Water stored in Enders Reservoir, along with natural flows from Frenchman and Sticking Water Creeks, supplies the Culbertson Canal and the Culbertson Extension Canal systems, which serve 9,600 acres in the FVID and 11,490 acres in the H&RWID. Project irrigators depend on storage in Enders Reservoir to supplement their natural flow water rights to meet crop requirements. Reclamation has a long-term water service contract with both districts. The reservoir and lands surrounding the reservoir also provide fishing, flat-water recreation, hunting, and camping benefits.

The water supply in Enders Reservoir has been declining for decades. Reclamation studies in 1977 and 1996 showed that surface water inflows into Enders dropped drastically due to intensive drilling of irrigation wells upstream and to soil and water conservation practices. Due to depletions of surface flows, the districts have not received a full water supply since the early 1970's. The last time the reservoir reached the top of conservation pool (TOC) at elevation 3112.3 feet was in 1968.

Purpose and Scope

The purpose of the *Frenchman Unit Appraisal Report* is to determine whether alternative plans analyzed in this report have sufficient potential to justify further Federal involvement, including a detailed feasibility report on the Unit. The report is organized in seven chapters:

- Chapter 1—Purpose and scope; study authority; setting of the Unit; related studies and activities; and a summary of public involvement
- Chapter 2—Problems and needs of the Unit
- Chapter 3— Resources and management opportunities in the area
- Chapter 4—Alternatives to meet study objectives
- Chapter 5—Potential effects of alternative plans

- Chapter 6—Consultation and coordination
- Chapter 7—Conclusions and recommendations.

Study Authority

This appraisal study is authorized under Federal Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and acts amendatory thereof and supplementary thereto).

Setting

Frenchman Unit

The Unit is one of four in Reclamation's Frenchman-Cambridge Division. It is located on Frenchman Creek, a tributary to the Republican River in Nebraska near the Kansas border. The Republican River drains about 7,700 square miles in Colorado, 7,500 square miles in Kansas, and 9,700 square miles in Nebraska, for a total of 24,900 square miles. The drainage area above Enders Reservoir is about 950 square miles, of which 790 square miles contributes to surface runoff.

The study area is about 9,465 square miles in size: the entire Frenchman Creek drainage basin, including the FVID, H&RWID, and Riverside Irrigation District (RID). The Unit's surface water supply originates at Enders Reservoir and natural flows into Frenchman Creek below the dam (see map at the front of this report).

The project area is bounded on the south by the Republican River and on the east by Red Willow Creek. Frenchman and Red Willow Creeks drain into the Republican River to the west and east of McCook, Nebraska, respectively. The boundary also follows the Platte River to the north, and the High Plains Aquifer in the west. This corresponds with the Republican River Compact Administration (RRCA) groundwater model domain. The study area encompasses six Nebraska counties: Chase, Dundy, Hays, Hitchcock, Perkins, and Red Willow.

Nebraska's Upper and Middle Republican River Natural Resource Districts (NRD's) encompass the Frenchman Creek basin, including Enders Reservoir and FVID and H&RWID lands. The Upper Republican NRD includes 1,728,070 acres in Chase, Dundy, and Perkins counties. The NRD contains 12 towns, with a total population of about 8,900. The Middle Republican NRD contains most of Frontier County, all of Hayes, Hitchcock and Red Willow counties, and the southern third of Lincoln County. It covers 2,459,520 acres.

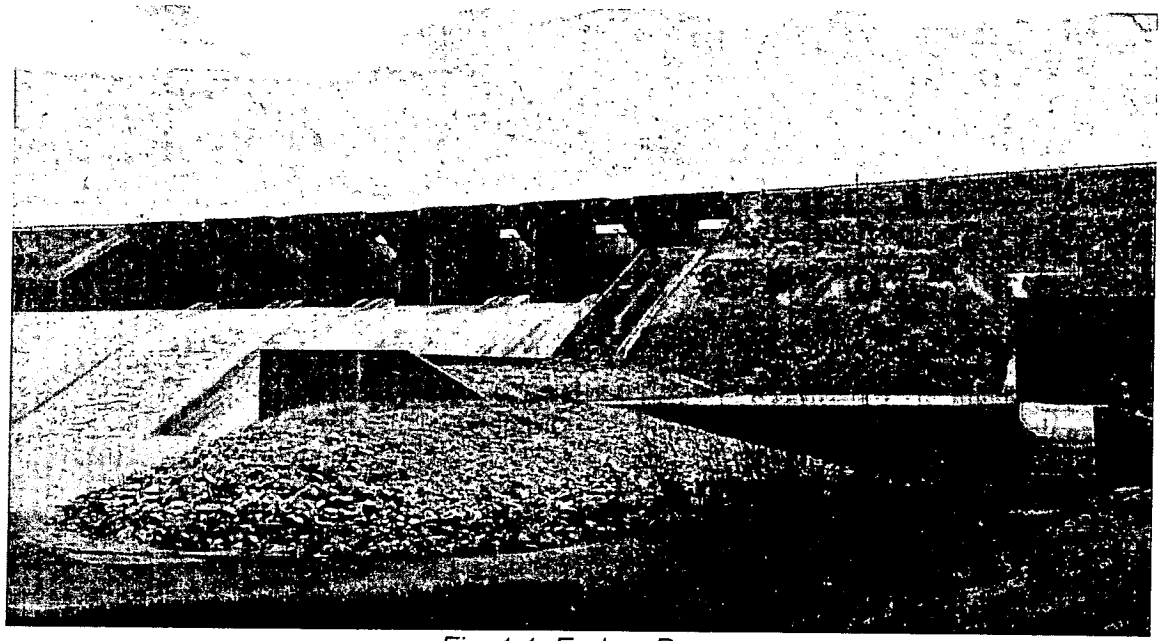


Fig. 1.1: Enders Dam

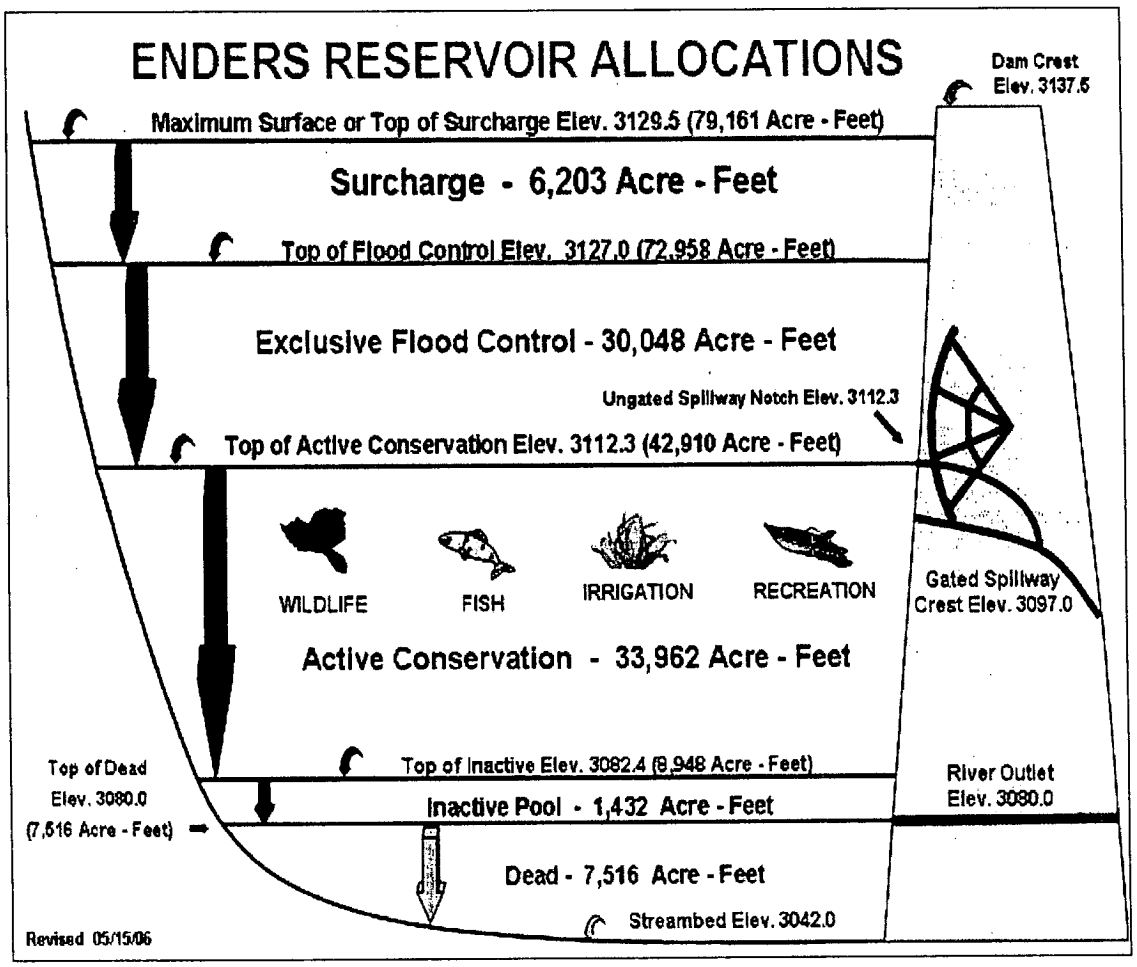
Water stored in Enders Reservoir—along with flows from the Frenchman and Stinking Water Creeks—supplies the Culbertson Canal and the Culbertson Extension Canal Systems (see map at front). Reservoir allocations are shown in Fig. 1.2. Cropping patterns and yield data obtained from a 1998 Reclamation repayment study showed that the primary irrigated crops in the District were corn, alfalfa, and soybeans. On a percentage basis, corn accounted for 86 percent of the irrigated acres, alfalfa was 8 percent, and soybeans were 6 percent. Primary dry land crops include a wheat-eco fallow corn-fallow rotation.

During normal Unit operations, FVID diverts and delivers early season natural flows from the Frenchman and Stinking Water Creeks. When irrigation releases begin from Enders Reservoir, FVID and H&RWID share the storage releases and the natural flows. FVID historically received a greater supply due to their deliveries from natural flows.

Republican River Compact

The Republican River's water supply is allocated to Colorado, Nebraska, and Kansas through the Republican River Compact (Compact) ratified by Congress in 1943. The Compact specifies allocation of the *virgin water supply*, defined as the un-depleted water supply in the basin. Each of the three states is allocated a percentage of the virgin water supply: Colorado 11 percent, Nebraska 49 percent, and Kansas 40 percent.

Fig. 1.2: Enders Allocations



In 1998, Kansas filed suit in the U.S. Supreme Court alleging that Nebraska violated the Compact by using more that their respective shares of the Republican River water supply. The states negotiated a settlement, which was approved by the Supreme Court in May 2003. This *Final Settlement Stipulation* (FSS) provided for Compact accounting that included stream depletions attributable to groundwater use.

I don't know that those were the years we were out of compliance. The R+P the issue was not the only reason 962 was passed

From 2003-2006, Nebraska has exceeded its allocation. In an effort to achieve compliance with the FSS, the state enacted LB 962 in 2004. This legislation requires that the Nebraska Department of Natural Resources (DNR) and the natural resource districts (NRD's) develop an integrated surface water/groundwater management plan for fully and over appropriated basins. The Republican River Basin is currently designated as fully appropriated.

The DNR and NRD's have developed and formally adopted *Integrated Water Management Plans* (IMP's) to bring Nebraska into compliance with the Compact. The plans include limiting shares of the state's groundwater depletions to the Upper Republican NRD at 44 percent, the Middle Republican NRD at 30 percent, and the

Lower Republican NRD at 26 percent. Total available groundwater depletions (following depletions from surface water diversions) would be set to the percentages listed. The DNR predicts that these target depletion limits could be met with a 20 percent reduction in groundwater pumping volumes from the baseline value established during the period 1998-2002.

I don't know that "reduction of gw pumping volumes is right" — not sure

Other Plans to Comply with the Compact

Beginning in 2006, the DNR and/or NRD's have annually purchased or leased surface water from irrigation districts to improve streamflows which would help the state achieve Compact compliance. In 2007, Nebraska enacted LB 701 granting the Republican River NRD's taxing authority in the Republican River Basin to fund surface water purchases. A local group challenged LB 701 as unconstitutional, and a hearing was held in Lancaster County District Court on January 24, 2008. The District Court judge ruled on May 19, 2008, that LB 701 taxing authority is unconstitutional. The Nebraska Attorney General's Office has filed an appeal with the Nebraska Supreme Court.

Just a portion of it is unconstitutional

By existing water right law, all inflows to Enders Reservoir, and natural flows to Frenchman Creek below the dam, belong to the Unit. These water rights are needed to meet irrigation requirements of the FVID and H&RWID. For a detailed description of the Unit's water rights, see Appendix A.

Surface water interests in Nebraska formed the Republican River Basin Irrigation District Council (Council) in an effort to preserve and protect surface water rights and to give surface water interests a voice in water management and water policy development. FVID, H&RWID, and RID are members of this council.

Like Nebraska, Colorado has exceeded its Compact allocations from 2003-2006 by about 11,000 AF/year. The Republican River Water Conservation District (RRWCD) was created by Colorado to help the state come into compliance with the Compact. To reduce consumptive use, the RRWCD offered incentives for voluntary retirement of water rights.

A proposal is being considered to drain Bonny Reservoir in order to reduce evaporative losses. The RRWCD's most recent proposal included purchasing groundwater rights to pump an estimated 15,000 AF/year through a 12.5-mile pipeline to the North Fork of the Republican River near the Colorado-Nebraska state line.

Recreation

Enders Reservoir provides both water based and land based recreational activity. At TOC (elevation 3112.3 feet), the reservoir provides 1,707 acres of surface area. The last time Enders reached this level was 1968. Recreation facilities at Enders Reservoir include 2 boat ramps, 2 campgrounds with more than 150 tent sites and 32 recreational vehicle sites, 8 picnic areas, and a designated swimming beach.

The Nebraska Game and Parks Commission (NGPC), FVID, and H&RWID are discussing a minimum pool for recreational use at Enders. NGPC would pay the districts to forego irrigation releases from the reservoir in order to increase water for recreation, fish, and wildlife benefits. Funding and agreement terms remain to be negotiated.

Administration of Water in Nebraska

Groundwater and surface water are administered separately in Nebraska. The DNR regulates surface water rights state-wide, while groundwater is regulated locally by the NRD's.

Nebraska's *Groundwater Management Act* restricts the use of groundwater under certain prescribed conditions but does not control depletion of surface streamflows by groundwater development.

Related Studies

Several studies have been done on the Unit and the Republican River Basin. Reclamation studies include:

- *Definite Plan Report: Frenchman-Cambridge Division, Pick-Sloan Missouri Basin Program* (1951)
- *Appraisal Report, Frenchman Unit* (1977)
- *Republican River Basin Water Management Study* (1985)
- *Resource Management Assessment, Republican River Basin, Water Service Contract Renewal* (1996)
- *Frenchman Valley Irrigation District, Hitchcock County, Payment Capacity Analysis (1998)*
- *Final Environmental Impact Statement: Republican River Basin Nebraska and Kansas Repayment and Long-Term Water Service Contract Renewals* (2000).

A complete list of studies can be found in "References Cited".

Public Involvement

Reclamation has several partners in this study: the NDNR, FVID, H&RWID, RID, Upper and Middle Republican NRD's, and the NGPC. Several meetings have been conducted with partners and various stakeholders. A summary of public involvement activities can be found in Chapter 6.

Chapter 2: *Problems and Needs*

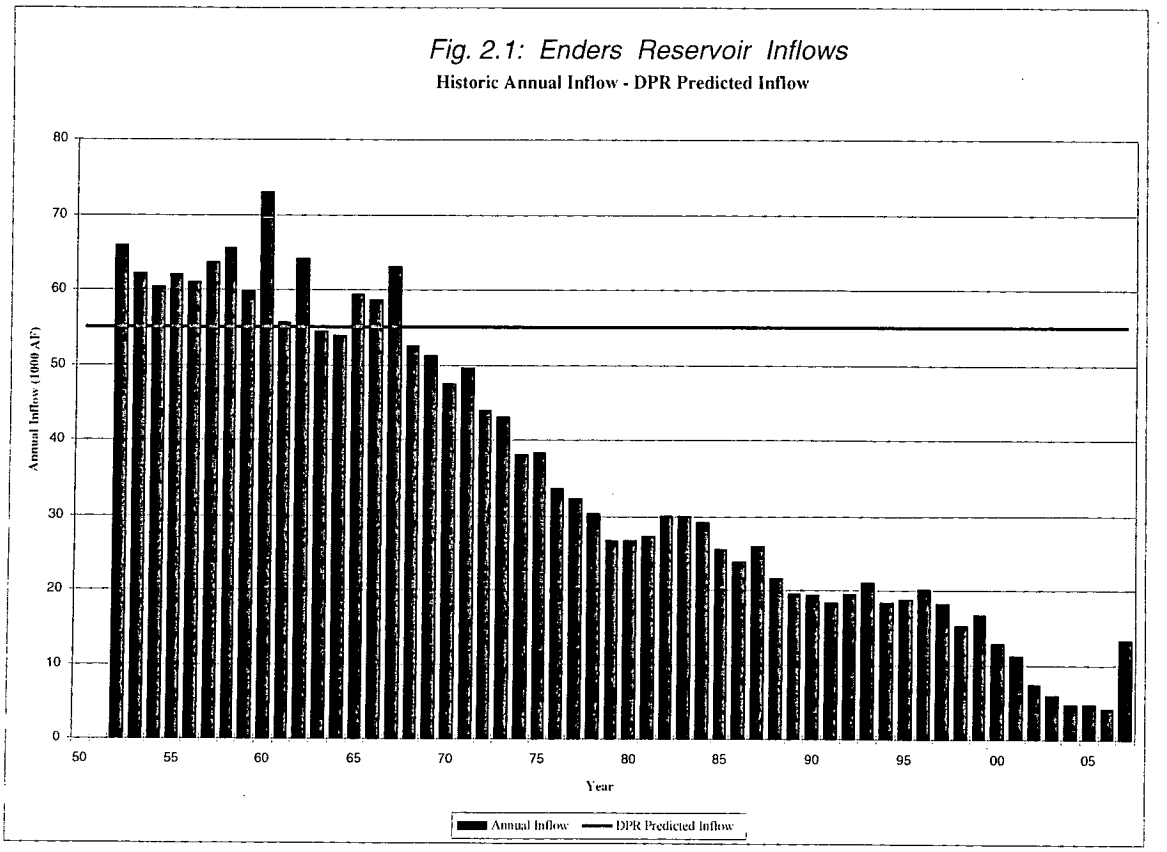
Chapter 2 defines the problems and needs of the Unit area, both present and future. It also lists planning objectives and constraints.

Problems

Declining Water Supply in the Basin

Fig. 2.1 shows annual inflows from Frenchman Creek into Enders Reservoir. The red line in the figure represents reservoir inflows predicted in Reclamation's DPR. The inflows were about 66,000 AF in 1952, a year after the dam closed. Inflows reached their highest point at 74,000 AF in 1961.

Fig. 2.1: Enders Reservoir Inflows



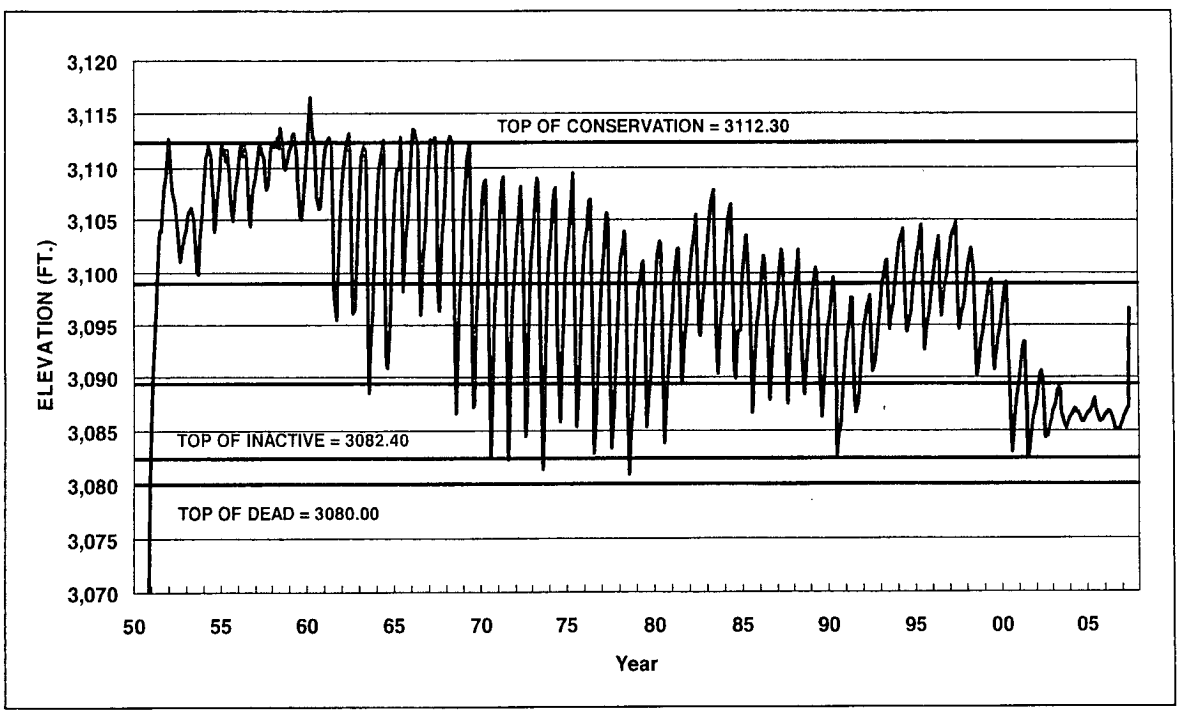
Inflows routinely averaged above those predicted in Reclamation's *Definite Plan Report* (DPR) until the late 1960s, before steadily declining to around 28,000 AF in 1979, where they leveled off until 1984. From that date, inflows declined to just below 20,000 AF in

1989, where they stayed until about 1997. From 1997, inflows continued the downward trend, reaching a historic low of 4,284 AF in 2006. Storms in June 2007 resulted in higher inflows to the reservoir, providing uncharacteristic annual inflows of 13,258 acre-feet. The downward trend is expected to otherwise continue.

