

## 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 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 lowering their water right due to non-use (see Water Rights, page 14).

### **Irrigation**

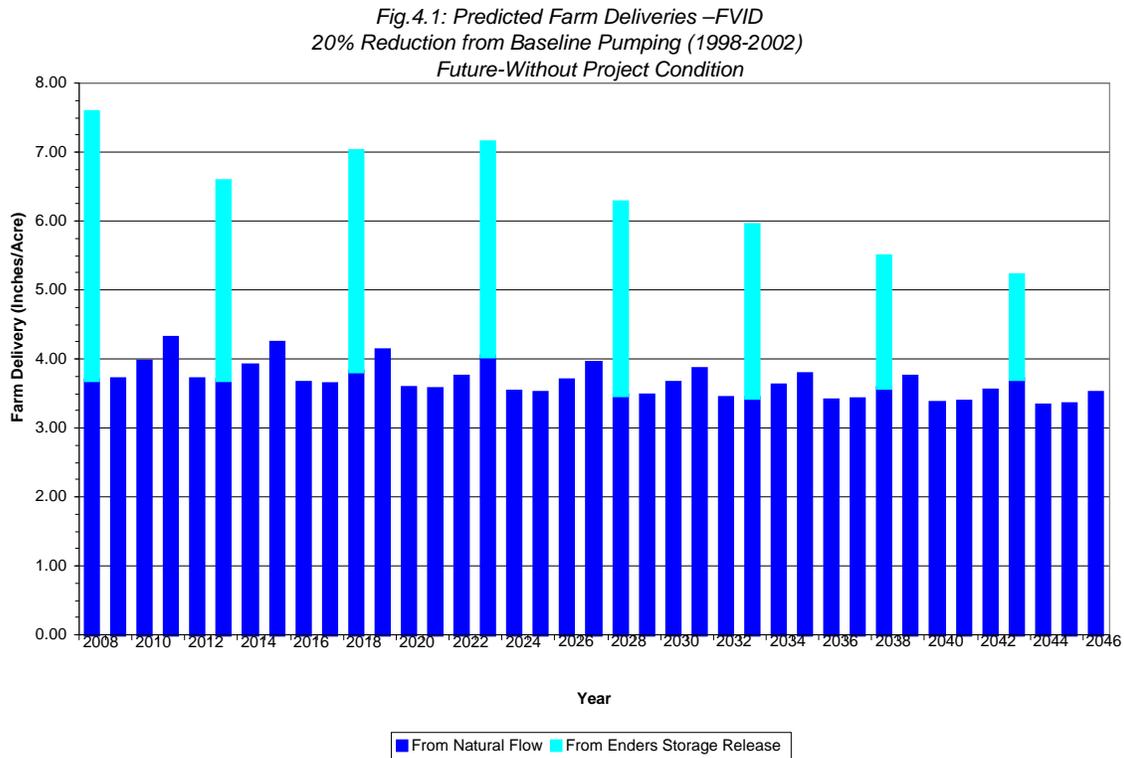
In the Future-Without Project Condition, Enders Reservoir would continue to provide irrigation water when available to 9,292 acres in the FVID and 11,915 acres in the H&RWID. According to project water rights, diversion of all available natural flows would continue and Enders storage would be available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

Due to the limited available (and predicted) inflows and conservation storage in Enders Reservoir, it was assumed that H&RWID would not take delivery water in the Future-Without Project Condition. It was also assumed that FVID would utilize available conservation storage every fifth year. This would result in FVID delivering an average of less than 4 inches per acre from natural flows each year and an additional 3 inches per acre every fifth year from storage releases as shown in Fig. 4.1.



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.