Water Demands Exceed Supply

Water demands exceed available water supplies (both current and predicted) in the Frenchman Basin. Declining inflows to Enders Reservoir presents an unfavorable future outlook for project landowners. Fig. 2.2 shows historic end-of-month (EOM) elevations for the reservoir. As shown, inflows were sufficient to consistently fill the reservoir every year until the late 1960's. The last time the reservoir reached TOC (elevation 3112.3 feet, contents 42,910 AF) was in 1968. During the 1970's, inflows to the reservoir and available natural flows began to drop to a point where water deliveries to both districts were reduced. The districts began to conserve storage in Enders for future-year deliveries in the 1980's and 1990's, shown in Fig. 2.2 by the decrease in the annual fluctuation in elevation. Since 2000, inflows to the reservoir had declined to the point where there is not enough water to justify irrigation releases to both FVID and H&RWID. The last time H&RWID took storage water was 2001; the last time FVID took storage water was 2003.

Fig. 2.2: Reservoir End-of-Month Elevations



Studies indicate a direct connection between intensive groundwater pumping in the basin and declining streamflows in Frenchman Creek. A 1963 study by the U.S. Geological Survey looked at geology and irrigation patterns in the basin above the town of Palisade (see map at front). The study analyzed the extent to which future pumping of groundwater might deplete streamflows in Frenchman and Stinking Water creeks (Cardwell and Jenkins ____). A 1974 report provided similar geo-hydrologic data to the Southwest Nebraska Groundwater Conservation District as a basis to assess effects of future groundwater withdrawals in their district (Leonard and Huntoon____).

Reclamation (1977) evaluated the water supply as:

> *The primary problem facing the Frenchman Unit is the continuing decline of the water supply from Enders Reservoir. The results of this appraisal study indicate that intensive private irrigation well development upstream has caused depletion of the base flow of the Frenchman River* (p. I-1).

This report concluded that intensive groundwater development above Enders depleted streamflows at a faster rate than anticipated when the Unit was constructed, and that—unless Nebraska protected surface water rights from depletions caused by groundwater development—the depletion of surface water would continue.

The report made several recommendations:

It is recommended that the State of Nebraska and the Frenchman Valley and H & RW Irrigation Districts pursue the following plans of action:

> *1. Provide measures to protect developed surface water rights from groundwater development in the Frenchman River watershed*
>
> *2. Continue close cooperation with interested local, state, and Federal agencies for the assessment of the basin's hydrologic conditions and develop plans leading to stabilization of the Frenchman Unit's water supply, and*
>
> *3. Investigate the potential for a program pursuant to the Rehabilitation and Betterment Act for ground-water development within or adjacent to the irrigation districts (p.VI-2).*

During renewal of FVID's water service contract in 1996, Reclamation looked at historic and future surface and groundwater supplies in the basin. The report concluded that streamflows in the Republican River Basin had declined due to irrigation, groundwater pumping, and conservation practices:

> *The drilling of wells and the use of groundwater has had an adverse effect on the available flow in the rivers above the reservoirs. Because of the development,*

inflows to Reclamation reservoirs have steadily decreased, diminishing the ability to capture non-irrigation stream flows at all reservoirs within the system.

Water supplies in the tributaries and at stream flow locations upstream of the reservoirs have also shown a decline over the years. This trend can be associated with increases in diversion due to irrigation, groundwater pumping, conservation practices, and stock ponds developed in the basin. Soil and water conservation practices (residue management, terracing, and farm ponds) contribute the largest depletions to the basin water supply. During the past 3 decades, soil and water conservation practices have increased dramatically. . . . Overall, increased water usage has led to a decline in the available water supply in the Republican River and its tributary streams (p.14).

Needs

Irrigation

The Unit is authorized to provide a supplemental water supply for FVID and H&RWID from storage in Enders Reservoir and natural flows of Frenchman and Stinking Water Creeks below the reservoir. Flows are diverted from Frenchman Creek into the Culberson Canal at the Culbertson Diversion Dam near Palisade, Nebraska (see map at front). Normal operations of the Unit expect that reservoir levels gradually rise in the spring towards TOC (Figs.1.2 and 2.2). Irrigation releases from Enders Reservoir normally deplete conservation storage by late summer.

Because of declining inflows into the reservoir, the Unit has not operated as planned since the reservoir last filled in 1968. As the water supply declined, project operations have changed, both districts taking less water from storage in order to save it for the future. Reservoir storage continued to decline: in 2001 there was insufficient water available to justify releases for both districts. Also in 2001, H&RWID did not deliver water for the first time. Storage levels have dropped to a point where FVID elected not to use available storage in 2004. FVID irrigated 2,048 acres by diverting available natural flows below the reservoir.

Continued declining streamflows, both above and below Enders Reservoir, have resulted in reduced deliveries to project lands. As surface water supplies dropped, the irrigation districts delivered less water to fewer acres. With limited water supplies, most project irrigators have installed groundwater wells in order to make up for the shortfall from surface water supplies. An estimated 90 percent of project lands use groundwater to offset the shortage of surface water.

The decline in average water deliveries to FVID and H&RWID is shown in Table 2.1. Deliveries declined 70 percent from 1970-2000 for FVID, 69 percent for H&RWID.

Table 2.1: Irrigation Water Deliveries

	Frenchman Valley District	Hitchcock and Red Willow District
	On-Farm Deliveries 5-Year Average (in/ac)	On-Farm Deliveries 5-Year Average (in/ac)
1966-1970	22.0	17.1
1971-1975	18.9	15.0
1976-1980	13.1	9.4
1981-1985	9.8	8.6
1986-1990	8.6	6.5
1991-1995	5.7	5.1
1996-2000	6.5	5.3

Recreation and Fish and Wildlife

To provide an estimate of visitation by recreation activity, a recently published report by the NGPC was used (Holland and Gabelhouse 2006). Total recreation use averaged approximately 43,000 visits annually and ranged from a low of 39,812 visits to a high of 46,760 visits. Most visits—nearly 80 percent—occurred during the high use season from May to September. The recreation activities identified from highest to lowest visitation levels were camping, fishing, boating, swimming, wildlife observation, hunting, and other (primarily walking/hiking). Camping was by far the most popular recreational activity followed by fishing.

Declining inflows lead to lower reservoir levels resulting in decreased recreation, fish and wildlife benefits at Enders Reservoir. If recreation benefits continue to diminish, the NGPC may have difficulty in justifying future investments in recreation facilities.

Other Needs

One of the identified benefits of the Frenchman-Cambridge Division with a full water supply included maintaining water quality. Reduced streamflows and a lessened water supply from the Unit have caused adverse effects on municipal wells.

Groundwater withdrawals from the area exceed recharge, resulting in groundwater level declines (see Appendix C). The Unit operations provide recharge benefits through canal and lateral seepage, system waste, and on-farm deep percolation. As the Unit's water supply declined, recharge benefits also declined. If the Unit does not deliver water, groundwater levels in the project area would decline at a faster rate.

Planning Objectives/Constraints

Alternative plans were developed to meet planning objectives, while avoiding constraints. Planning objectives are:

- Maintain the viability of the FVID and H&RWID
- Maintain recreation at Enders Reservoir by establishing a minimum pool
- Protect the Federal investment in the Unit.

Constraints are:

- The volume of water available according to location and timing
- The Compact and FSS, including meeting sub-basin allocations
- Nebraska water laws and regulations
- The IMP's for the Upper and Middle Republican NRD's
- The RRWCD in Colorado
- The Flood Control Act of December 22, 1944 as amended, which authorized the Unit of the Frenchman-Cambridge Division.

Chapter 3: *Resources and Opportunities*

This chapter presents an inventory of present resources and a forecast of resources in the future which had a bearing on formulation of alternatives to meet needs of the Unit.

Inventory of Existing Conditions

Land Resources

The Unit lies within a deep valley eroded by Frenchman Creek. This valley is mantled by alluvial (water borne) and loess (wind borne) deposits of soil, underlain by Ogallala sediments and Pierre Shale. The highly pervious alluvium, which is a mixture of sand and gravels deposited along the stream channel, was formed by erosion of the Ogallala Formation. Frenchman Creek has eroded the valley ranging from 1-3 miles in width.

Soils have developed from highly calcareous formations under climatic conditions favoring fairly rapid vegetative growth and decay. In the nearly level bottom lands, soils vary from silty textures in loess to sandy and loamy soils formed in eolian sands. The ridge top soils consist of loamy soils developed from weathered sandstone on the uplands.

Surface and Groundwater Supply

The Republican River Basin in the southwestern part of the state includes Frenchman Creek (see map at front). The Unit receives water from Frenchman Creek stored in Enders Reservoir, from natural flows in Frenchman Creek below Enders, and from the natural flows in Stinking Water Creek. The Ogallala Aquifer, a sub-unit of the High Plains Aquifer composed of unconsolidated clay, silt, sand, and gravel, supplies groundwater a large section of Nebraska. Generally, the aquifer is from 50-300 feet below the surface. Average thickness exceeds 1,000 feet in west-central Nebraska, although the average thickness is about 200 feet. Recharge to the aquifer is primarily from precipitation but also from seepage from groundwater and surface water irrigation.

Surface water supplies have drastically declined in the Basin, the main causes appear to be groundwater development and soil and water conservation practices. Groundwater levels also continue to decline, with some levels dropping more than 50 feet since initial well development (see Appendix C). DNR and the NRDs have implemented plans to reduce pumping to bring Nebraska into compliance with the Compact. Republican River Compact Administration (RRCA) groundwater modeling shows somewhat stabilized streamflows at the planned 20 percent reduced level of depletion from the 1998-2002 baseline pumping volumes. Even with these plans, however, the lag effect of upland wells will eventually cause streamflows to continue to fall (See Figure 3.2).

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Appendix B contains *Density of Registered Irrigation Wells in Nebraska, August 2007*, while Appendix C contains *Groundwater-level Changes in Nebraska: Predevelopment to Spring 2007.*

Surface and Groundwater Quality

The main factor in determining surface water quality during low water is flow and quantity, since biochemical oxygen demands (BOD), nutrients, numbers of bacteria, and turbidity are at their lowest levels during low flow periods.

The water in Frenchman Creek and Enders Reservoir are turbid, containing a moderate concentration of dissolved minerals. There is enough oxygen concentration to support warm-water aquatic life. Within the upper Republican River Basin, water quality parameters are changed by the addition of water of poorer quality from Frenchman, Red Willow, and Medicine creeks. Agricultural practices and agricultural runoff contribute to the increase in fecal coliform, turbidity, suspended solids, and nitrates.

Water quality analysis in 1994 indicated that water quality is generally good throughout the Unit except for selenium. Frenchman Creek carries a fairly high level of nutrients, as evidenced by the high concentrations of nitrates and phosphates.

The Ogallala Aquifer contains water of good-to-excellent quality. Ogallala water tends to be a calcium-magnesium-bicarbonate type when the formation overlies Pierre Shale, and a calcium-bicarbonate type when it overlies Niobrara Chalk.

Alluvium and terrace groundwater deposits have poorer quality water than the Ogallala. A large number of water-quality samples from these deposits exceeded the maximum contaminant levels for total dissolved solids (TDS), sulfate, chloride, and nitrate-nitrogen. These deposits act as collection zones for dissolved salts moving from nearby aquifers to major streams; water tables are generally shallower allowing higher evaporation rates and an increase in salt concentration; and agricultural practices are among the reasons for the increased TDS. When compared to Ogallala water, water from alluvial deposits shifts to sodium-bicarbonate-sulfate type.

Water Rights

Project water rights held by the United States and both districts will not be cancelled by Nebraska for non-use for a period of at least 30 years. As listed in *Nebraska State Statute 46-229.04*, unavailability of project water is an appropriate cause for non-use and project water rights can remain in place for up to 30 consecutive years without deliveries. For basins designated as fully or over appropriated, non-use of project water rights can be extended beyond the 30 year period by petition of the water right holder to DNR.

I am pretty sure this is right, but I don't know SW law that well — you should check w/ Ron

Biological Resources

Grasslands

Before agricultural development, short grass and mixed grass prairie communities were prevalent throughout the prairie region. Most plant species are widely distributed. Vegetative patterns are essentially similar, with the differences largely a matter of local climate, moisture and soil conditions.

Cropland

Non-irrigated farmland in the project area is either dry-land cropland or tame pasture. Crops include wheat, grain sorghum, and forage sorghum. Grazing and hay lands are planted primarily with tame species such as alfalfa, bromegrass, sweet clover, and a variety of wheat grasses.

Irrigated Cropland

The three major irrigated crops in the area are corn, soybeans, and alfalfa. Irrigation has allowed production of other diversified crops such as grain sorghum and sugar beets. With development of ethanol plants in the Republican River Basin, there may be more of a shift to corn, with a consequent reduction in the acres of the other diversified crops.

Woodland and Riparian Communities

Riparian vegetation in the project area occurs mostly in narrow strips from 20-100 feet wide along some reaches of Frenchman Creek. Trees common to the floodplain include cottonwood, elm, box elder, black willow, green ash, black and honey locust, black walnut, and hackberry.

Woodland trees are also found in a few hilly areas and along wooded draws. Prairie thickets are composed of wildrose, hawthorne, snowberry silverberry, wild plum, and chokecherry. Shelterbelt species commonly found around farmsteads include cottonwood, green ash, elm, ponderosa pine, Russian olive, and eastern red cedar.

Avian and Terrestrial Wildlife and Migratory Waterfowl

The diverse habitats in the Unit support a variety of wildlife species. Big game species include white-tailed and mule deer and turkey. Common small game species include the ring-necked pheasant, mourning dove, bobwhite quail, cottontail rabbit, and fox squirrels. Weasels, striped and spotted skunk, coyotes, bobcats, raccoon, black-tailed jackrabbits, and ground squirrels, to name a few, are widely distributed throughout the Unit. Mink and muskrat are associated with aquatic habitats. Beaver occur in the perennial streams and willow-covered overflow areas. Enders Reservoir is within the Central Flyway for waterfowl and shorebirds. Large concentrations of birds use the project area during spring and fall migrations.

Aquatic Resources

Game fish species in the reservoir include walleye, white bass, black and white crappie, and channel catfish. The NGPC's fisheries management goal for Enders Reservoir is to

provide quality angling opportunities for priority species, which include walleye, hybrid striped bass, white bass, white and black crappie, and channel catfish. The NGPC also manages for a balanced largemouth/smallmouth bass-bluegill population. Management objectives are to maintain walleye populations. The NGPC's *Standard Survey Summary and Work Plan for Enders Reservoir* (2003-2004) outlines long-range goals and objectives to maintain a healthy fishery and sustain the recreational use at the reservoir.

Federally-Listed and Proposed Threatened and Endangered Species, Candidate Species, and Species of Concern

The U.S. Fish and Wildlife Service (FWS) provided information on threatened, endangered, proposed, and candidate species and species of concern that may be present within or migrate through the Unit.

The FWS defines *endangered* as those species in danger of extinction throughout all or a significant part of their range. *Threatened* are species likely to become endangered within the foreseeable future throughout all or a significant part of their range. The current list includes mammals, birds, fish, insects, and plants.

Nine species as shown in Table 3.1 have been listed as threatened (T) or endangered (E). These are the threatened piping plover and western prairie fringed orchid and the endangered Eskimo curlew, interior least tern, whooping crane, black-footed ferret, American burying beetle, and Topeka shiner. There is no designated critical habitat in the Unit or at Enders Reservoir.

Candidate species (CS) are those petitioned species whose status is of concern, but more information is needed before they can be proposed for listing by the FWS. Candidate species receive no statutory protection under the Endangered Species Act (ESA); however, the FWS encourages partnerships to conserve these species because they may warrant future protection.

Species of Concern (SOC) are species which the FWS has some concern regarding status and threats, but for which insufficient information is available to indicate a need to the list the species under the ESA. Species of concern do not carry any procedural or substantive protection under ESA.

One species—the mountain plover—has been designated as proposed (P), three species—the swift fox, sturgeon chub, and black-tailed prairie dog—have been designated as CS, and three species—plains topminnow, plains minnow, and flathead chub—have been designated as SOC.

Table 3.1: T&E Species/Species of Concern

	Threatened Species	Endangered Species	Candidate Species	Proposed Species	Species of Concern
piping plover	X				
Eskimo curlew		X			
interior least tern		X			
whooping crane		X			
black-footed ferret		X			
American burying beetle		X			
Western prairie fringed orchid	X				
Topeka shiner		X			
mountain plover				X (T)	
swift fox			X		
sturgeon chub			X		
Black-tailed prairie dog			X		
Plains topminnow					X
Plains minnow					X
flathead chub					X

Cultural and Historic Resources

Before written history, the Unit was occupied by humans for more than 11,000 years. There is evidence that some of the oldest human occupants in North America inhabited the project area.

There are no sacred sites known to exist within the Unit.

Indian Trust Assets (ITA's)

American ITA's are legal interests in assets held in trust by the United States for Indian Tribes or individual Indians. Assets can be considered as anything that has monetary value, including real property, physical assets, or intangible property rights. Examples of resources that could be considered ITA's are land, minerals, hunting and fishing rights, water rights, and instream flows.

More than 40 treaties, executive orders, and legislative documents regarding the Kansa, Pawnee, Northern Cheyenne, Northern Arapaho, Potawatomi, Wyandot, Delaware, Chippewa, Seneca, Mixed Seneca, Shawnee, and Quapaw Tribes, among others, were reviewed to determine whether potential ITA's were present in the Unit. Based upon the information reviewed, it has been determined that there are no ITA's within the Unit.

Recreation

Enders Reservoir generates both water based and land based recreational activity. The reservoir provides about 671 acres of surface area at TOC. Recreation facilities at Enders Reservoir include 2 boat ramps, 2 campgrounds (more than 150 tent sites, 32 recreational vehicle sites), 8 picnic areas, and a designated swimming beach.

Detailed recreation information is summarized in *Frenchman Valley Appraisal Study- Recreational Analysis* in Appendix D. Table REC1 in that appendix displays the most recent five years (2002-2006) of available recreation visitation data by month at *Enders State Recreation Area* obtained from the NGPC. Total recreation use across this period averaged about 43,000 visits annually, ranging from a low of 39,812 visits to a high of 46,760. Most visits, nearly 80 percent, occurred during the high use season from May-September.

Using the full year visitation and percentage by activity estimates, the annual recreation economic value at Enders Reservoir averaged nearly $1.9 million. Focusing primarily on the May-September high recreation season, the annual recreational economic value averaged $1.47 million. The top three activities in terms of economic value were camping, fishing, and boating.

Agricultural Economics

This analysis focuses solely on the changes in pumping costs that would be borne by irrigators for each alternative plan. Detailed information concerning agricultural economics is summarized in *Frenchman Valley Appraisal Study- Agricultural Economics Analysis* in Appendix E.

FVID lands lie along the north side of the Frenchman Creek from the Village of Palisade to the Driftwood Creek in Hitchcock County. H&RWID lands lie north of the Republican River, west of Driftwood Creek in Hitchcock County and extend to just east of the town of McCook (see map in the front of the report. Annual precipitation generally averages about 20 inches per year.

There are 9,292 acres in FVID, 11,695 acres in the H&RWID. Cropping patterns and yield data obtained from Reclamation's 1998 payment capacity study showed that the primary irrigated crops were corn, alfalfa, and soybeans. On a percentage basis, corn accounted for 86 percent of the irrigated acres, alfalfa was 8 percent, and soybeans were 6 percent. Primary dryland crops include a wheat-eco fallow corn-fallow rotation.

Although crop yield data was obtained from the National Agricultural Statistics Service, it is used only in a qualitative manner for this analysis. The qualitative caveat on yields is that the analysis assumes those yields can be consistently attained by applying 12 acre-inches of water. Pumping costs would fluctuate depending on the energy cost. It is assumed that energy costs would increase by 5 percent per year.

Forecast of Future Conditions

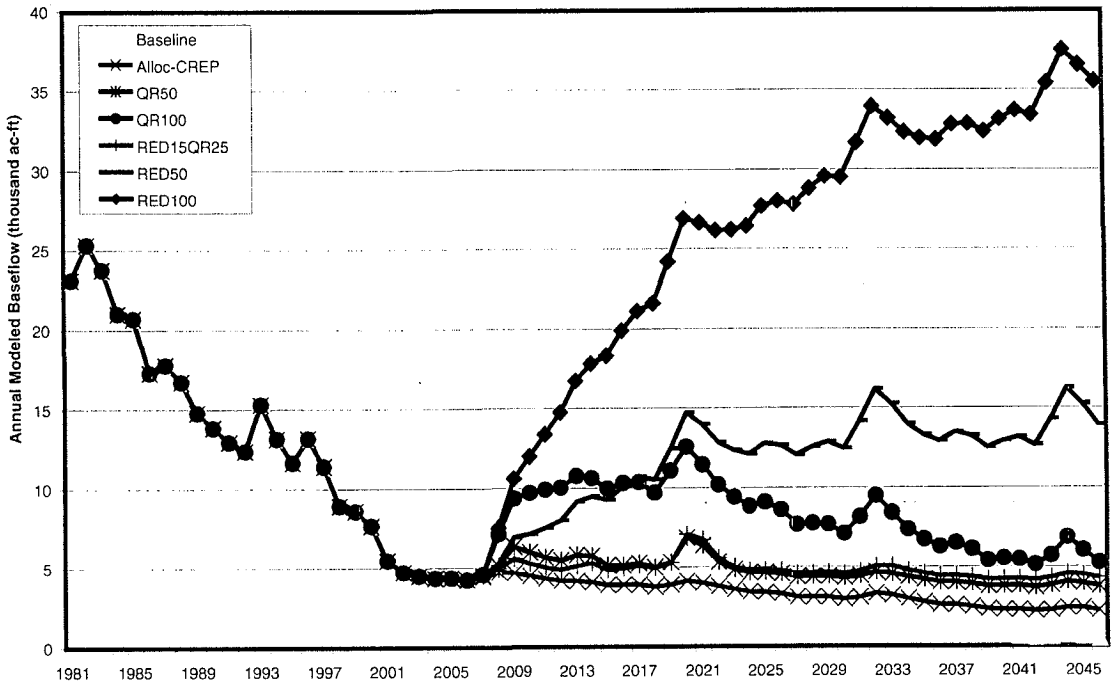
Groundwater Model

The RRCA Groundwater computer model was selected to estimate future streamflows and water supplies for various alternative plans. This model, covering the entire project area, provided an existing tool for predicting future water supplies.

Initial Modeling

Initial model runs incorporated existing NRD pumping allocations and conservation programs, such as the *Conservation Reserve Enhancement Program* (CREP) and the *Environmental Quality Incentives Program* (EQIP) to determine future water supplies in the Frenchman River Basin. Participating agencies identified potential alternative plans, along with corresponding water demands for each. DNR then proceeded with model runs to see if these water demands could be met by reducing groundwater pumping. These early runs analyzed a number of various reduced pumping scenarios, such as reducing alluvial wells, upland wells, or various reductions in both (Fig. 3.1).

Fig. 3.1: Frenchman Creek at Imperial
Average Inflow Conditions Scenario



Alloc-CREP – Predicted flows incorporating existing allocation and existing retirement programs
QR50 – Reduce pumping from quick response wells by 50%
QR100 – Reduce pumping from quick response wells by 100%
RED15QR25 – Reduce all wells by 15% and reduce quick response wells an additional 25%
RED50 – Reduce pumping from all wells by 50%
RED100 – Reduce pumping from all wells by 100%

Three climate scenarios were chosen for model runs using historic precipitation records. The *dry scenario* was represented by repeating data from 2000 (16.2 inches/year), *average scenario* by repeating precipitation data from 1988-1991 (20.1 inches/year), and the *wet scenario* by precipitation records from 1987 (21.7 inches/year). The average year modeling scenario was selected for predicting future streamflows for the project area.

Updated Modeling

A number of events presented opportunities to improve assumptions made for the *Future-Without-Project Condition* (see Chapter 4 for the definition). Nebraska's concerns with complying with the Compact led to updates of the IMP for each NRD (including groundwater management plans). DNR/NRD plans for Compact compliance include limiting shares of Nebraska's groundwater depletions for the Upper Republican

I have no idea what they are talking about here. Pumps haven't changed but the gw mgmt. area rules have changed.

NRD at 44 percent, the Middle Republican NRD at 30 percent, and the Lower Republican NRD at 26 percent. Under this plan, total available groundwater depletions (following the depletions from the surface water diversions) would be set to the percentages listed. The DNR/NRD's plan predicted that these target depletion limits could be met with a 20 percent reduction in pumping volumes from a baseline value established from 1998-2002.

check to see if this might

This updated plan provided a better prediction of actions affecting future streamflows. DNR made adjustments to the model inputs by incorporating this 20-percent reduction in pumping from the baseline. These updated model runs were used to predict future streamflows, which in turn were used to evaluate the alternative plans in this report.

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The updated modeling results using the DNR/NRD's plan for compliance show little improvement to inflows into Enders Reservoir and small increases in natural flows available at the Culbertson Diversion Dam 50 river miles downstream of the reservoir. Fig. 3.2 shows future predicted inflows to the reservoir, both with the initial modeling and with the updated DNR/NRD's plan for compliance. Fig. 3.3 shows a comparison of the future predicted inflows using the DNR/NRD's plan (20-percent reduction in pumping), future inflows with all pumping off, and expected inflows as listed in Reclamation's DPR.

It became evident in these initial and updated modeling runs that all of the water demands in the basin could not be met, even with pumping reduced to zero.

Fig. 3.2: Enders Reservoir

Predicted Average Annual Inflows

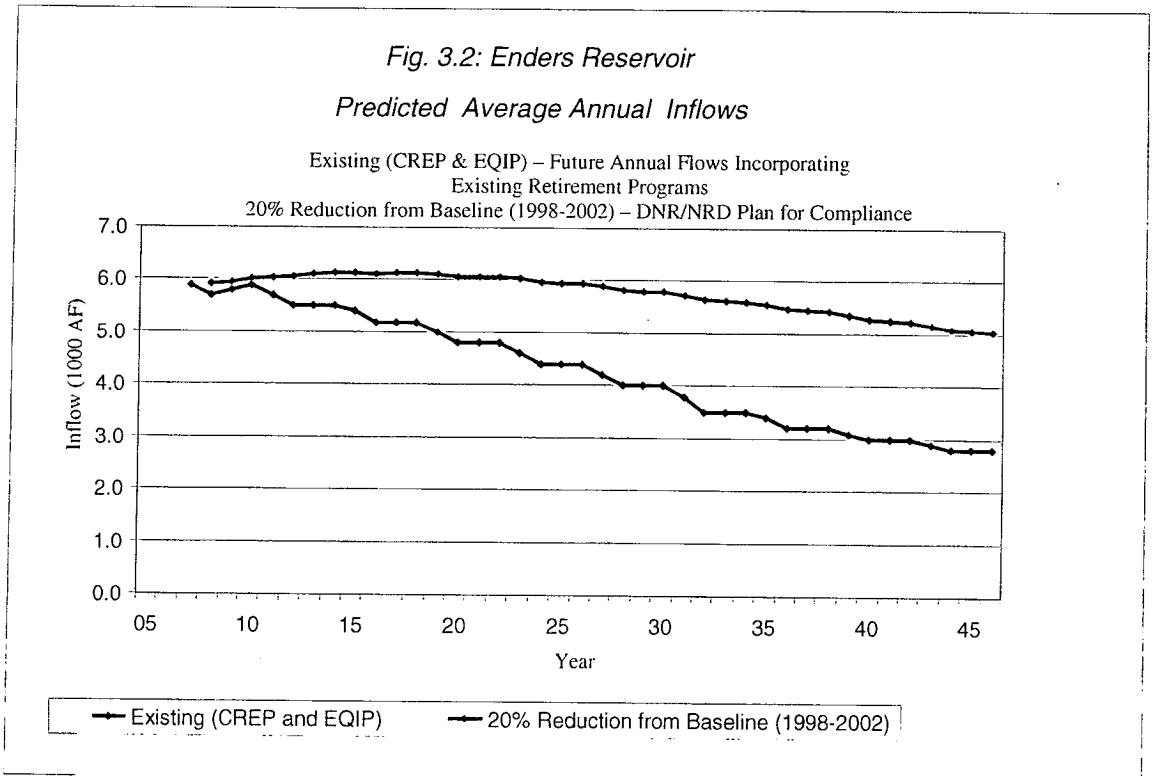
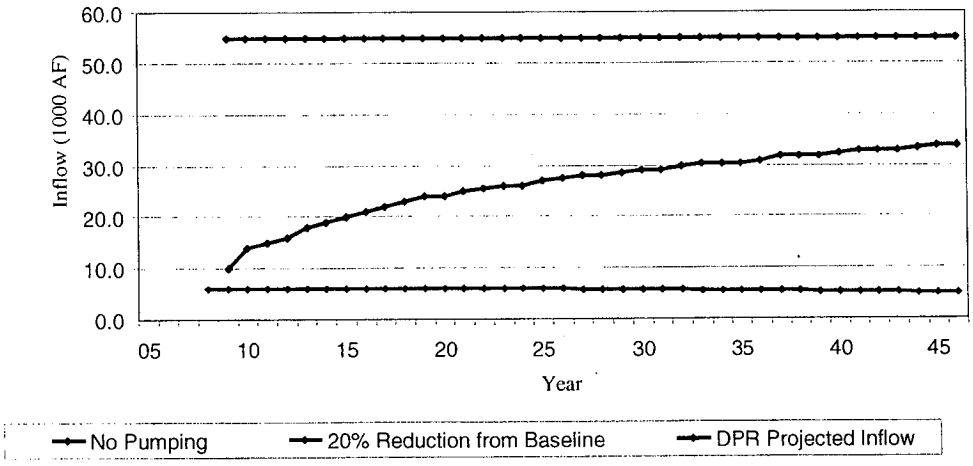


Fig. 3.3: Enders Reservoir

Predicted Average Annual Inflows

No Pumping, 20% Reduced Pumping from Baseline (1998-2002), DPR Projected Inflow



Chapter 4: *Alternatives*

This chapter presents alternative plans developed to meet planning objectives while avoiding violating the constraints to the extent possible. The *Future-Without Project Condition,* the condition to be expected in the study area if no Reclamation action were taken, is included as the basis by which the other alternatives are evaluated and compared. This chapter concludes with a section on "Alternatives Considered but Dropped from the Study".

Alternative Formulation

Alternatives were formulated through the steps described below:

- Input from study partners at the May 4, 2005, technical meeting (Appendix F).
- Conference calls were conducted between study managers and the study team to develop alternative screening criteria. Twenty-two individual criteria were developed in the categories of effectiveness, implementability, and cost (see Chapter 5). These criteria were refined as formulation progressed.
- A workgroup of study managers and some team members drafted summary tables for the four alternatives (including the Future-Without Project Condition). The workgroup scored each alternative as "good," "fair," or "poor" according to the alternative criteria.
- Draft summary tables were exchanged among the workgroup for review and comment with the following stipulations: review the appraisal report for each alternative; review the summary table for each alternative; mark ratings disagreed with and add suggested ratings with an explanation. Put comments in a box on the table provided for the purpose for that particular alternative. The workgroup comments were compiled as a starting point for discussion.
- Conference calls were held to resolve concerns and differences; review ratings; and finalize the summary table.

Three alternatives were developed using the formulation process described above:

- Flow-through Alternative
- Recreation Alternative, and
- Groundwater Recharge Alternative.

These alternatives are detailed below following the Future-Without Project Condition.

Future-Without Project Condition

The Future-Without Project Condition represents "no change" in present conditions of the Unit. To the extent possible and—given the severe depletion in inflows—this alternative would maintain the viability of the FVID and H&RWID, would maintain at least some recreation in the reservoir, and would protect the Federal investment in the Unit.

The FVID can continue to operate utilizing available natural flows with/or without limited irrigation storage releases. There is enough natural flow available for the FVID to continue to operate and meet their contract obligations. H&RWID's contract repayment obligations are based on the amount of irrigation storage available in Enders Reservoir. With limited irrigation storage available, H&RWID's payments are small enough that they can continue to make payments in the event that streamflows improve providing future project deliveries, without the fear of losing their water right due to non-use (see Water Rights, page 14).

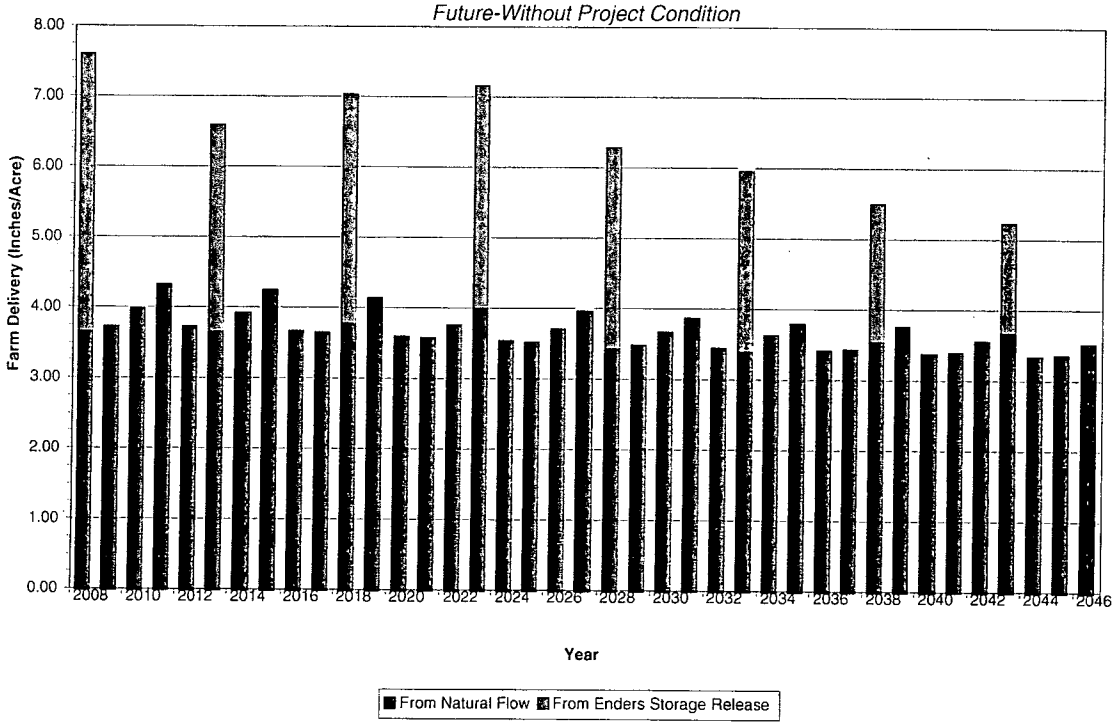
Irrigation

In the Future-Without Project Condition, Enders Reservoir would continue to provide irrigation water when available to 9,292 acres in the FVID and 11,915 acres in the H&RWID. According to project water rights, diversion of all available natural flows would continue and Enders storage would be available for irrigation releases down to the bottom of conservation, elevation 3082.40 feet.

With the 20 percent reduction in baseline (1998-2002) groundwater pumping volume proposed by DNR and the Upper and Middle Republican NRD's to comply with the Compact, inflows into the reservoir would stabilize at the 6,000 AF/ year level for a few years but would continue to drop in the future when the lag effect from the upland wells began to affect streamflows (see Fig. 3.2). The FVID and H&RWID receive authorized project benefits by diverting available natural flows from the Creek and by using project water stored in the reservoir. Because of the lack of available storage water in Enders, the Unit's delivery system would only benefit FVID.

The Future-Without Project Condition would require guidelines for when available reservoir storage could be used for project purposes. Available natural flows would provide an on-farm delivery of about 4 inches/acre to the FVID. Due to the limited available (and predicted) inflows and conservation storage in Enders Reservoir, it was assumed that H&RWID would not deliver water in the Future-Without Project Condition-Project-Condition. It was also assumed that the FVID would utilize available conservation storage every fifth year. This would result in FVID delivering an average of just less than 4 inches per acre from natural flow each year and an additional 3 inches per acre every fifth year from storage releases as shown in Figure 4.1.

Fig.4.1: Predicted Farm Deliveries –FVID
20% Reduction from Baseline Pumping (1998-2002)
Future-Without Project Condition



If H&RWID elects to utilize their limited available storage (in an effort to retain their water rights and/or to provide groundwater recharge benefits), they would be able to deliver approximately 2 inches per acre every fifth year. If H&RWID elects to deliver water, this would lower the deliveries to FVID to a level approximately equivalent to FVID's deliveries by natural flows only, or lowering the fifth year deliveries by 2.5 to 3 inches per year.

Figures 4.2 and 4.3 show predicted deliveries for FVID and H&RWID, respectively, if H&RWID elected to take their share of reservoir storage every fifth year. For this scenario, it was assumed that H&RWID would take water in July. This would result in all Enders storage and the natural flows available in July being divided equally between all project acres.

Fig. 4.2: Predicted Farm Deliveries - Frenchman Valley Irrigation District
20% Reduction from Baseline Pumping (1998-2002)
Future-Without Project Condition - Sharing July with H & RW Irrigation District

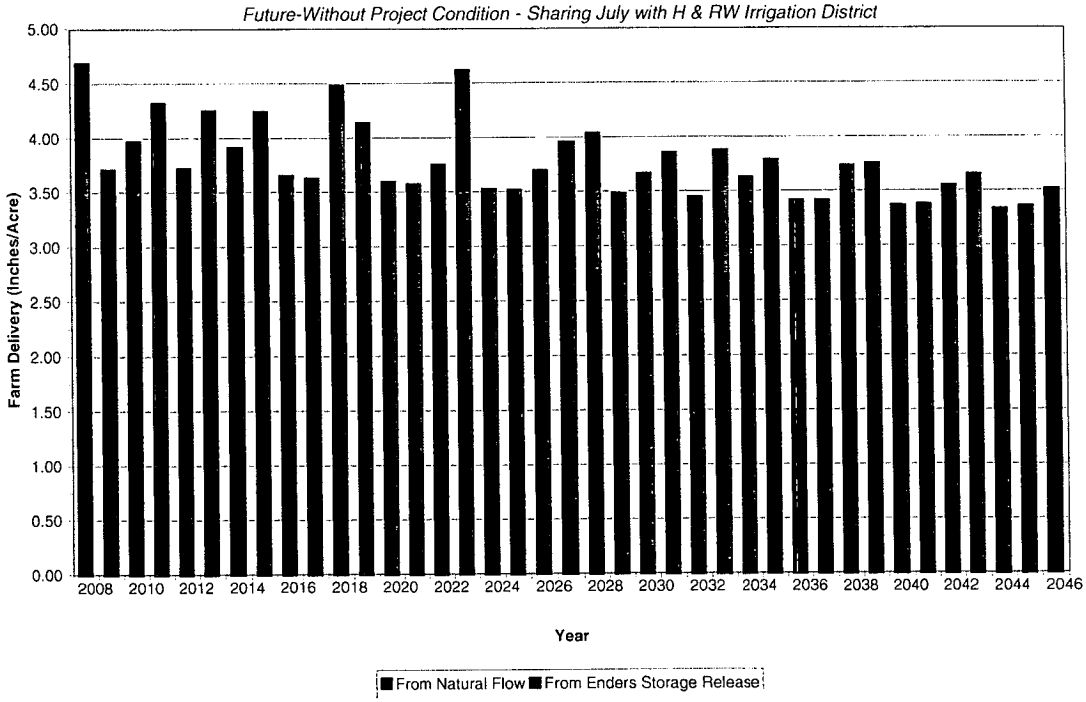
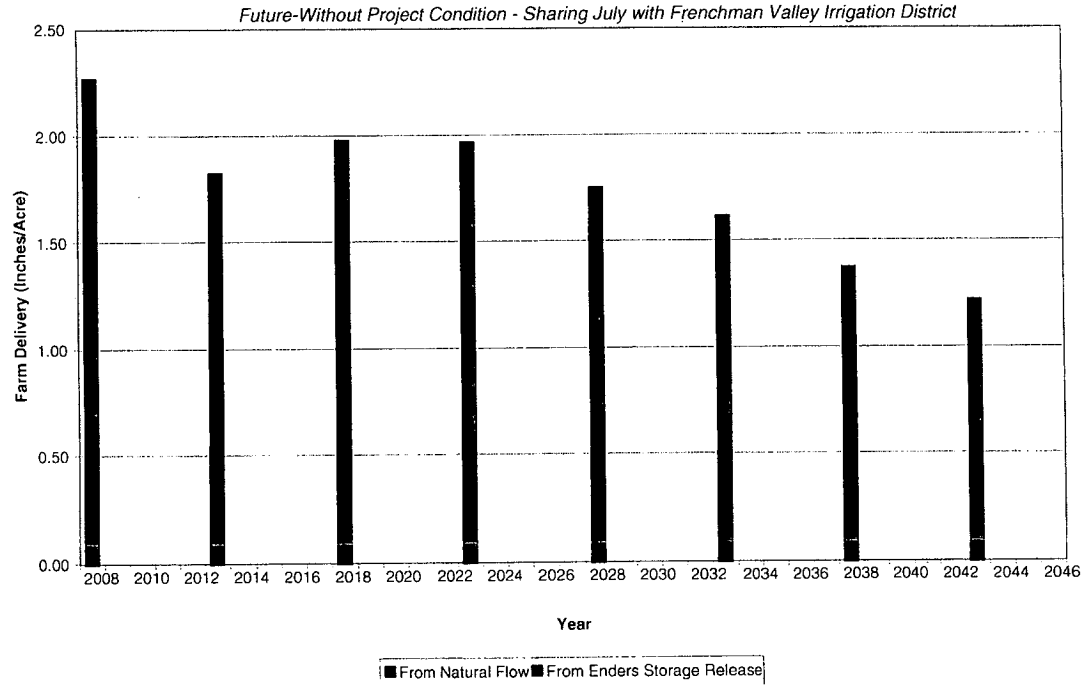


Fig. 4.3: Predicted Farm Deliveries - H&RW Irrigation District
20% Reduction from Baseline Pumping (1998-2002)
Future-Without Project Condition - Sharing July with Frenchman Valley Irrigation District



A detailed agricultural economic analysis is summarized in Appendix E.

Recreation, Fish, and Wildlife

There are 751 acres of land designated as a State Recreation Area and 2,892 acres designated as a Wildlife Management Area at Enders. At TOC (elevation 3112.4 feet), the reservoir has about 1,707 surface acres. In the Future-Without Project Condition, the NGPC continues to administer and manage land and water at the reservoir for recreation, fish, and wildlife. However, the reservoir surface area would be 627 acres at elevation 3082.4 feet.

Hunting for big game, waterfowl, and upland game birds is popular on public lands at Enders Reservoir. These activities are expected to continue into the future regardless of the alternative.

Fishing for white bass, crappie, northern pike, wipers, catfish, and walleye is available in Enders Reservoir. Flat-water recreation is also popular. Interest in fishing and flat-water recreation declines when the reservoir elevation in Enders in later August and early September. This trend would continue.

Detailed information concerning recreation activities at Enders Reservoir is summarized in Appendix D.

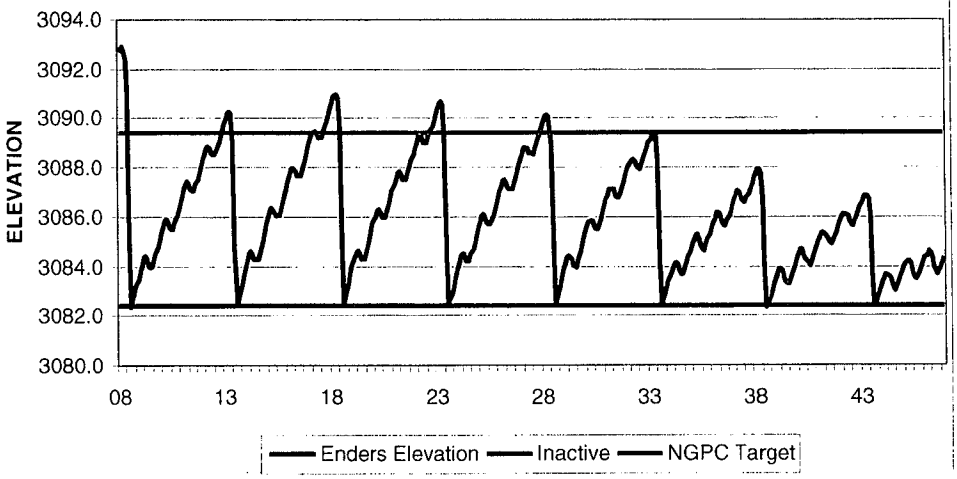
Reservoir Operations

In the Future-Without Project Condition there would be no change in the project authorized purposes or in Enders Reservoir allocations. The maximum water surface is 3129.5 feet (79,161 AF); top of the flood control pool elevation 3127.0 feet (72,958 AF); TOC is elevation 3112.3 feet (42,910 AF); and the active conservation pool would extend down to elevation 3082.4 feet (8,948 AF).

Modeling results for the Future-Without Project Condition showed that inflows initially stabilize around 6,000 AF/year until the year 2025, before reverting back to a slow decline (see Fig 3.2). Assumptions were made on future reservoir operations using predicted inflows and predicted available natural flows. After reviewing available irrigation storage, it was hypothesized that the FVID would request irrigation releases every fifth year. This would result in FVID project acres receiving about 3 inches/acre from Enders Reservoir.

The reservoir would gradually rise to an average elevation of 3090.0 feet on the fifth year before irrigation releases would drop it back to the bottom of conservation pool, elevation 3082.4 feet. Predicted surface water elevations in the reservoir are shown in Fig. 4.4 in relation to NGPC's target elevation.

Fig. 4.4: Enders Reservoir Estimates
Predicted Elevation
Future-Without Project Condition- FVID 3" Deliveries Every 5 Years



Agricultural Economics

In the Future-Without Project Condition, the FVID would receive 3 acre-inches of water from reservoir storage every five years. In the years no storage water was delivered, each project acre would receive 4 acre-inches of natural flows and 8 acre-inches of pumped groundwater. In the years when storage water was delivered, each acre would receive 4 acre-inches of natural flows, 3 acre-inches of storage water, and 5 acre-inches of pumped groundwater. (Table 2 in Appendix E shows the water delivery schedule, the volume of water delivered from pumping or storage, the net present value of the pumping cost per acre-inch, the pumping cost per acre, and the total pumping cost for all project acres in FVID.)

The net present value of groundwater pumping costs for FVID ranged from $8.34/acre in 2008 to an estimated $17.64/acre in 2046. When all pumping costs for all years and for 9,292 project acres in FVID were added up, there would be an outlay of $4.96 million for pumping costs. This $4.96 million would be costs incurred by project irrigators due to the lack of a full project water supply. Cost of pumping project water verses pumping groundwater was considered in determining this estimate. Pumping of project water was assumed necessary due to the high percentage of sprinkler irrigation in the project area.

Flow through Alternative

In this alternative, the outlet works gates at Enders Dam would be fully opened to bypass flows through the reservoir to the Frenchman Creek. This alternative would maintain

viability of the FVID and H&RWID and it would significantly reduce water-based recreation in Enders Reservoir.

FVID would continue to operate by diverting the available natural flows and by diverting the Enders Reservoir bypassed flows. These available flows would supply enough water to keep the FVID in operation and would allow FVID to meet their contract obligations. By eliminating the conservation storage in Enders Reservoir, H&RWID would not be able to divert water without some sort of agreement with the FVID. If the Districts do agree to share available flows, both of the Districts' repayment contracts would need to be revised.

Irrigation

Inflows in this alternative would pass directly through the reservoir to the Creek downstream, where they would be available for diversion by FVID and H&RWID. The FVID's natural flow water right is senior to that of H&RWID. Currently, H&RWID would only receive irrigation water if storage water were released from the reservoir. In order to share natural flows, an agreement between the two districts would be required.

If inflows into Enders were passed through and not stored, they would add to existing natural flows available at the Culbertson Diversion Dam. Bypassing inflows would equal about 0.6 inches/acre that would become available to the FVID, for a total delivery of approximately 4.5 inches/acre. If the natural flows were shared between FVID and H&RWID, the total delivery to both districts would be slightly less than 2 inches/acre. Predicted water deliveries to the FVID in this alternative are shown in Fig. 4.5, while deliveries to both FVID and HR&WID are shown in Fig. 4.6.

Fig. 4.5: Predicted Farm Deliveries FVID
20% Reduction from Baseline Pumping (1998-2002)
Flow Through Alternative

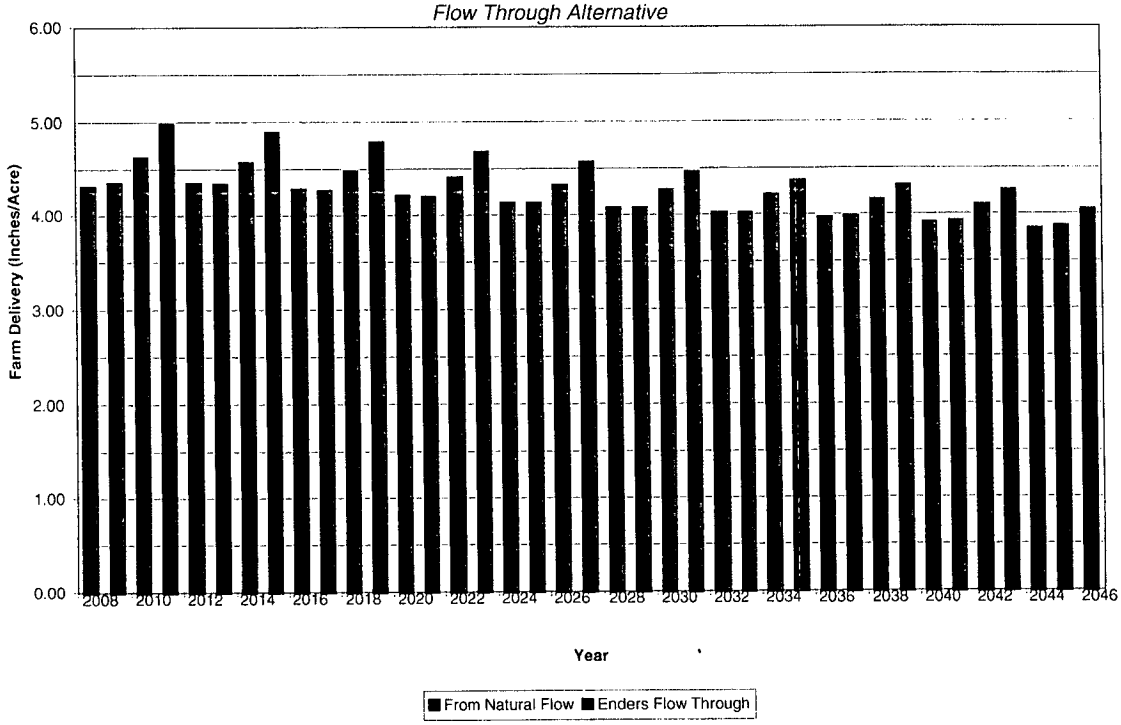
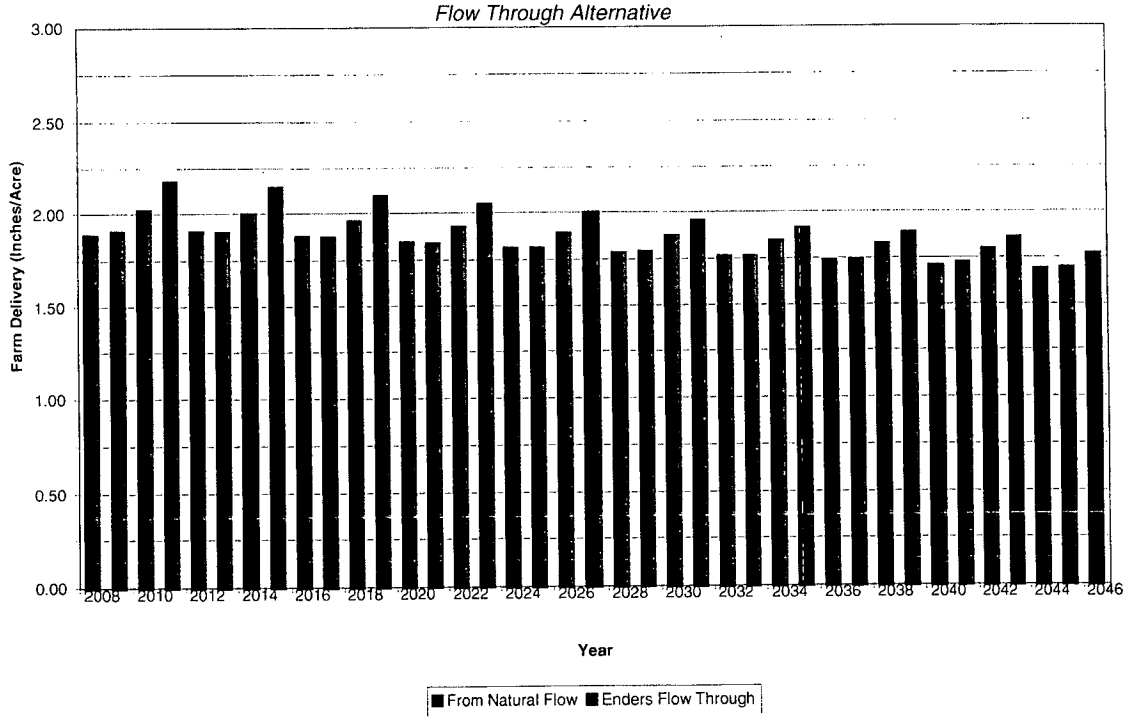


Fig. 4.6: Predicted Farm Deliveries - FVID and H&RWID
20% Reduction from Baseline Pumping (1998-2002)
Flow Through Alternative



Recreation, Fish, and Wildlife

No boat ramp facilities would be available for use in the Flow through Alternative (see Table REC5 in Appendix D). When compared to the Future-Without Project Condition, this alternative would:

- Reduce availability of the Center Dam Boat Ramp from January-June during wet conditions (without a *2-foot cushion* which is without 2 feet being added to each ramp to allow for boat launching during low water conditions).

- Reduce availability of the new Low Water Boat Ramp in all months during wet conditions (with 2-foot cushion), and in all months during average and wet conditions (without 2-foot cushion).

- Reduce availability of Cow Swimming Beach during high use season in May and June during average conditions and May-September during wet conditions.

This alternative would result in a significant loss of recreational visits to the reservoir, with consequent adverse economic effects when compared to the Future-Without Project Condition. Recreational use would be severely limited as the reservoir was drawn down to designated dead pool. There would be 567 surface acres available at elevation 3080.0 feet. The NGPC might continue to manage lands around the reservoir for hunting and camping, but fishing and flat-water recreation would all but disappear.

Reservoir Operations

Since Enders Reservoir would be operated as a flow-through facility in this alternative, remaining storage would be at the top of dead pool at elevation 3080.0 feet (7,516 AF). The reservoir would still be capable of storing flood flows.

Agricultural Economics

In the Flow through Alternative, there would be no water deliveries from reservoir storage to FVID and H&RWID. Irrigators within the FVID would take 4.5 inches/acre of natural flows annually and pump 7.4 inches/acre of groundwater per year of the study period. Pumping costs were figured on pumping 7.4 inches/acre annually, with an increasing cost for electrical energy. Pumping costs would range from $9.24/acre to $16.37/acre on a net present value basis. The net present value of pumping costs for all 9,292 acres in the FVID would add up to $4.96 million.

Table 3 in Appendix E shows natural flows, volume pumped per year, total deliveries per acre per year, pumping costs per year, and the total amount of pumping expenses that would accrue.

Recreation Alternative

The Recreation Alternative would establish a new minimum pool at elevation 3089.4 feet in Enders to maintain the existing reservoir fishery and increase other forms of flat-water recreation. This elevation was recommended by the NGPC in their Standard Survey Summary and Workplan: Enders Reservoir, 2003-2004 (2006). The top of the inactive pool would remain at elevation 3082.4 feet (storage of 8,948 AF, at 627 surface acres). This alternative would sustain the viability of the FVID and H&RWID, would continue to provide recreation benefits, and would protect the Federal investment in the Unit.

In the Workplan the NGPC also recommended establishment of a minimum pool at Enders Reservoir at elevation 3099 feet. A review of the initial hydrology modeling, however, showed that there would not be adequate inflows into the reservoir to reach and/or sustain this elevation. The target minimum pool was established at elevation 3089.4 feet and adopted for the Recreation Alternative.

Irrigation

For this alternative, it was assumed that storage above reservoir elevation 3089.4 feet would be available for irrigation releases for the FVID and/or H&RWID. RRCA groundwater modeling showed inflows into Enders would support the higher minimum pool, but that there would not be adequate inflows to support yearly irrigation storage deliveries.

Two reservoir operation conditions were reviewed, one without reservoir storage deliveries and one with reservoir storage deliveries. In the Recreation Alternative with storage deliveries, the higher minimum pool would result in less available irrigation storage, meaning further reductions in the water available to H&RWID. For this alternative, it was assumed that all storage water would be utilized by FVID. Storage above elevation 3089.4 feet would be released every five years similar to the Future-Without Project Condition. These releases would be added to the natural flows generated below the reservoir and would be diverted into the Culbertson Canal for delivery to FVID project acres. This would result in an initial additional delivery of about 1.5 inches/acre every fifth year to the FVID only. As inflows declined, storage available for irrigation releases would eventually be reduced to 1 inch/acre in the year 2028, and to 0.5 inches/acre in 2033. With future inflow declines caused by the lag effect of upland groundwater wells, eventually the small amount of available irrigation storage would diminish. Predicted deliveries are shown in Fig. 4.7.

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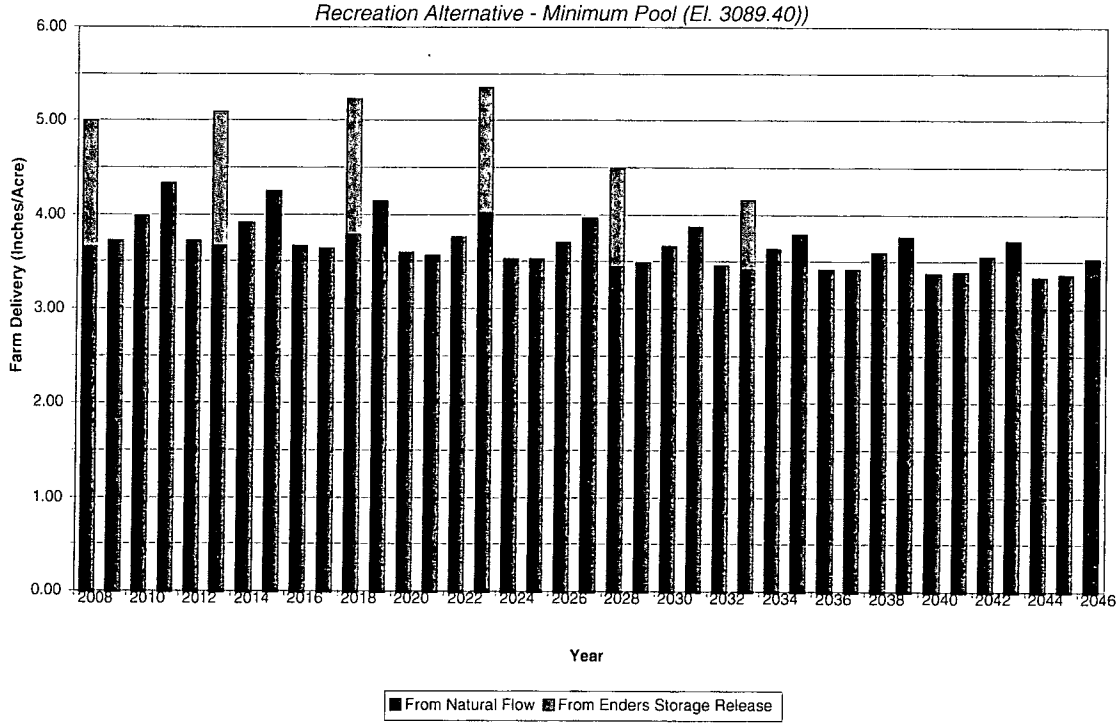
Fig. 4.7: Predicted Farm Deliveries in the FVID
20% Reduction from Baseline Pumping (1998-2002)
Recreation Alternative - Minimum Pool (El. 3089.40))



Note: If this alternative were combined with the Groundwater Recharge Alternative, any storage water above elevation 3089.4 feet would be released each year.

Recreation, Fish, and Wildlife

In this alternative, there would be about 14,426 AF of storage and about 825 surface acres in the reservoir at elevation 3089.4 feet. The NGPC would continue to manage lands and water at the reservoir. Hunting would continue, and camping, fishing, and flat-water recreation would improve when compared to the Future-Without Project Condition.

This analysis considered two scenarios for this alternative: recreation without irrigation deliveries from storage, and recreation with irrigation deliveries.

Recreation without Storage Deliveries

For this scenario without deliveries, all recreational facilities would be available except for the Center Dam Boat Ramp during dry conditions (with the 2-foot cushion). (See Table REC7 in Appendix D.) Compared to the Future-Without Project Condition, this alternative without storage deliveries would:

- Increase availability of the Center Dam Boat Ramp in all months during average and wet conditions and during dry conditions in March and April (with a 2-foot cushion). Without the 2-foot cushion, the increase in availability would occur

during all months during average and dry conditions and from July-December during wet conditions.

- Increase availability of the Low Water Boat Ramp in all months during average and dry conditions (with the 2-foot cushion), and in all months during dry conditions (without the 2-foot cushion).

- Increase availability of Cow Beach during high use season of July-September during average conditions and May-September during dry conditions.

This scenario would provide the largest gain in recreational visits and economic effects when compared to the Future-Without Project Condition.

Recreation with Storage Deliveries

For this scenario with deliveries, the Center Dam Boat Ramp would be generally unavailable (except from January-May during wet conditions) with the 2-foot cushion, and generally available (except in August and September during dry conditions) without the 2-foot cushion. The Low Water Ramp and Cow Beach would be available across during all water conditions (see Table REC8 in Appendix D).

Compared to the Future-Without Project Condition, this scenario would:

- Increase availability of the Center Dam Boat Ramp from January-May during wet conditions with the 2-foot cushion. Without the 2-foot cushion, availability would increase in all months during average and dry conditions (except for August and September during dry conditions, and from July-December during wet conditions).

- Increase availability of the Low Water Boat Ramp in all months during average and dry conditions (with the 2-foot cushion), and in all months during dry conditions (without the 2-foot cushion).

- Increase availability of Cow Beach in the high use season of July-September during average conditions and May-September during dry conditions.

This scenario would result in a gain in recreational visits and economic effects when compared to the Future-Without Project Condition, but perhaps somewhat less than this alternative without storage deliveries.

Reservoir Operations

The new minimum pool of elevation 3089.4 feet could be achieved several ways:

- Congressional legislation could change authorized project purposes from "irrigation and flood control" to "recreation, fish and wildlife, and flood control".

This would eliminate irrigation storage in the reservoir and transfer the conservation pool to the NGPC.

- Develop a multi-year agreement between NGPC and the FVID and H&RWID to establish the new minimum pool elevation. As part of the agreement, the FVID and H&RWID would agree not to request irrigation releases once the reservoir reached elevation 3089.4 feet. Similar agreements have been established for other Reclamation reservoirs. Reservoir storage above the new minimum pool would be available to the districts and would most likely be released intermittently.

- This study assumed the new minimum pool would be achieved by modifying existing FVID and H&RWID contracts. During contract negotiations with the irrigation districts in the Republican and Solomon River Basins in 2000 and 2001 respectively, higher minimum pools were established at four reservoirs. A higher minimum pool at Enders Reservoir was considered, but was not implemented due to the existing shortfalls in project water supplies from declining inflows. Modifying present contracts would not require Congressional legislation and would retain irrigation as an authorized project purpose.

Currently, the active conservation pool has 33,962 AF and 1,707 surface acres between elevations 3112.3 and 3082.4 feet. By raising the minimum pool elevation to 3089.4 feet, there would be 28,901 AF of conservation storage available for irrigation. The existing contracts with FVID and H&RWID could be changed by designating the new minimum pool elevation at 3089.4 feet, reducing the volume of water available for irrigation releases.

Fig. 4.8 shows reservoir elevations for the Recreation Alternative without deliveries from storage compared to both NGPC target elevations (elevation 3089.4 feet and elevation 3099.0 feet) while Figure 4.9 shows the elevations for the Recreation Alternative with deliveries compared to the NGPC target elevation of 3089.4 feet.

Fig. 4.8: Enders Reservoir

Predicted Elevations

Recreation Alternative - No Deliveries

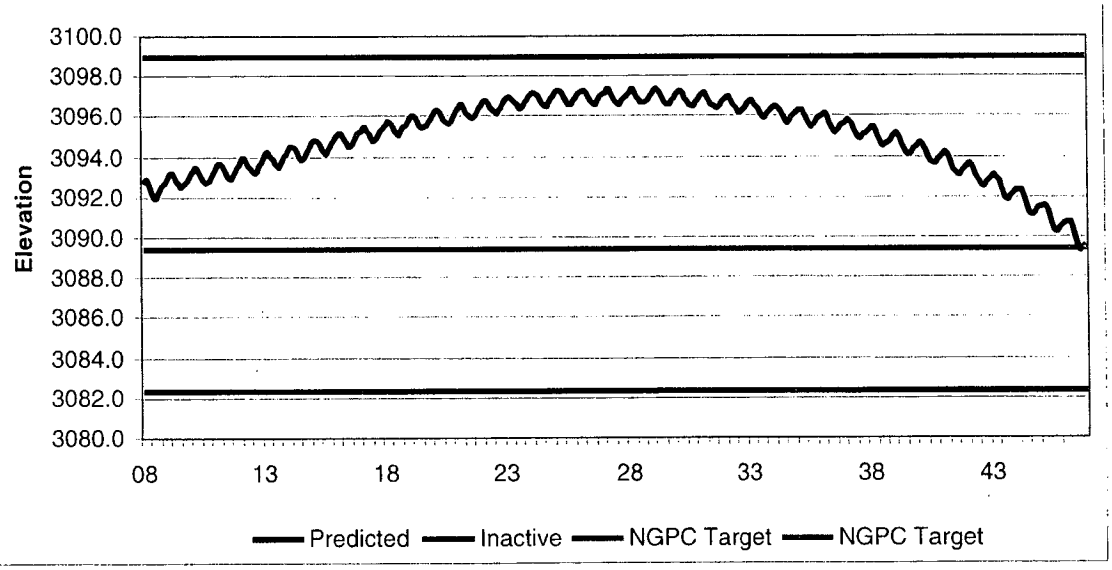
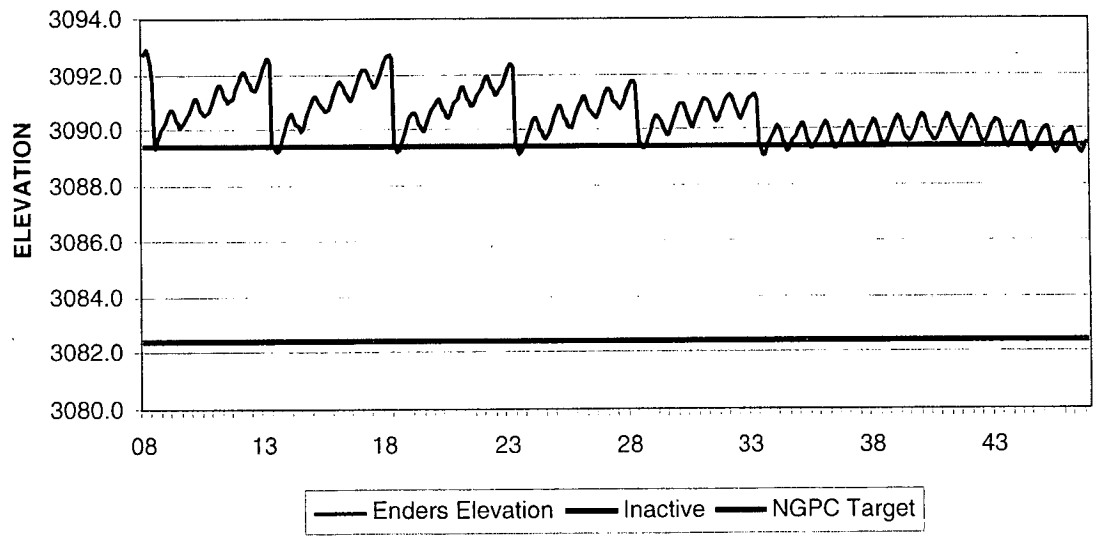


Fig. 4.9: Enders Reservoir

Predicted Elevations

Recreation Alternative – With Deliveries



Agricultural Economics

The agricultural economics analysis evaluated the same possibilities for the Recreation Alternative as the other analyses: recreation without deliveries from storage and recreation with deliveries from storage.

Recreation without Storage Deliveries

This scenario assumes that no storage water from Enders Reservoir would be released. Project acres in the FVID would receive 4 acre-inches from natural flows and 8 acre-inches of pumped groundwater each year. H&RWID would not receive any project water and would rely totally on groundwater (12 acre-inches).

Pumping costs would range from $9.92/acre to $17.64/acre on a net present value basis. The net present value of pumping costs for 9,292 acres in the FVID is about approximately $5.34 million. (Table 5 in Appendix E shows the volume of groundwater pumped per year, total deliveries per year, pumping costs per year, and the total amount of pumping expenses that would accrue under this scenario.)

Recreation with Storage Deliveries

This scenario assumes the FVID would deliver 2 acre-inches of storage water from the reservoir every 5 years. Project acres would receive 8 acre-inches of pumped groundwater and 4 acre/inches of natural flows in four of every five years. In the fifth year, project acres would receive 6 acre-inches of pumped groundwater, 4 acre-inches of natural flows, and 2 acre-inches of storage water. H&RWID would not receive any project water and would rely totally on groundwater (12 acre-inches).

Pumping costs would range from $7.55/acre to $17.64/acre on a net present value basis. The net present value of pumping costs for 9,292 acres in the FVID is about $5.07 million. (Table 6 in Appendix E shows the project deliveries, volume pumped per year, total deliveries per year, pumping costs per year, and the total amount of pumping expenses that would accrue under this scenario.)

Groundwater Recharge Alternative

This alternative would eliminate project deliveries and the Frenchman Unit would be operated in an effort to recharge groundwater in the project area.

With this alternative, the Districts would continue to divert available flows (with and without reservoir releases) into the delivery system for the purpose of recharging the groundwater in the project area. These diversions would be recognized for recharge benefits but would also be recognized as a benefit for irrigation.

Reclamation recognizes that the Frenchman Unit systems losses are being utilized by groundwater pumpers in the project area. In the Groundwater Recharge Alternative, even

though the Districts may not be making deliveries from the canal/lateral system, the diverted flows are being used for irrigation by groundwater pumpers.

Conversion to a recharge project would raise a number of questions that would have to be addressed:

1. Should the delivery system be operated with natural flows only (no releases from Enders Reservoir)?

2. Should the delivery system be operated with natural flows and use available storage from Enders above the top of the inactive pool (elevation 3082.4 feet)?

3. Should the delivery system be operated with natural flows only in combination with minimum pool at Enders (elevation. 3089.4 feet), with no releases from Enders Reservoir?

4. Should the delivery system be operated with natural flows and using Enders storage above the minimum pool at elevation 3089.4 feet?

This alternative would maintain the viability of the FVID by providing project water through the delivery system to be pumped by project irrigators. H&RWID's viability would depend upon an agreement with FVID for sharing natural flows for recharge in the eastern portion of the Unit. Recreation benefits would remain the same or increase (in comparison to the Future-Without Project Condition), depending on which minimum pool was selected in conjunction with this alternative (existing elevation 3082.4 feet or NGPC target elevation 3089.0 feet). The Federal investment could be protected by the repayment of contracts by the groundwater recharge beneficiaries.

Irrigation

The project would be operated to deliver water throughout the delivery system. Storage water from Enders Reservoir would be released yearly regardless of the target pool elevations of 3082.4 and 3089.4 feet. The FVID and H&RWID would agree to share natural flows.

Groundwater is currently being recharged from operating the delivery system, but it is not an authorized purpose of the project. As inflows to the reservoir have diminished, the Unit has been operating with natural flows below the dam. Both project and non-project irrigators have drilled groundwater wells to compensate for shortages from the surface water supply. An estimated 90 percent of project lands are now irrigated with groundwater, and irrigators acknowledge that delivery system losses are recharging the groundwater aquifer in the area.

Reclamation recognizes that under normal project operations, delivery system losses are recharging the groundwater in the project area. If the project is changed to a groundwater

recharge project, Reclamation would continue to acknowledge irrigation as an authorized project purpose. Project diversions are eventually used by groundwater pumpers for irrigation.

Under Nebraska law, the FVID has the senior water right to natural flows in the Frenchman Creek. Currently, the delivery system is only operated within the FVID area. The H&RWID, who has a junior natural flow right, receives water only when storage water is released from Enders Reservoir. In order to expand groundwater benefits from natural flows down to the H&RWID area, the current water rights would need to be amended and/or changed.

Recreation, Fish, and Wildlife

Recreation, fish, and wildlife benefits for the Groundwater Recharge Alternative would be based on the selection of the minimum pool elevation to be utilized with this alternative.

If the minimum pool is set at the top of inactive pool (elevation 3082.4 feet) and assuming that inflows are released for recharge, the reduction in recreational facility availability mirrors that of the Flow through Alternative. None of the recreation facilities would be available in the Groundwater Recharge Alternative (see Table REC6 in Appendix D).

This alternative would result in a loss in recreational visits and economic value when compared to the Future-Without Project Condition and similar to effects of the Flow through Alternative. There would be 8,948 AF of storage and about 627 acres of surface area at elevation 3082.4 feet. The NGPC might continue to manage wildlife land and water at the reservoir for recreation, fish, and wildlife. Primitive camping and hunting might still continue, but there would be no fishing or flat-water recreation opportunities. The NGPC has expressed concerns in investing in facility improvements with lower reservoir levels.

If the minimum pool is set at the NGPC target elevation of 3089.4 feet, there would be an increase in recreation, fish and wildlife benefits that would be similar to that of the Recreation Alternative with storage releases (see Table REC8 in Appendix D).

This alternative would result in an increase in recreational visits and economic value when compared to the Future-Without Project Condition and similar to the effects of the Recreational Alternative.

There would be 14,426 AF of storage and about 825 acres of surface area available. This higher minimum pool would provide NGPC with a more consistent reservoir pool and increase their confidence in investing in facility improvements.

Reservoir Operations

The Groundwater Recharge Alternative would allow for several possible operational schemes. Water releases could begin as early as March 1st each year, with releases equaling inflows to maintain the reservoir above the selected minimum pool (whether existing top of inactive elevation 3082.4 feet of the NGPC target elevation of 3089.4 feet). Another possibility would be to store minimal inflows (to offset reservoir evaporation and seepage losses) to prevent the reservoir from dropping below the selected minimum pool elevation. A third possibility would be to store water in the reservoir over several years and then make it available for releases during dry or drought periods.

Any water stored in Enders Reservoir above the selected minimum pool would be available for release on request of the FVID and/or H&RWID. Storage water above the minimum pool would be released for groundwater recharge in the project area. These releases would be added to natural flows and diverted into the Culbertson Canal in an effort to recharge groundwater in the project area. For this study, it was assumed that the operational season for the Ground Recharge Alternative would be March 1-November 30 each year.

Agricultural Economics

Water diverted into the delivery system (from natural flows and/or storage releases) would not be delivered to project acres in this alternative. Project acres in the FVID and the H&RWID would receive no surface water deliveries and would receive 12 acre-inches of pumped groundwater each year. (Table 4 of Appendix E shows the volume of water pumped per year, total deliveries per year, pumping costs per year, and the total amount of pumping expenses that would accrue.)

Pumping costs would range from $14.76/acre to $26.47/acre. The net present value of pumping costs for the 9,292 acres in the FVID add up to $7.76 million (See Appendix E).

Alternatives Considered But Dropped

Three other alternatives were proposed during the study but were dropped from consideration.

Breach Enders Dam Alternative

Breaching Enders Dam would eliminate flood control protection provided by the Unit. Even though inflows have declined, the dam continues to provide flood control benefits by providing storage during the few large runoff events that do occur. The Flow-through Alternative would achieve the same objectives as the Breach Enders Dam Alternative but

would retain flood control benefits. For this reason, the alternative was dropped from further consideration.

Enders Reservoir Minimum Pool at Elevation 3099 Feet Alternative

The NGPC also recommended establishment of a minimum pool at Enders Reservoir at elevation 3099 feet. Review of the initial hydrology modeling, however, showed that there would not be adequate inflows into the reservoir to reach and/or sustain this elevation. The target minimum pool was established at elevation 3089.4 feet and adopted for the Recreation Alternative. This alternative was dropped from further consideration.

Restore Project Water Supply Alternative

An initial interest of FVID, H&RWID, and Reclamation was to restore a full project water supply to the Unit, originally established at 18 inches/acre in the DPR. An updated full water supply goal was determined to provide enough natural flows and reservoir storage to supply all project acres with 12 inches/acre. Initial modeling indicated this goal might not be obtainable, even with drastic reductions in groundwater pumping to zero. Discussion included legitimacy of eliminating all groundwater irrigation above the project to provide a full water supply for 22,207 project acres. The drastic measures needed and the expense to achieve this goal caused this alternative to be dropped from further consideration.

Additional Storage Facilities Alternative

During the initial scoping of alternatives, previously identified reservoir sites were reviewed. This alternative was dropped from consideration due to water rights issues and water shortages in the lower portion of the basin. Any new storage rights would be junior to existing downstream water rights.

Chapter 5: *Potential Effects of the Alternatives*

Evaluation

Alternatives were evaluated against the Future-Without Project Condition according to the planning objectives and constraints; the degree to which they would solve problems, meet needs and take advantage of opportunities in the project area; and address their environmental and social acceptability. This evaluation is shown in Table 5.1.

The study partners developed specific standards of effectiveness, implementability, and costs to evaluate the alternatives, too. These standards are:

Effectiveness

Effectiveness measures how well an alternative meets the defined objectives. Factors considered include the alternative's technical effectiveness to meet the objectives, reliability, and Republican River Basin-wide distribution of benefits and effects, including fish, wildlife, and recreation. For this study, effectiveness considered:

- Reservoir yield in AF
- Likelihood the yield would benefit Frenchman Creek
- Ability to help sustain alluvial groundwater levels
- Ability to help sustain natural flows
- Ability to maintain irrigation benefits
- Ability to sustain flood flows within natural variability in terms of timing, frequency, magnitude
- The Unit's ability to reliably deliver project water in the future
- The Unit's ability to replace or reduce groundwater demand
- Potential for unintended environmental consequences

Implementability

Implementability includes both the technical and administrative feasibility of the alternative. It considers characteristics of the proposed alternative. Implementability includes an alternative's political constraints, including the social equity of benefits and effects and public support or opposition. Implementability considered:

- Hydrologic constraints
- Environmental concerns, such as fish, wildlife, and recreation
- The state of technology, such as computer water models
- Legal and regulatory concerns at the local, state, and Federal levels
- Water rights

- Compatibility of the project with other water users
- Complexity of crossing jurisdictional boundaries
- Likely support or opposition

Costs

O&M pumping costs rather than capitalized costs were considered to determine ratings.

Comparison

Planning Objectives and Constraints

The Future-Without Condition would maintain the viability of the FVID and the H&RWID, although with continued reduced irrigation benefits because of lessened inflows into Enders Reservoir. The Future-Without Project Condition would also reduce recreation at the reservoir. For maintaining irrigation and recreation benefits, even though at a reduced level, the Future-Without could be said to protect the Federal investment in the Unit.

The Flow-through Alternative would be similar to the Future-Without Project Condition regarding irrigation benefits, but it would virtually eliminate flat-water recreation. It would also be similar to the Future-Without in protecting the Federal investment, although there might be a question of who would pay for those benefits.

The Recreation Alternative would likely maintain the viability of the districts, but there would be less storage available to them because of the higher minimum pool established for recreation. Recreation would be improved compared to the Future-Without and the Federal investment would be protected, although with greater recreational and fewer irrigation benefits.

The Groundwater Recharge Alternative would maintain viability of the districts. It would not change recreation in comparison to the Future-Without Project Condition. Thus, the Federal investment would be protected, with irrigation and recreational benefits maintained.

Problems and Needs

Neither the Future-Without Project Condition, nor any of the alternatives, would do anything to restore the declining water supply in the Frenchman River Basin. Water demands would continue to exceed supply. Irrigation, recreation, and the other needs would remain the same in the Future-Without Project Condition and the alternatives, with the exception that groundwater recharge in the project area would be improved as expected in the Groundwater Recharge Alternative.

Environmental and Social Acceptability

Recreation and fish and wildlife would continue in the Unit in the Future-Without Project Condition. Walleye, crappie, bass and crappie fishing would continue to attract anglers

to the 671 surface-acre reservoir under the Future-Without Project Condition, and big game, game birds, and waterfowl to the lands surrounding the reservoir. Threatened and Endangered species, cultural resources, and ITA's would be unaffected in the Future-Without Project Condition and in all of the alternatives. The Unit would continue to provide irrigation benefits on a much reduced basis because of intensive groundwater pumping and soil and water conservation measures upstream. Only the FVID will receive irrigation water in the Future-Without Project Condition: 4 inches/acre from natural flows below Enders Dam, and 3 inches/acre from Enders Reservoir every fifth year (assuming a 20 percent reduction in groundwater pumping upstream). H&RWID will receive nothing.

In the Flow-through Alternative, flat-water recreation and fishing would almost be eliminated because of the smaller reservoir area (567 surface acres at elevation 3080.0 feet). Wildlife might increase due to the exposed lands in the reservoir's upper end. The Unit would receive slightly more irrigation benefits per year as compared to the Future-Without Project Condition, 4.5 inches/acre from natural flows below the dam to FVID. If FVID and H&RWID shared natural flows, benefits would be slightly less than 2 inches/acre.

Flat-water recreation, fishing, and wildlife would be better in the Recreation Alternative than in the Future-Without Project Condition, with the reservoir of 825 surface acres at elevation 3089.4 feet. The Unit would receive a slight decreased irrigation benefit compared to the Future-Without Project Condition. FVID would receive 3.5 inches per acre annually from natural flows and would receive an additional 1.5 inches per acre from storage every fifth year.

In the Groundwater Recharge Alternative, flat-water recreation and fishing would almost be eliminated with the minimum pool remaining at elevation 3082.3 feet. Reduced visitation would add to NGPC's concerns about investing in new facilities and maintaining existing recreation facilities. All project lands would need to pump groundwater.

Table 5.1: Evaluation of the Alternatives

Alternative	Objectives/Constraints	Problems/Needs	Environmental/Social Acceptability
Future-Without Project Condition	This alternative would maintain viability of the FVID and H&RWID, although irrigation benefits would continue to be limited because of reduced inflows into the reservoir. Recreation would also continue but lessened for the same reason. Thus, this alternative would protect the Federal investment though it would offer reduced benefits. This alternative would meet the provisions in the districts' water service contracts, comply with Nebraska state water laws and regulations, and meet within the Republican River Compact.	The Future-without Condition would do nothing about the declining water supply in the Frenchman River Basin, so water demands would continue to exceed water supply. At a reduced level, this alternative would meet irrigation; recreation and fish and wildlife; and other needs.	Recreation and fish and wildlife benefits would slightly decline in this alternative; T&E species, cultural resources, and ITA's would be unaffected.
Flow through Alternative	The Flow through Alternative would maintain viability of the FVID and H&RWID, irrigation water would come from bypassing inflows into Enders, and from natural flows. Recreation would continue at a much reduced level because flows would pass through the reservoir. This alternative would protect the Federal investment though it would offer reduced benefits. This alternative would not meet the provisions of the districts' water service	This alternative would do nothing about the declining water supply in the basin, so water demands would continue to exceed water supply. It would, at a reduced level, meet irrigation; wildlife; and some recreational needs, but flat-water recreation and fishing would be greatly reduced.	Some recreation and wildlife would continue at a reduced level, but flat-water recreation and fishing would be reduced; T&E species, cultural resources, and ITA's would be unaffected. NGPC may possibly stop investing new facilities and maintaining existing recreational facilities at Enders Reservoir.

	contracts, but would comply with state water laws and the Compact.		
Recreation Alternative	The Recreation Alternative would maintain viability of the FVID and H&RWID but there would be less reservoir storage available to them because of the new minimum pool. Recreation would improve for the same reason. This alternative would protect the Federal investment though it would offer reduced benefits. This alternative would meet the provisions in the districts' water service contracts, would comply with state water laws and the Compact.	This alternative would do nothing about the declining water supply in the basin, so water demands would continue to exceed water supply. It would, at a reduced level, meet irrigation; recreation and fish and wildlife; and other needs.	Recreation and fish and wildlife would improve in this alternative; T&E species, cultural resources, and ITA's would be unaffected. NGPC may possibly stop investing new facilities and maintaining existing recreational facilities at Enders Reservoir.
Groundwater Recharge Alternative	This alternative would maintain viability of the FVID and H&RWID as it would recharge groundwater in the project area. It would not maintain recreation at the reservoir. It would protect the Federal investment but at the expense of recreational benefits. This alternative would not meet provisions in the districts' water service contracts, but would comply with state water laws and the Compact.	This alternative would do nothing about the declining water supply in the basin, so water demands would continue to exceed water supply. It would provide for groundwater irrigation, but not those of recreation and fish and wildlife. All irrigation would be pumped from groundwater.	Recreation and fish and wildlife would decline in this alternative; T&E species, cultural resources, and ITA's would be unaffected.

Chapter 6: *Consultation and Coordination*

Public Involvement

This appraisal study began with identification of potential study partners and the various stakeholders. Once that step had been accomplished, Reclamation conducted many meetings involving the study partners. Each entity had the chance to shape planning objectives, initial alternatives, and the alternatives included in the draft version of appraisal report. Interests are listed in Appendix F.

Study partners funded their own expenses to attended meetings and conference calls; provided Reclamation with written comments and suggestions on documents and reports; and agreed to provide information and reports that related to their special expertise and/or jurisdiction. While there was no cost sharing required the DNR performed the hydrologic modeling.

Coordination with Interests and Other Agencies

Reclamation's partners in this study are listed below. Table 6.1 lists dates, locations, and attendees of meetings.

- Nebraska Department of Natural Resources
- Frenchman Valley Irrigation District
- Hitchcock & Red Willow Irrigation Districts
- Riverside Irrigation District
- Middle Republican Natural Resources District
- Upper Republican Natural Resources District
- Nebraska Game & Parks Commission

Table 6.1: Meetings of the Study Partners

Date	Location	Attendees
May 4, 2005	McCook	All
June 7, 2005	McCook	All
September 23, 2005	Grand Island	All
December 7, 2005	North Platte	All
July 20, 2006	Lincoln	Reclamation, DNR (modeling meeting)
October 18, 2006	Conference Call	Reclamation, DNR (modeling call)
February 15, 2007	Cambridge	All
February 23, 2007	Grand Island	Reclamation, DNR (modeling meeting)
June 8, 2007	Grand Island	Reclamation, DNR (modeling meeting)
August 24, 2007	McCook	All
October 1, 2007	Grand Island	Internal Reclamation briefing
February 14, 2008	McCook	All

Chapter 7: *Conclusions and Concerns*

Conclusions

Because of the severe decline in streamflows in the Frenchman River Basin due to intensive groundwater pumping and soil and water conservation measures, the Unit no longer operates as authorized.

Study modeling results using DNR/NRD developed IMP's show only a small increase in streamflows in the basin. The surface water supply of the Unit will not return to levels necessary to sustain all project irrigation requirements.

Future Surface Water Supply

The future surface water supply will not provide enough water to support both the 9,292 project acres of the FVID and the 11,915 acres of the H&RWID.

Reclamation's Appraisal report, Unit (1977) stated:

> *. . . the severe depletion to stream flow expected to result from irrigation well development upstream from the Culbertson Diversion Dam would reduce the acreage that can be provided an adequate project water supply to 10,250 acres. This supply was estimated to average 1.34 feet/acre during the 8-year period* (p. IV-14).

Using the RRCA groundwater model to predict streamflows for the next 40 years, along with historic streamflows and delivery records, the future available surface water above Culbertson Diversion Dam could provide an adequate water supply for an estimated 3,300 acres (based on a 12 inches/acre supply). This estimate is based on an assumed four-month irrigation season and a delivery system efficiency estimate of 40 percent.

Without drastic reductions in groundwater pumping in the Frenchman Basin, there will not be enough streamflows to provide any sizeable deliveries to the H&RWID. The H&RWID's current contract with Reclamation allows them to continue to "wait and see" in case drastic measures cause future streamflows to increase. Also, the H&RWID can retain their water right for a period of 30 years due to the shortages (possibly extended by petition-see Appendix A).

Recreation Opportunities

Benefits

RRCA groundwater modeling shows that future streamflows in the Frenchman River Basin will increase slightly from present levels and will stabilize at these levels for a short period before the lag effect from upland groundwater wells causes streamflows to decline again. The modeling indicates that these slight improvements to streamflows above Enders Reservoir will provide enough water to maintain the higher minimum pool of elevation 3089.4 feet of the Recreation Alternative. This would result in increased recreational facility availability, visitation, and economic value compared to the Future-Without Project Condition. Reservoir operations show that the supply to project irrigators of sustaining the higher minimum pool would be approximately 2 inches/acre every fifth year.

Recreational economic value for 2002-2006 was estimated using the average number of current visits by recreational activity. Using the full year visitation and percentage by activity estimates, recreation value averaged nearly $1.9 million yearly. Focusing on estimates of visits during the high recreational season (May-September) applied by recreational activity to an estimate of average visits by recreational activity provided an estimate of average yearly recreational economic value averaging $1.5 million yearly. The top three activities in terms of economic value proved to be camping, fishing, and boating.

Flat-water recreation and fishing would benefit from establishment of a higher minimum pool at the reservoir. A new minimum pool at elevation 3089.4 feet would maintain a surface area of 825 acres and 14,426 AF of water in the reservoir. Data show that the fishery in Enders would benefit from the higher minimum pool, especially panfish and open water species.

Concerns

With declining inflows and lower reservoir levels, the NGPC has concerns about investing in future recreational facilities at the reservoir or maintaining existing facilities because of budgetary constraints and variable water storage levels in the reservoir.

Groundwater Recharge Opportunities

Benefits

Groundwater recharge benefits from operating the Unit's delivery system are well recognized by project irrigators. An estimated 90 percent of project lands irrigated by surface water are also irrigated with groundwater (see Appendix B). Without operating the delivery system, groundwater levels in the project area will continue to decline at a faster rate than if the system were operating.

The FVID has an 1890 senior water right and will continue to divert available natural flows. In order to provide groundwater recharge benefits with FVID natural flows to H&RWID project lands, an agreement would have to be made between the two districts.

Concerns

There are concerns connected to groundwater recharge, too. These are:

- The DNR would need to acknowledge groundwater recharge as a beneficial use.

- If it would not change the priority date, the DNR might need to amend and/or change the FVID's natural flow right from an irrigation benefit to a groundwater recharge benefit.

- If groundwater benefits were realized in the H&RWID project area, the DNR might need to amend and/or change the districts' natural flow rights and storage use rights.

- If using available storage in Enders Reservoir for groundwater recharge, the DNR might need to amend and/or change the United States' storage use water right from supplemental irrigation to groundwater recharge.

- Project boundaries might need to be adjusted to include non-project lands benefiting from project recharge.

- It is the DNR's preliminary opinion that project operations could continue with the FVID using natural flows to prime the delivery system to prepare for delivering natural flows and storage water in Enders, with the acknowledgement that the benefits of groundwater recharge were an authorized project benefit.

- If the project boundaries were expanded, a study would be required to determine which lands would benefit from project recharge.

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Appendix A

Nebraska Resources Newsletter, Issue 28, July 2008
Published Quarterly by the Nebraska Department of Natural Resources
301 Centennial Mall / P.O. Box 94676 / Lincoln, NE 68509-4676

Cancelling a Surface Water Right for Nonuse, by Pam Anderson

In Nebraska, **all water appropriations must be for a beneficial or useful purpose.** When an appropriator fails to use the water for the beneficial use specified in the permit for **more than five years, the water right can be cancelled** by the Department. Water rights can only be lost after going through a cancellation procedure with full due process protections. Water rights are not lost by forfeiture or any automatic process in Nebraska.

A cancellation starts with an investigation by the local field office staff. If they determine that there was water available during the last five years and that there was not "sufficient cause" to not use the water, then the appropriator will be sent a "Notice of Preliminary Determination of Nonuse." State law dictates what is "sufficient cause" for not using a water appropriation for five years. **Section 46-229.04** describes the complete list of acceptable excuses for not using the water.

46-229.04.
(2) Sufficient cause for nonuse shall be deemed to exist for up to thirty consecutive years if such nonuse was caused by the unavailability of water for that use. For a river basin, subbasin, or reach that has been designated as overappropriated pursuant to section 46-713 or determined by the department to be fully appropriated pursuant to section 46-714, the period of time within which sufficient cause for nonuse because of the unavailability of water may be deemed to exist may be extended beyond thirty years by the department upon petition therefor by the owner of the appropriation if the department determines that an integrated management plan being implemented in the river basin, subbasin, or reach involved is likely to result in restoration of a usable water supply for the appropriation.
(3) Sufficient cause for nonuse shall be deemed to exist indefinitely if such nonuse was the result of one or more of the following:

(a) For any tract of land under separate ownership, the available supply was used but on only part of the land under the appropriation because of an inadequate water supply;
(b) The appropriation is a storage appropriation and there was an inadequate water supply to provide the water for the storage appropriation or less than the full amount of the storage appropriation was needed to keep the reservoir full; or
(c) The appropriation is a storage-use appropriation and there was an inadequate water supply to provide the water for the appropriation or use of the storage water was unnecessary because of
climatic conditions.

(4) Sufficient cause for nonuse shall be deemed to exist for up to fifteen consecutive years if such nonuse was a result of one or more of the following:

(a) Federal, state, or local laws, rules, or regulations temporarily prevented or restricted such use;
(b) Use of the water was unnecessary because of climatic conditions;

(c) Circumstances were such that a prudent person, following the principles of good husbandry, would not have been expected to use the water;
(d) The works, diversions, or other facilities essential to use the water were destroyed by a cause not within the control of the owner of the appropriation and good faith efforts to repair or replace the works, diversions, or facilities have been and are being made;
(e) The owner of the appropriation was in active involuntary service in the armed forces of the United States or was in active voluntary service during a time of crisis;
(f) Legal proceedings prevented or restricted use of the water; or
(g) The land subject to the appropriation is under an acreage reserve program or production quota or is otherwise withdrawn from use as required for participation in any federal or state program or such land previously was under such a program but currently is not under such a program and there have been not more than five consecutive years of nonuse on that land since that land was last under that program.

The Department may specify by rule and regulation other circumstances that shall be deemed to constitute sufficient cause for nonuse for up to fifteen years.

The water right is cancelled if the appropriator doesn't respond to the notice. However, the appropriator may disagree with the Department's preliminary determination and request a contested case hearing. The hearing resembles a trial but there is a hearing officer instead of a judge or magistrate and the rules of evidence are not followed strictly. If the appropriator cannot prove that he or she had sufficient cause to not use the water, the water right is cancelled.

There is no increase in stream flow when a water right is cancelled for nonuse. This is because the water hadn't been diverted from the stream for at least five years prior to the cancellation. It is in effect "paper water" at that point. **The Department does not rely on "paper water" to determine if there is unappropriated water available for a new water use.** Instead, the historic flow method is used. The Department looks at stream gage data, observation and experience from water administration to decide if there is enough flowing water to issue a permit. The Department does not attempt to add up all of the water rights that have ever been issued and calculate how much "paper water" has been appropriated. It would be impossible to get an accurate picture of available stream flow by adding up all of the permits in a basin. Every year, the amount of water diverted from the stream changes because farmers change crops and each crop has different water needs or a farmer may put his or her land in EQIP or CREP and not irrigate at all for several years. The prior appropriation system is dynamic and rewards the senior irrigators who developed their fields first. Junior irrigators are entitled to take whatever is left.

The fact that an appropriator is not using his or her water right and it hasn't been cancelled yet does not affect whether or not a basin is determined to be fully appropriated. The only appropriations considered are those actually being used. A basin is fully appropriated if a senior appropriator requests junior appropriators that are diverting water to be closed so often that the junior appropriators cannot divert at least 65% of the water needed during the peak irrigation season or 85% during the entire season. **An unused paper water right does not factor into the calculations at all.**

Frenchman River – Natural Flow Water Rights

Frenchman Valley Irrigation District	D-24R	130.86 cfs	05/16/1890	9160.4 ac
H & RW Irrigation District	A-3869AR	16.64 cfs	04/03/1946	1415.0 ac
H & RW Irrigation District	A-6214R	136.80 cfs	04/16/1954	9576.0 ac
H & RW Irrigation District	A-9697R	2.24 cfs	03/04/1959	157.0 ac
Frenchman Valley Irrigation District	A-9802R	1.89 cfs	03/17/1960	132.0 ac
H & RW Irrigation District	A-13016R	9.76 cfs	04/03/1946	683.0 ac
H & RW Irrigation District	A-14249R	.86 cfs	06/04/1976	60.0 ac
H & RW Irrigation District	A-15678R	.34 cfs	07/10/1980	24.0 ac
Riverside Irrigation Company, Inc.	D-10AR	.73 cfs	12/19/1893	51.1 ac
Riverside Irrigation Company, Inc.	D-18	4.16 cfs	07/28/1894	291.0 ac
Riverside Irrigation Company, Inc.	A-1674	2.71 cfs	07/03/1922	190.0 ac
Riverside Irrigation Company, Inc.	A-3477R	2.00 cfs	07/31/1941	140.0 ac

Frenchman River – Storage Water Right

Bureau of Reclamation	A-3899	44,079 AF	05/01/1946

Storage Use Water Rights

Enders, Strunk, Harlan County, and Swanson Reservoirs

Bureau of Reclamation	A-6225HR	04/16/1954
Covers flow rights A-3869AR		
Bureau of Reclamation	A-6225HR	04/16/1954
Covers flow rights A-6214R		

Enders, Strunk, Harlan County, Swanson, and Hugh Butler Lake Reservoirs

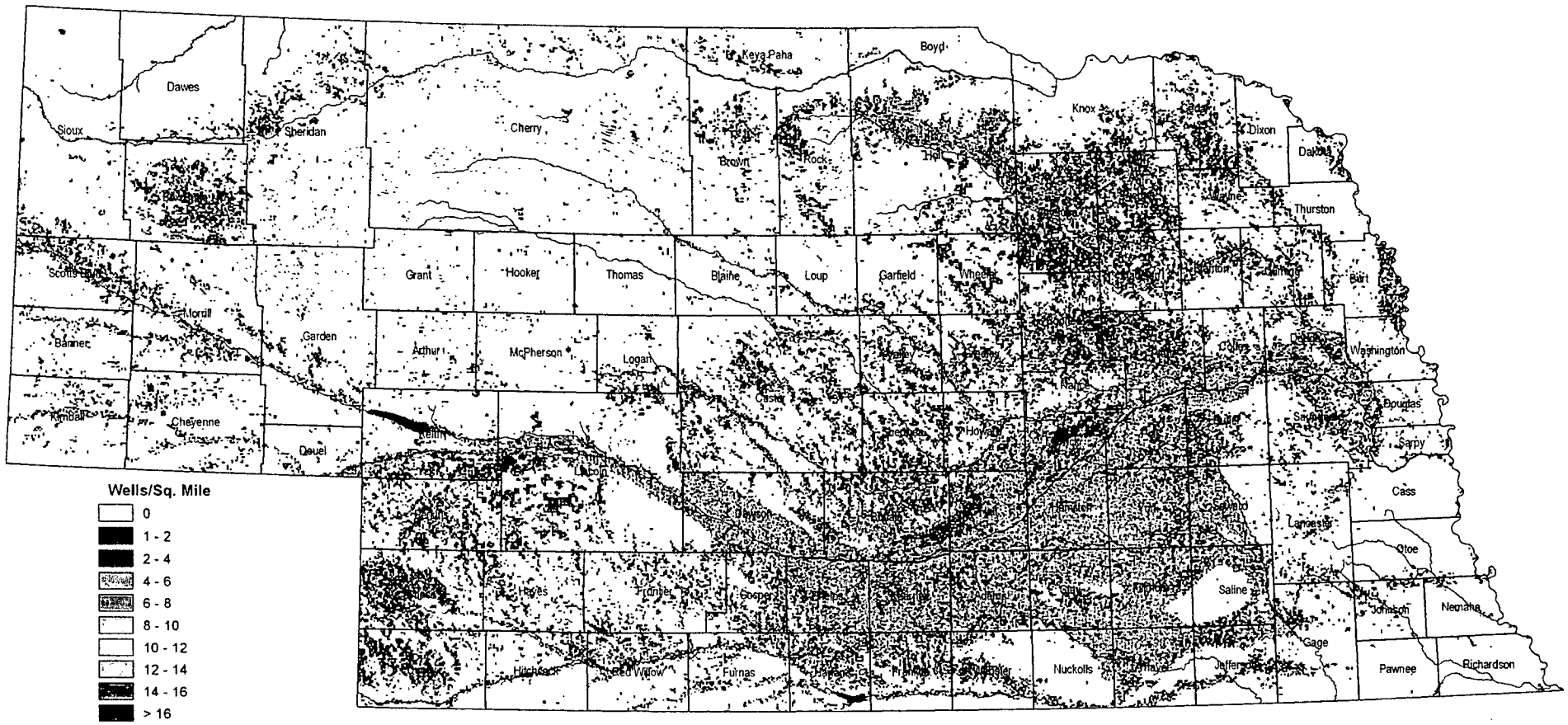
Bureau of Reclamation	A-9782	12/16/1959
Covers flow rights D-24-30, A-6214, A-9697, A-9802		
Bureau of Reclamation	A-15839	04/18/1981
Covers flow rights A-13016R, A-14249R, A-15678R		

Total Natural Flow Rights

Frenchman Valley Irrigation District	132.75 cfs	9,292.4 acres
H & RW Irrigation District	164.40 cfs	11,915 acres
Riverside Irrigation Company	9.60 cfs	672.1 acres

Appendix B

Density of Registered Irrigation Wells in Nebraska
August 2007



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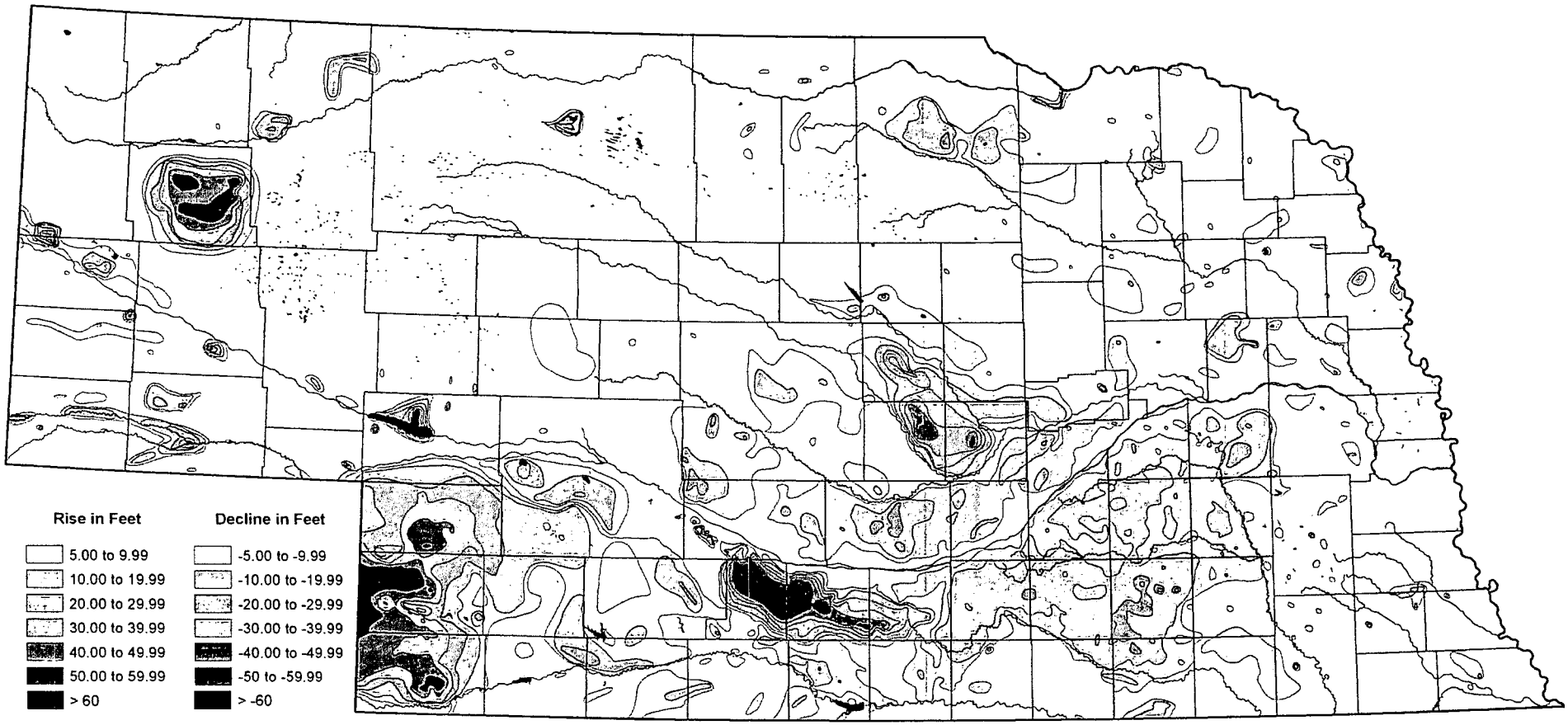
Mark Burbach, Water Levels Coordinator, CSD

Appendix C

Groundwater-level Changes in Nebraska - Predevelopment to Spring 2007



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U.S. Geological Survey
Water Resources Division - Nebraska District

Nebraska Natural Resources Districts

Central Nebraska Public Power and Irrigation District

Mark Burbach, Water Levels Coordinator, CSD

September 2007

Appendix D

Frenchman Valley Appraisal Study
Recreation Analysis

Jonathan Platt
Natural Resource Economist
Bureau of Reclamation

The recreation analysis for this appraisal level assessment of the Frenchman Valley Study alternatives focuses exclusively on effects at Enders Reservoir. Recreation effects of the proposed alternatives at other regional reservoirs or river segments were considered insignificant and were not addressed in the analysis.

Affected Environment:

This section presents estimates of current recreation visitation and economic value at Enders Reservoir. Enders Reservoir generates both water based and land based recreational activity. The reservoir provides approximately 1,707 acres of surface area and 26 miles of shoreline at full pool.

Recreation facilities at Enders Reservoir include two boat ramps, two campgrounds (150+ tent sites, 32 recreational vehicle sites), eight picnic areas, and one designated swimming beach.

Table REC1 presents the most recent five years (2002-2006) of available recreation visitation data by month at Enders State Recreation Area as obtained from the Nebraska Game and Parks Commission (NGPC). Total recreation use across this period averaged approximately 43,000 visits annually and ranged from a low of 39,812 visits to a high of 46,760 visits. The majority of the visits, nearly 80 percent, occurred during the high use season from May to September.

To measure the economic value associated with this visitation, estimates of economic value per visit were applied to the visitation estimates. However, the visitation estimates first needed to be grouped by primary recreation activity because the economic values per visit vary by recreation activity. To provide an estimate of visitation by recreation activity, a recently published study by Holland and Gabelhouse (2006) was used. This 1999 study surveyed recreators at Enders Reservoir. Table REC2 presents the visitation percentages by primary recreation activity at Enders Reservoir across the entire year and for the high use recreation season (May-September) as obtained from the survey. While the data from the survey was for 1999 and not the 2002-2006 period, the assumption is that the visitation percentages by recreation activity typically do not change significantly from one year to the next within the same general time period. The recreation activities identified in the survey from highest to lowest visitation levels were camping, fishing, boating, swimming, wildlife observation, hunting, and other (primarily walking/hiking). Camping was by far the most popular recreational activity accounting for 55.4% of the full year visitation and 63.2% of the high season use followed by fishing at 21.5% of the full year and 18.7% of the high season use.

Economic values per visit by activity were obtained from a meta analysis study conducted by Loomis (2005). This study determined economic value estimates by recreation activity from

hundreds of recreation economic benefit studies conducted from 1967 through 2003. These studies were separated by recreation activity and geographic region. Economic values were selected from the intermountain region (which includes Nebraska) for the recreation activities listed above. The values were then indexed to February 2008 dollars. The economic values per visit were determined to be highest for boating, fishing, and hunting, with the lowest values for swimming and camping.

Applying these values by recreation activity to the average current visitation estimates by recreation activity provides an estimate of average annual recreation economic value for the 2002 through 2006 period. Using the full year visitation and percentage by activity estimates, annual recreation economic value averaged nearly $1.9 million. Focusing purely on the high recreation season visitation estimates and percentages, the annual recreation economic value averaged $1.47 million. The top three activities in terms of economic value proved to be camping, fishing, and boating.

In addition to the visitation and economic value estimates, a simple recreation facility availability analysis was conducted for the years 2002-2006 to be consistent with the timeframe associated with the visitation and value estimates. While Chapter 5 – Potential Effects of the Alternatives will be focusing on differences between facility availability between the proposed alternatives, this same analysis for the 2002-2006 time period is intended to provide some historical perspective. Average and dry/wet (10%/90%) condition end of month (EOM) water levels were compared to high and low end usability thresholds for the two boat ramps and one swimming beach (see the recreation environmental consequences section for more detail on the methodology).

The boat ramps were evaluated from two perspectives, one where two feet were added to the bottom of each ramp to allow for launching and the other where the bottom of the ramp was simply used as the low end threshold. As shown in Table REC3, the boat ramps vary in terms of their availability based on the water condition and the assumptions regarding the low end usability threshold. When the two foot water level cushion is added to the bottom of the ramps, the Center Dam ramp is unavailable across the entire 2002-6 period. The new "low water" ramp is available from January or February through June during average and wet conditions. Considering the absolute low end of the ramps as the usability threshold improves availability, especially for the new low water ramp, which is available in all months except July through September under dry conditions. During the high use recreation season from May through September, Cow Beach boat ramp is available from May through July or August during average and wet conditions, but only May and June during dry conditions.

Table REC1: Average Annual and Monthly Visitation at Enders State Recreation Area (SRA)

Source: Nebraska Game & Parks Commission

Year	Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2002	ENDERS SRA	1,663	1,417	1,575	1,785	6,475	8,750	8,750	4,550	1,925	1,050	1,225	1,575	40,740
2003	ENDERS SRA	1,487	1,400	1,522	1,803	7,000	9,275	9,800	5,250	1,750	1,120	1,050	1,487	42,944
2004	ENDERS SRA	1,400	1,050	1,312	1,750	6,650	8,750	6,300	4,200	5,250	1,400	1,050	700	39,812
2005	ENDERS SRA	1,050	1,225	1,330	1,330	5,250	9,100	9,800	8,750	5,600	1,050	1,225	1,050	46,760
2006	ENDERS SRA	875	700	700	1,225	5,075	8,750	9,450	8,750	5,775	1,137	1,225	1,050	44,712
	Monthly Average:	1,295	1,158	1,288	1,579	6,090	8,925	8,820	6,300	4,060	1,151	1,155	1,172	42,994
	Percent by Month:	3.01	2.69	3.00	3.67	14.16	20.76	20.51	14.65	9.44	2.68	2.69	2.73	
	High Season (May-Sept) Average:	34,195												
	High Season (May-Sept) Percent:	79.54												

Table REC2: Average Annual Recreation Visitation and Economic Value by Activity

Recreation Activities	Full Year Percent (1)	High Season (May-Sept) Percent (1)	Full Year Visitation	High Season (May-Sept) Visitation	(2004 $) Economic Value per Visit (2)	(2008 $) Economic Value per Visit (2)	(2008 $) Full Year Value	(2008 $) High Season (May-Sept) Value
Camping	55.39	63.22	23,814	21,618	34.72	38.39	914,201	829,896
Fishing	21.49	18.72	9,239	6,401	49.57	54.81	506,391	350,844
Boating	8.54	8.79	3,672	3,006	53.68	59.35	217,922	178,398
Swimming	5.22	6.19	2,244	2,117	29.54	32.66	73,301	69,134
Wildlife Observation	4.34	2.19	1,866	749	37.24	41.18	76,830	30,835
Hunting	3.88	0.29	1,668	99	48.55	53.68	89,547	5,323
Other (Walking)	1.14	0.6	490	205	38.53	42.60	20,880	8,741
	100.00	100.00	42,994	34,195			1,899,073	1,473,171

Data Sources: (1) Holland and Gabelhouse (2006), (2) Loomis (2005)

Table REC3: Recreation Facility Availability Years 2002-2006 Note: YES = Available, NO = Unavailable

EOM Water Levels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg:	3086.7	3087.3	3087.7	3088.1	3088.2	3088.0	3086.2	3085.7	3085.3	3085.4	3085.7	3086.0
10%:	3086.3	3086.6	3086.8	3086.9	3086.7	3086.4	3085.0	3084.8	3084.7	3085.1	3085.3	3085.7
90%:	3087.3	3088.3	3089.1	3089.8	3090.0	3089.6	3087.0	3086.4	3085.8	3085.9	3086.1	3086.3

I. Boat Ramps: 2 feet added to bottom of ramps to allow for launching

Center Dam: Low: 3091 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3087 High: 3102

Average:	NO	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO

II. Boat Ramps: 2 feet not added to bottom of ramps

Center Dam: Low: 3089 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3085 High: 3102

Average:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10%:	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES	YES	YES
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

III. Beaches:

Cow Beach: Low: 3086 High: 3100

Average:	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	YES
10%:	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
90%:	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES	YES

Environmental Consequences:

The focus of the recreation analysis is on a comparison of recreation facility availability at Enders Reservoir for each of the proposed "action" alternatives compared to the No Action Alternative.

Methodology:

The availability of three primary water based recreation facilities found at Enders Reservoir were compared across the alternatives: 1) Center Dam boat ramp, 2) New "Low Water" boat ramp, and 3) Cow beach. The most current usability thresholds for the boat ramps were obtained from NGPC. The Center Dam ramp has a low end threshold of 3089 (bottom of the ramp) and a high end threshold of 3118 (top of the ramp). The New "Low Water" ramp has a low end threshold of 3085 and a high end threshold of 3102. To prevent boat trailers from running off the ends of the ramps, an assumption was made that the ramps would be closed when reservoir water levels dropped within two feet of the end of each ramp. This implies that the low end threshold for the Center Dam ramp increases to 3091 and the New "Low Water" ramp to 3087. While this reflects a "best guess" estimate of facility availability, the analysis was also run using the full length of the ramps from top to bottom. In addition, the Park Manager at Enders estimated Cow Beach to be most usable between elevations 3086 and 3100.

End of Month (EOM) water levels at Enders Reservoir were projected by Reclamation hydrologists for each alternative from 2008 through 2046. From this data, water level estimates were developed for average, dry (10^{th} percentile), median (50% percentile), and wet (90^{th} percentile) conditions by month and alternative.

Finally, the EOM water level estimates by alternative and hydrologic condition were compared to the high and low end usability thresholds by recreation facility to estimate future facility availability by month and alternative. The facility availability for each of the proposed action alternatives was then compared to the facility availability for the No Action Alternative to estimate the change in facility availability for the action alternatives (changes in availability are shown in bold in the tables). Note that the facility availability for each alternative is a rough estimate since it is based on EOM water levels. Obviously water levels can vary across the days in each month and even across the hours in each day, but water levels often tend to trend up or down within a month based on irrigation demands.

Facility Availability Results:

Recreation facility availability is presented for each of the alternatives. For the proposed action alternatives, emphasis is placed on the change in facility availability as compared to the No Action Alternative.

No Action Alternative: As shown in Table REC4 (displayed at the end of this section), the boat ramps vary in terms of their availability based on both the water condition and the assumptions regarding the low end usability threshold. When the two foot water

cushion is added to the bottom of the ramps, the Center Dam ramp shows up as unavailable across all water conditions. The new "low water" ramp only shows up as available during wet conditions, albeit for all months. Using the absolute low end of the ramps as the threshold improves availability. The Center Dam ramp becomes available in wet conditions, but only for January through June. The new low water ramp shows availability in all months during average and wet conditions, but no availability during dry conditions. During the high use recreation season from May through September, Cow Beach shows availability only in May and June during average conditions. The beach shows up as unavailable during dry conditions and available during wet conditions.

Flow Through Alternative: As presented in Table REC5, none of the facilities show up as available under any of the water conditions with the Flow Through Alternative. Compared to the No Action Alternative, this represents a reduction in facility availability as follows –

- Center Dam Ramp: Reduction in availability from January to June under wet conditions (without 2' cushion)

- New "Low Water" Ramp: Reduction in availability across all months under wet conditions (with 2' cushion), and in all months under average and wet conditions (without 2' cushion).

- Cow Beach: Reduction in availability during high use season for May and June during average conditions and May through September during wet conditions.

This alternative would be expected to result in a loss in recreation visitation and economic value as compared to the No Action Alternative.

Groundwater Recharge Alternative: As presented in Table REC6, none of the facilities show up as available under any of the water conditions with the Groundwater Recharge Alternative. Compared to the No Action Alternative, the reduction in facility availability mirrors that of the Flow Through Alternative.

This alternative would be expected to result in a loss in recreation visitation and economic value as compared to the No Action Alternative similar to the Flow Through Alternative.

Recreation Alternative without Deliveries: As presented in Table REC7, all of the facilities show up as available under each of the water conditions with the Recreation Alternative without Deliveries, except for the Center Dam ramp under dry conditions (with the 2' cushion).

Compared to the No Action Alternative, this represents an increase in facility availability as follows -

• Center Dam Ramp: Increase in availability in all months during average and wet conditions and under dry conditions during March and April (with 2' cushion). Without the 2' cushion, the increase in availability occurs in all months during average and dry conditions and from July through December during wet conditions.

• New "Low Water" Ramp: Increase in availability occurs across all months under average and dry conditions (with 2' cushion), and in all months under dry conditions (without 2' cushion).

• Cow Beach: Increase in availability during high use season for July through September during average conditions and May through September during dry conditions.

This alternative would be expected to result in the largest gain in recreation visitation and economic value as compared to the No Action Alternative of all the proposed action alternatives.

Recreation Alternative with Deliveries: As shown in Table REC8, the Center Dam ramp is generally unavailable (except from January through May during wet conditions) with the 2' cushion and generally available (except in August and September during dry conditions) without the 2' cushion. The New "Low Water" ramp and Cow Beach show up as available across all water conditions.

Compared to the No Action Alternative, this represents an increase in facility availability as follows -

• Center Dam Ramp: Increase in availability from January to May under wet conditions with the 2' cushion. Without the 2' cushion, the increase in availability occurs in all months during average and dry conditions (except for August and September in dry conditions), and from July through December during wet conditions.

• New "Low Water" Ramp: Increase in availability occurs across all months under average and dry conditions (with 2' cushion), and in all months under dry conditions (without 2' cushion).

• Cow Beach: Increase in availability during high use season for July through September during average conditions and May through September during dry conditions.

This alternative would be expected to result in a gain in recreation visitation and economic value as compared to the No Action Alternative, but perhaps somewhat less than the Recreation Alternative without Deliveries.

Table REC4: Recreation Facility Availability - No Action Alternative

Note: YES = Available, NO = Unavailable

EOM Water Levels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg:	3086.5	3086.7	3086.9	3086.9	3086.8	3086.4	3085.5	3085.1	3085.3	3085.5	3085.7	3086
10%:	3083.9	3084.1	3084.3	3084.4	3084.2	3084	3083.7	3082.4	3082.7	3082.9	3083.2	3083.6
90%:	3089.7	3089.9	3090.1	3090.2	3090.1	3089.1	3088.1	3088.1	3088.3	3088.5	3088.7	3088.9

I. Boat Ramps: 2 feet added to bottom of ramps to allow for launching

Center Dam: Low: 3091 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3087 High: 3102

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

II. Boat Ramps: 2 feet not added to bottom of ramps

Center Dam: Low: 3089 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3085 High: 3102

Average:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

III. Beaches:

Cow Beach: Low: 3086 High: 3100

Average:	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table REC5: Recreation Facility Availability - Flow Through Alternative

Note: YES = Available, NO = Unavailable

EOM Water Levels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg:	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080
10%:	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080
90%:	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080

I. Boat Ramps: 2 feet added to bottom of ramps to allow for launching

Center Dam: Low: 3091 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3087 High: 3102

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

II. Boat Ramps: 2 feet not added to bottom of ramps

Center Dam: Low: 3089 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3085 High: 3102

Average:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

III. Beaches:

Cow Beach: Low: 3086 High: 3100

Average:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO	NO	NO	NO	NO	**NO**
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Note: **Bolded cells** reflect changes from the No Action Alternative.

Table REC6: Recreation Facility Availability - Groundwater Recharge Alternative Note: YES = Available, NO = Unavailable

EOM Water Levels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg:	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4
10%:	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4
90%:	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4	3082.4

I. Boat Ramps: 2 feet added to bottom of ramps to allow for launching

Center Dam: Low: 3091 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3087 High: 3102

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

II. Boat Ramps: 2 feet not added to bottom of ramps

Center Dam: Low: 3089 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3085 High: 3102

Average:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

III. Beaches:

Cow Beach: Low: 3086 High: 3100

Average:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	NO	NO	NO	NO	NO	**NO**
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Note: **Bolded cells** reflect changes from the No Action Alternative.

Table REC7: Recreation Facility Availability – Recreation Alternative Without Deliveries Note: YES = Available, NO = Unavailable

EOM Water Levels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg:	3093.1	3093.2	3093.3	3093.3	3093.1	3092.9	3092.7	3092.5	3092.4	3092.5	3092.7	3092.8
10%:	3090.8	3090.9	3091.1	3091.1	3090.9	3090.6	3090.3	3090.1	3090.0	3090.1	3090.3	3090.5
90%:	3095.0	3095.1	3095.3	3095.2	3095.1	3094.9	3094.7	3094.6	3094.5	3094.5	3094.7	3094.9

I. Boat Ramps: 2 feet added to bottom of ramps to allow for launching

Center Dam: Low: 3091 High: 3118

Average:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
10%:	NO	NO	**YES**	**YES**	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

New Ramp: Low: 3087 High: 3102

Average:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
10%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

II. Boat Ramps: 2 feet not added to bottom of ramps

Center Dam: Low: 3089 High: 3118

Average:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
10%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
90%:	YES	YES	YES	YES	YES	YES	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

New Ramp: Low: 3085 High: 3102

Average:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

III. Beaches:

Cow Beach: Low: 3086 High: 3100

Average:	YES	YES	YES	YES	YES	YES	**YES**	**YES**	**YES**	**YES**	**YES**	YES
10%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: **Bolded cells** reflect changes from the No Action Alternative.

Table REC8: Recreation Facility Availability – Recreation Alternative With Deliveries Note: YES = Available, NO = Unavailable

EOM Water Levels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg:	3090.3	3090.5	3090.6	3090.6	3090.4	3089.8	3089.6	3089.4	3089.4	3089.6	3089.8	3090.0
10%:	3089.6	3089.8	3089.9	3089.9	3089.7	3089.3	3089.2	3089.0	3088.9	3089.1	3089.3	3089.4
90%:	3091.3	3091.4	3091.6	3091.6	3091.5	3090.7	3090.4	3090.3	3090.2	3090.4	3090.6	3090.8

I. Boat Ramps: 2 feet added to bottom of ramps to allow for launching

Center Dam: Low: 3091 High: 3118

Average:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
10%:	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
90%:	**YES**	**YES**	**YES**	**YES**	**YES**	NO	NO	NO	NO	NO	NO	NO

New Ramp: Low: 3087 High: 3102

Average:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
10%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

II. Boat Ramps: 2 feet not added to bottom of ramps

Center Dam: Low: 3089 High: 3118

Average:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
10%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	NO	NO	**YES**	**YES**	**YES**
90%:	YES	YES	YES	YES	YES	YES	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

New Ramp: Low: 3085 High: 3102

Average:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
10%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

III. Beaches:

Cow Beach: Low: 3086 High: 3100

Average:	YES	YES	YES	YES	YES	YES	**YES**	**YES**	**YES**	**YES**	**YES**	YES
10%:	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
90%:	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: **Bolded cells** reflect changes from the No Action Alternative.

References

Holland, R. and Z. Gabelhouse. 2006. Characterization of Outdoor Recreationists Using Four Bureau of Reclamation Reservoirs, Park Facilities, and Associated Wildlife Lands in the Republican River Basin. Report submitted to: U. S. Department of Interior, Bureau of Reclamation, Grand Island, NE.

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Appendix E

Frenchman Valley Appraisal Study
Agricultural Economic Analysis

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The agricultural assessment of the Frenchman Valley Appraisal Study focuses exclusively on effects to irrigated lands in the Frenchman Valley Irrigation District (FVID). More specifically, this analysis focuses solely upon the changes in pumping costs that will be borne by farmers under each of the selected Alternatives.

Affected Environment -

The Frenchman Valley Irrigation District lands lie along the Frenchman Creek in Hitchcock County. Annual precipitation generally averages about 21 inches per year.

The primary irrigated crops in the district include corn, soybeans, and alfalfa. Primary dryland crops include a wheat-eco fallow corn-fallow rotation.

Data from the 2002 census of agriculture shows that there were 299 farms in Hitchcock County encompassing 433,525 acres of land. The average size of farms was 1,450 acres. There were 119 irrigated farms in Hitchcock County in 2002, with a total of 228,403 acres. The average size of irrigated farms was 1,919 acres. The number of farms in Hitchcock County has generally been on a downward trend over time while the size of the remaining farms has trended upward. For example, the 1992 census of agriculture showed that the number of farms was 399, with the average size of those 1992 farms being 1,097 acres. There were 128 irrigated farms in 1992 with and average size of 1,303 acres.

The 2000 census of population shows that 3,111 people live in Hitchcock County in 1,292 homes. The median income for those households was $28,287 in 2000.

Frenchman Valley Irrigation District -

There are 9,295 acres in the District. Cropping pattern and yield data obtained from a 1998 repayment study showed that the primary irrigated crops in the District were corn, alfalfa, and soybeans. On a percentage basis, corn accounted for 86 percent of the irrigated acres, alfalfa was 7.75 percent, and soybeans were 6 percent.

Crop yields were obtained from the National Agricultural Statistics Service website so that a county average yield could by calculated and presented for informational purposes. The county average yields for Hitchcock County are shown in Table 1.

Table 1. Hitchcock County Average Yields, 2002-2006.

	2002	2003	2004	2005	2006	AVG
Corn	141	164	187	190	187	173.8
Soybeans	44	48	52	57	59	52
Alfalfa	4.5	5	5.1	5.4	4.3	4.9

Even though the crop yield data was obtained, it is used only in a qualitative manner in the analysis. The qualitative caveat on the yields shown in Table 1 is that the analysis assumes that those yields can be consistently attained by applying 12 acre-inches of water. Because of that assumption, the analysis can proceed by focusing only on pumping costs because all the other costs of production will be held constant throughout the period of study. Pumping costs will fluctuate depending on the energy cost. It is assumed that energy costs will increase by 5 percent per year.

Analysis Methodology -

This analysis will proceed based on the following assumptions:

1) Water applications will be a constant 12 acre-inches for all years.
2) Storage water deliveries will come every 5 years, at different rates for the selected Alternatives.
3) In years that storage water is available, pumping will make up the difference between the storage water amount and the 12 acre-inches that is assumed to be the "full" supply.
4) Pumping energy costs will be inflated 5 percent per year over the analysis period.

The basic assumption for this analysis is that 12 acre-inches of irrigation water will result in the county average yields shown in Table 1. In the years where storage water is delivered to District acres, there will be less pumping. For example, in years that no storage water is delivered to farms, 12 acre-inches of water per acre will be pumped. On the year that 4 acre-inches of storage water is delivered, only 8 acre-inches of water will be pumped. Thus, the impacts will be based on a change in pumping energy.

Yield will be held constant over the period of analysis. Pumping energy costs will be inflated 5 percent per year.

After estimating the pumping cost for each year in the period of analysis and for the amount pumped under each Alternative, the costs will be deflated back to current-year (2008) dollars. The current planning rate of 4.875 percent will be used as the deflator. Once the pumping costs have been estimated for each Alternative, they will be compared to the Future Without Alternative. The pumping costs for each Alternative will be shown.

Environmental Consequences -

The focus of the agricultural analysis is on a comparison of pumping costs for each of the proposed "action" alternatives compared to the No Action Alternative.

Future No Action Alternative -

Under this Alternative, the District will receive 3 acre-inches of storage water every 5 years. In those years that no storage water is delivered, each irrigated acre will receive 4 acre-inches of natural flow deliveries and 8 acre-inches of pumped water. In the years that storage water is delivered each acre will receive 4 acre-inches of natural flow water, 5 acre-inches of pumped water, and 3 acre-inches of storage water. Table 2 shows the water delivery schedule, the amount delivered from pumping or storage water, the net present value of the pumping cost per acre-inch, the pumping cost per acre, and the total pumping cost for all acres in the District.

Table 2. Future Without Alternative – Natural Flows, Amount Pumped, Storage Water Deliveries, Total Deliveries per Acre, Pumping Costs per Acre, and the Total Pumping Costs for 9,295 Acres in FVID.

Year	Natural Flow	Pumped	Surface Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2008	4	5	3	12	$8.34	$77,551
2009	4	8		12	$9.67	$89,918
2010	4	8		12	$10.96	$101,855
2011	4	8		12	$11.37	$105,726
2012	4	8		12	$11.67	$108,430
2013	4	5	3	12	$7.48	$69,509
2014	4	8		12	$12.21	$113,505
2015	4	8		12	$12.35	$114,834
2016	4	8		12	$12.77	$118,702
2017	4	8		12	$13.02	$121,038
2018	4	5	3	12	$8.41	$78,189
2019	4	8		12	$13.56	$126,008
2020	4	8		12	$13.70	$127,359
2021	4	8		12	$13.97	$129,841
2022	4	8		12	$14.18	$131,816
2023	4	5	3	12	$9.08	$84,415
2024	4	8		12	$14.64	$136,069
2025	4	8		12	$14.81	$137,635
2026	4	8		12	$14.99	$139,365
2027	4	8		12	$15.22	$141,497
2028	4	5	3	12	$9.68	$89,969
2029	4	8		12	$15.53	$144,305
2030	4	8		12	$15.69	$145,808
2031	4	8		12	$15.88	$147,571
2032	4	8		12	$16.06	$149,308
2033	4	5	3	12	$10.17	$94,507
2034	4	8		12	$16.29	$151,382
2035	4	8		12	$16.46	$152,974
2036	4	8		12	$16.58	$154,092
2037	4	8		12	$16.69	$155,131
2038	4	5	3	12	$10.54	$97,976

Year	Natural Flow	Pumped	Surface Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2039	4	8		12	$16.94	$157,418
2040	4	8		12	$17.06	$158,603
2041	4	8		12	$17.14	$159,337
2042	4	8		12	$17.25	$160,364
2043	4	5	3	12	$10.88	$101,096
2044	4	8		12	$17.45	$162,158
2045	4	8		12	$17.54	$163,027
2046	4	8		12	$17.64	$163,930
SUM of Pumping Costs						$4,962,218

The net present value of pumping costs ranged from $8.34 per acre in 2008 to an estimated $17.64 per acre in 2046, on a net present value basis. When all the pumping costs for all the years and the 9,295 acres in the District are added up, there will be an outlay of $4.96 million dollars for pumping costs.

Flow Through Alternative -

Under the Flow Through Alternative, there are no storage deliveries to the District. Thus, the irrigated acres in the District will pump 7.4 acre-inches every year of the study period and 4.6 acre-inches of natural flow water will be delivered annually. Pumping costs are based on pumping 7.4 acre-inches annually with an increasing cost for electrical energy. Table 3 shows the natural flow amounts, amount pumped per year, total deliveries per acre per year, pumping costs per year, and the total amount of pumping expenses that will accrue.

Table 3. Flow Through Alternative – Amount Pumped, Storage Water Deliveries, Total Deliveries Per Acre, Pumping Costs per Acre, and the Total Pumping Costs for 9,295 Acres in FVID.

Year	Natural Flow	Pumped	Surface Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2008	4.6	7.4		12	$9.24	$85,917
2009	4.6	7.4		12	$9.49	$88,177
2010	4.6	7.4		12	$9.94	$92,427
2011	4.6	7.4		12	$10.34	$96,090
2012	4.6	7.4		12	$10.67	$99,214
2013	4.6	7.4		12	$10.90	$101,322
2014	4.6	7.4		12	$11.30	$104,992
2015	4.6	7.4		12	$11.43	$106,222
2016	4.6	7.4		12	$11.86	$110,247
2017	4.6	7.4		12	$12.05	$111,960
2018	4.6	7.4		12	$12.32	$114,497
2019	4.6	7.4		12	$12.54	$116,557
2020	4.6	7.4		12	$12.75	$118,548

Year	Natural Flow	Pumped	Surface Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2021	4.6	7.4		12	$13.00	$120,809
2022	4.6	7.4		12	$13.19	$122,604
2023	4.6	7.4		12	$13.41	$124,612
2024	4.6	7.4		12	$13.61	$126,476
2025	4.6	7.4		12	$13.76	$127,897
2026	4.6	7.4		12	$13.93	$129,469
2027	4.6	7.4		12	$14.14	$131,416
2028	4.6	7.4		12	$14.30	$132,901
2029	4.6	7.4		12	$14.41	$133,965
2030	4.6	7.4		12	$14.56	$135,333
2031	4.6	7.4		12	$14.73	$136,943
2032	4.6	7.4		12	$14.90	$138,529
2033	4.6	7.4		12	$15.05	$139,871
2034	4.6	7.4		12	$15.13	$140,599
2035	4.6	7.4		12	$15.28	$142,046
2036	4.6	7.4		12	$15.39	$143,054
2037	4.6	7.4		12	$15.49	$143,991
2038	4.6	7.4		12	$15.62	$145,162
2039	4.6	7.4		12	$15.73	$146,212
2040	4.6	7.4		12	$15.85	$147,280
2041	4.6	7.4		12	$15.90	$147,796
2042	4.6	7.4		12	$16.01	$148,856
2043	4.6	7.4		12	$16.11	$149,747
2044	4.6	7.4		12	$16.19	$150,469
2045	4.6	7.4		12	$16.27	$151,251
2046	4.6	7.4		12	$16.37	$152,173
SUM of Pumping Costs						$4,955,631

Pumping costs range from $9.24 per acre to $16.37 per acre on a net present value basis. The net present value of pumping costs for all 9,295 acres in the District add up to $4.96 million.

Groundwater Recharge Alternative -

No storage water is delivered under this Alternative. No natural flows are delivered either. Irrigated acres within the District will only receive 12 acre-inches of pumped irrigation water each year of the study period. Table 4 shows the amount pumped per year, total deliveries per year, pumping costs per year, and the total amount of pumping expenses that will accrue.

Table 4. Groundwater Recharge Alternative – Natural Flows, Amount Pumped, Storage Water Deliveries, Total Deliveries, Pumping Costs per Acre, and the Total Pumping Costs for 9,295 Acres in the FVID.

Year	Natural Flow	Pumped	Surface Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2008	0	12		12	$14.76	$137,198
2009	0	12		12	$15.27	$141,976
2010	0	12		12	$15.92	$147,947
2011	0	12		12	$16.57	$153,978
2012	0	12		12	$17.12	$159,129
2013	0	12		12	$17.59	$163,468
2014	0	12		12	$18.15	$168,659
2015	0	12		12	$18.45	$171,489
2016	0	12		12	$19.08	$177,326
2017	0	12		12	$19.38	$180,171
2018	0	12		12	$19.83	$184,350
2019	0	12		12	$20.27	$188,381
2020	0	12		12	$20.55	$191,039
2021	0	12		12	$20.95	$194,761
2022	0	12		12	$21.21	$197,178
2023	0	12		12	$21.63	$201,033
2024	0	12		12	$21.96	$204,103
2025	0	12		12	$22.16	$205,980
2026	0	12		12	$22.49	$209,047
2027	0	12		12	$22.83	$212,245
2028	0	12		12	$23.10	$214,694
2029	0	12		12	($1.95)	($18,162)
2030	0	12		12	$23.53	$218,712
2031	0	12		12	$23.78	$221,001
2032	0	12		12	$24.09	$223,962
2033	0	12		12	$24.30	$225,847
2034	0	12		12	$24.43	$227,073
2035	0	12		12	$24.69	$229,462
2036	0	12		12	$24.87	$231,138
2037	0	12		12	$25.06	$232,964
2038	0	12		12	$25.24	$234,632
2039	0	12		12	$25.43	$236,371
2040	0	12		12	$25.62	$238,136
2041	0	12		12	$25.71	$239,006
2042	0	12		12	$25.88	$240,545
2043	0	12		12	$26.04	$242,028
2044	0	12		12	$26.19	$243,428
2045	0	12		12	$26.33	$244,724
2046	0	12		12	$26.47	$246,070
SUM of Pumping Costs						$7,761,089

Pumping costs range from $14.76 per acre to $26.47 per acre. The net present value of pumping costs for all 9,295 acres in the District add up to $7.76 million.

Recreation Without Storage Deliveries Alternative -

No storage water is assumed to be delivered under this Alternative. Irrigated acres within the FVID will receive 4 acre-inches of natural flow water and 8 acre-inches of pumped irrigation water each year of the study period. Table 5 shows the amount pumped per year, total deliveries per year, pumping costs per year, and the total amount of pumping expenses that will accrue.

Table 5. Recreation Without Storage Deliveries Alternative – Natural Flows Delivered, Amount Pumped, Storage Water Deliveries, Total Deliveries, Pumping Costs per Acre, and the Total Pumping Costs for 9,295 Acres in the FVID.

Year	Natural Flow	Acre-Inches Pumped	Storage Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2008	4	8		12	$9.92	$92,174
2009	4	8		12	$9.67	$89,918
2010	4	8		12	$10.96	$101,855
2011	4	8		12	$11.37	$105,726
2012	4	8		12	$11.67	$108,430
2013	4	8		12	$11.72	$108,979
2014	4	8		12	$12.21	$113,505
2015	4	8		12	$12.35	$114,834
2016	4	8		12	$12.77	$118,702
2017	4	8		12	$13.02	$121,038
2018	4	8		12	$13.27	$123,340
2019	4	8		12	$13.56	$126,008
2020	4	8		12	$13.70	$127,359
2021	4	8		12	$13.97	$129,841
2022	4	8		12	$14.18	$131,816
2023	4	8		12	$14.42	$134,022
2024	4	8		12	$14.64	$136,069
2025	4	8		12	$14.81	$137,635
2026	4	8		12	$14.99	$139,365
2027	4	8		12	$15.22	$141,497
2028	4	8		12	$15.40	$143,130
2029	4	8		12	$15.53	$144,305
2030	4	8		12	$15.69	$145,808
2031	4	8		12	$15.88	$147,571
2032	4	8		12	$16.06	$149,308
2033	4	8		12	$16.20	$150,565
2034	4	8		12	$16.29	$151,382
2035	4	8		12	$16.46	$152,974
2036	4	8		12	$16.58	$154,092
2037	4	8		12	$16.69	$155,131
2038	4	8		12	$16.81	$156,251
2039	4	8		12	$16.94	$157,418
2040	4	8		12	$17.06	$158,603
2041	4	8		12	$17.14	$159,337

Year	Natural Flow	Acre-Inches Pumped	Storage Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2042	4	8		12	$17.25	$160,364
2043	4	8		12	$17.36	$161,352
2044	4	8		12	$17.45	$162,158
2045	4	8		12	$17.54	$163,027
2046	4	8		12	$17.64	$163,930
SUM of Pumping Costs						$5,338,819

Pumping costs range from $9.92 per acre to $17.64 per acre on a net present value basis. The net present value of pumping costs for all 9,295 acres in the District add up to $5.34 million.

Recreation With Irrigation Deliveries -

Under this Alternative, the District will deliver 2 acre-inches of storage water every 5 years. Irrigated acres will receive 8 acre-inches of pumped water and 4 acre-inches of natural flow in four of every five years. In the fifth year, these acres will receive 5 acre-inches of pumped water, 4 acre-inches of natural flow, and 3 acre-inches of storage water. Table 6 shows the amount pumped per year, total deliveries per year, pumping costs per year, and the total amount of pumping expenses that will accrue.

Table 6. Recreation With Storage Deliveries Alternative – Natural Flows, Amount Pumped, Storage Water Deliveries, Total Deliveries, Pumping Costs per Acre, and the Total Pumping Costs, FVID

Year	Natural Flow	Pumped	Surface Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2008	4	6	2	12	$7.55	$70,194
2009	4	8		12	$10.26	$95,327
2010	4	8		12	$10.68	$99,276
2011	4	8		12	$11.11	$103,267
2012	4	8		12	$11.48	$106,672
2013	4	6	2	12	$8.93	$82,992
2014	4	8		12	$12.15	$112,972
2015	4	8		12	$12.30	$114,326
2016	4	8		12	$12.72	$118,217
2017	4	8		12	$12.97	$120,576
2018	4	6	2	12	$10.06	$93,497
2019	4	8		12	$13.51	$125,588
2020	4	8		12	$13.70	$127,359
2021	4	8		12	$13.97	$129,841
2022	4	8		12	$14.18	$131,816
2023	4	6	2	12	$10.93	$101,558
2024	4	8		12	$14.64	$136,069
2025	4	8		12	$14.81	$137,635
2026	4	8		12	$14.99	$139,365
2027	4	8		12	$15.22	$141,497

Year	Natural Flow	Pumped	Surface Water Del.	Total Water Del.	Pumping Cost/Acre	NPV of Total Cost
2028	4	6	2	12	$11.64	$108,168
2029	4	8		12	$15.53	$144,305
2030	4	8		12	$15.69	$145,808
2031	4	8		12	$15.88	$147,571
2032	4	8		12	$16.06	$149,308
2033	4	6	2	12	$12.24	$113,733
2034	4	8		12	$16.29	$151,382
2035	4	8		12	$16.46	$152,974
2036	4	8		12	$16.58	$154,092
2037	4	8		12	$16.69	$155,131
2038	4	6	2	12	$12.69	$117,954
2039	4	8		12	$16.94	$157,418
2040	4	8		12	$17.06	$158,603
2041	4	8		12	$17.14	$159,337
2042	4	8		12	$17.25	$160,364
2043	4	6	2	12	$13.08	$121,617
2044	4	8		12	$17.45	$162,158
2045	4	8		12	$17.54	$163,027
2046	4	8		12	$17.64	$163,930
SUM of Pumping Costs						$5,074,924

Pumping costs range from $7.55 per acre to $17.64 per acre on a net present value basis. The net present value of pumping costs for all 9,295 acres in the District add up to $5.07 million.

Comparison of Alternatives -

To complete the analysis, the results from each of the Alternatives are compared to the Future Without Alternative. The comparison will focus on the sum of pumping costs from Tables 2-6 above. Table 7 shows the sum of the pumping costs for each of the Alternatives.

Table 7. Sum of Pumping Costs for All Acres in the District, by Alternative.

Alternative	Acre-Inches Pumped	Total Costs	Difference
Future Without	8 or 5	$4,962,218	
Flow Through	7.4	$4,955,631	($6,587)
Groundwater Recharge	12	$7,761,089	$2,798,871
Recreation w/o Deliveries	8	$5,338,819	$376,601
Recreation w/ Deliveries	8 or 6	$5,074,924	$112,706

The Future Without Alternative had pumping costs of $4.962 million. In this Alternative, 3 acre-inches of storage water were delivered every 5 years over the period of study. Thus, a repeating cycle of pumping 8 acre-inches for four years was followed by one year

of pumping 5 acre-inches of water. Each year, there were 4 acre-inches of natural flow delivered.

The Flow Through Alternative had 4.6 acre-inches of natural flow delivered annually. Thus, for each acre to receive a 12 acre-inch supply of irrigation water, 7.4 acre-inches were pumped. There were no storage water deliveries made in any year. Total pumping costs for the Flow Through Alternative, at $4.755 million were $6,600 lower than the Future Without Alternative pumping costs.

The Groundwater Recharge Alternative had no natural flow deliveries made, nor were there any storage water deliveries. Under this Alternative, the highest pumping costs are seen, estimated at $7.76 million. Pumping costs for this Alternative are $2.8 million higher than the Future Without Alternative.

The Recreation Without Deliveries Alternatives had no storage water deliveries. However, there were natural flow deliveries of 4 acre-inches annually, so the amount pumped per acre was 8 acre-inches. Total pumping costs came to $5.34 million under this Alternative, $377,000 higher than the Future Without Alternative pumping costs.

The Recreation With Deliveries Alternative pumping costs came to $5.07 million. A repeating cycle of four years of pumping 8 acre-inches of water combined with 4 acre-inches of natural flow deliveries was followed by one year of pumping 6 acre-inches of water combined with 4 acre-inches of natural flow deliveries and 2 acre-inches of storage water deliveries. The Recreation With Deliveries Alternative had pumping costs of $113,000 more than the Future Without Alternative.

Appendix F

Frenchman Valley Meeting

McCook Field Office
May 4, 2005 – 10:30 a.m.

Agency	Name	Phone	Email
Bureau of Reclamation			
	Alice Johns	308-389-5301	ajohns@gp.usbr.gov
	Steve Ronshaugen	308-389-5304	sronshaugen@gp.usbr.gov
	Mike Kube	308-389-5321	mkube@gp.usbr.gov
	Jill Manring	308-389-5328	jmanring@gp.usbr.gov
	Jack Wergin	308-389-5322	jwergin@gp.usbr.gov
	Marv Swanda	308-345-1027	mswanda@gp.usbr.gov
	Bill Peck	308-345-1029	wpeck@gp.usbr.gov
	Craig Scott	308-345-1030	cscott@gp.usbr.gov
Nebraska Department of Natural Resources			
	Roger Patterson	402-471-2366	rpatterson@dnr.state.ne.us
	Steve Gaul	402-471-3955	sgaul@dnr.state.ne.us
	Jeff Shafer	402-471-0586	jshafer@dnr.state.ne.us
	Brad Edgerton	308-697-3730	ndwrcamb@swnebr.net
Frenchman Valley & H & RW Irrigation Districts			
	Don Felker – FV, HRW ID	308-345-5773	
	Jerry Kotschwar - FVID	308-278-2792	
	Kenneth Albert - FVID	308-278-2327	
	Roger Kolbet - H&RW ID	308-278-2239	
	Don Ruggles - H&RW ID	308-364-2750	
Middle Republican NRD			
	Dan Smith	308-367-4281	dsmith@mrnrd.org
Nebraska Game & Parks Commission			
	Larry Hutchinson	402-471-5554	lhutch@ngpc.state.ne.us
	Irvin Long	308-345-6507	ilong@ngpc.state.ne.us
	Bill Christensen	308-394-5118	enderssra@ngpc.state.ne.us
	Hal Walker	308-423-2080	hchatch@ngpc.state.ne.us
	Keith Koupal	308-865-5326	
	Darrol Eichner	308-284-8803	deichner@ngpc.state.ne.us

Flip Chart Notes from the May 4, 2005 Frenchman Valley Meeting

Game and Parks Interest

-Composition of fisheries
    •Chemical renovation
-Future reservoir water supply
-"Quality of Life" – Effects of decreasing population
-Cabin Owner interest
-Higher minimum pool, El. 3089.40 - Approximately 14,000 AF
-Preferred minimum pool, El. 3099.0
-Loss of habitat areas
-Water temps/ algae blooms increase with lower levels
-Fish kill/ human health with lower lake levels
-Capital investments for fisheries/ parks
-Need for creal user surveys (update?)
-Noxious weed problems with lower lake levels
-Off-road vehicle use
-Consistent water levels El. 3090.0? – 5/2002 last time reservoir was at this level
-Boat ramps
-Aesthetics
-Congestion in lake, parks area
    •Boating safety
    •Non-resident use
-Valuation of recreation facilities
-Non-resident economic benefit to local area
-1968 – last time reservoir filled
-Who pays for benefits?

NRD Interest

-No "new" restrictions on groundwater pumping
-Third party impacts from "new" restrictions
-Additional controls & regulations
-Who pays for benefits?
-Stay compliant with Compact

District Objectives/Goals

-Reservoir Water Supply
    •Natural flows cover half the district
    •Water right is 130 cfs. Current supply is 40 cfs.
-Reliability of reservoir supply and natural flow supply
-Financial Reliability of District
-Benefits to non-district area/ beneficiaries pay for benefits

DNR Interest

-Get most benefit of future water supply
-Compact implications (stay in compliance)
-Solvency of Districts
-Share benefits/ burden
-Improve water levels in lake and intentional ground water recharge (in targeted areas)
-"Streamline" study process
-Examine legal/administrative changes to change use to get greatest benefit

Existing Compact Groundwater Model

-"Do nothing"
-Evaluate alternatives
-Future water supplies

Reclamation Interest

-Protect Federal Investment
    •Both irrigation and fish/ recreation benefits
-Existing contracts with the Irrigation Districts
-Solvency of the Districts
-Meet authorized purposes of the project
-Storage and storage use rights are considerably higher than what is available
-Downstream Irrigation Districts Interest
-SOD Evaluation

Nebraska Investigations Program

Frenchman Valley Appraisal Study – A cost-shared study that will examine opportunities for more efficient management of water supplies in the Frenchman River Valley including Reclamation's Enders Reservoir, a feature of the Frenchman-Cambridge Division in Nebraska. The study will focus on problems and opportunities in an area that has experienced dramatically reduced ground and surface water supplies, including reduced reservoir inflows. The study area is covered by the recent Republican River Compact Settlement. More efficient management of Republican River can help extend water supplies and meet interstate compact needs as addressed in the Republican River Compact Settlement.

The study will identify whether there is a Federal interest in intensive management of interrelated groundwater and surface water supplies to meet Compact requirements as well as for meeting other economic and environmental needs. The study will be coordinated with the State, irrigation districts, and natural resources districts.

Draft 4/15/05

FRENCHMAN VALLEY STUDY

Goal

To evaluate alternative program activities, structural measures or incentives that can assist in optimizing existing facilities, providing lake level benefits, and providing recharge facilities for Enders Reservoir and the irrigated area it serves.

Objectives

1. Describe the Study Area
2. Consult with stakeholder groups
3. Evaluate problems and opportunities
4. Evaluate alternative choices for optimizing existing facilities related to Enders Reservoir and the irrigated area it serves
    a) Structural options
    b) Program options and incentives
    c) Other
5. Evaluate alternative choices for providing lake level benefits from Enders Reservoir
    a) Structural options
    b) Program options and incentives
    c) Other
6. Evaluate alternative choices for providing recharge benefits through use of Enders Reservoir
    a) Structural options
    b) Program options and incentives
    c) Other
7. Formulate alternative plans
8. Evaluate overall effects of plans
9. Compare plans
10. Provide recommendations

RID—Riverside Irrigation District

RRCA— Republican River Compact Administration

RRWCD—Republican River Water Conservation District

Reclamation – Bureau of Reclamation

SOC—Species of Concern

T - Threatened

TDS – Total dissolved solids

TOC – Top of conservation pool

Unit – Frenchman Unit