Figs. 4.2 and 4.3 shows 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

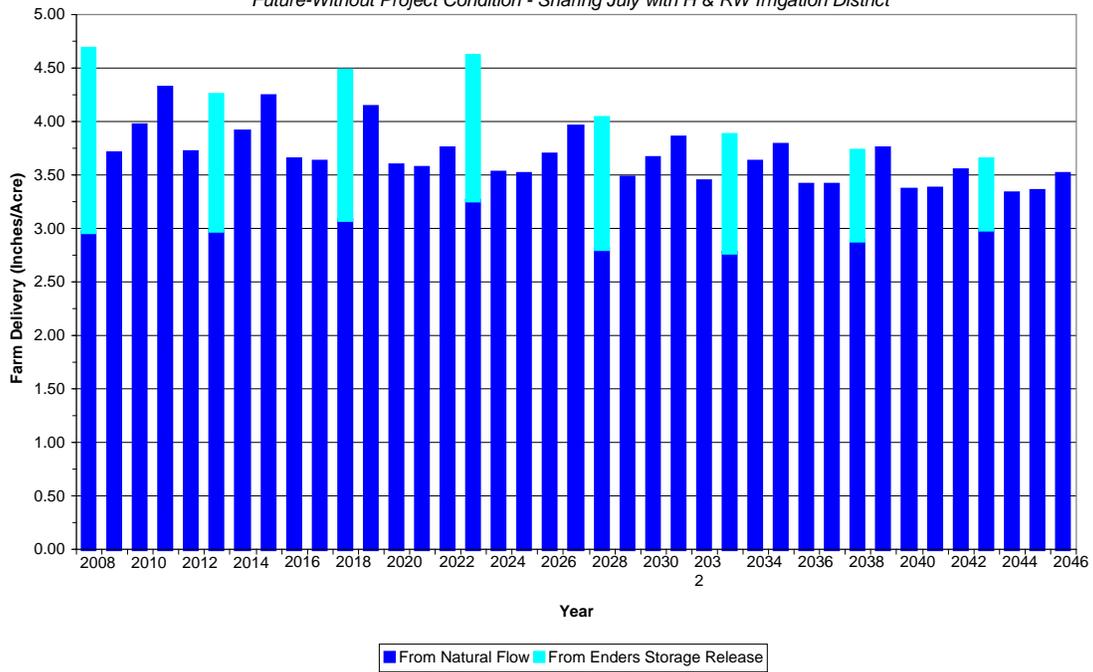
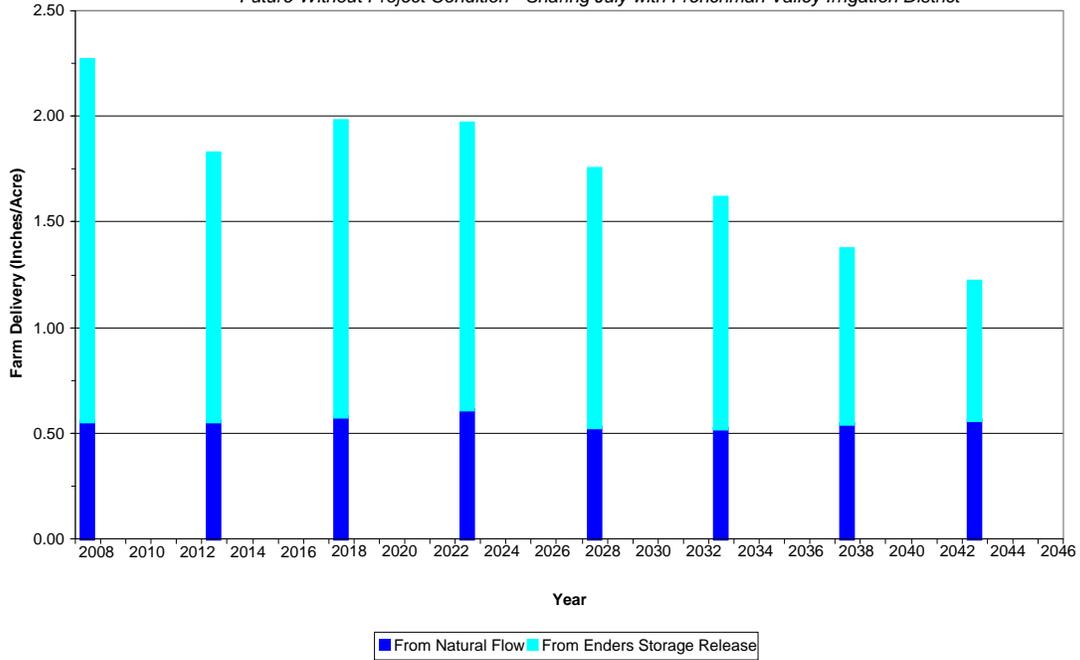


Fig. 4.3: Predicted Farm Deliveries - H&RW Irrigation District  
 20% Reduction from Baseline Pumping (1998-2002)  
 Future-Without Project Condition - Sharing July with Frenchman Valley Irrigation District



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.

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 at Enders declines when the reservoir elevation decreases. This trend would continue.

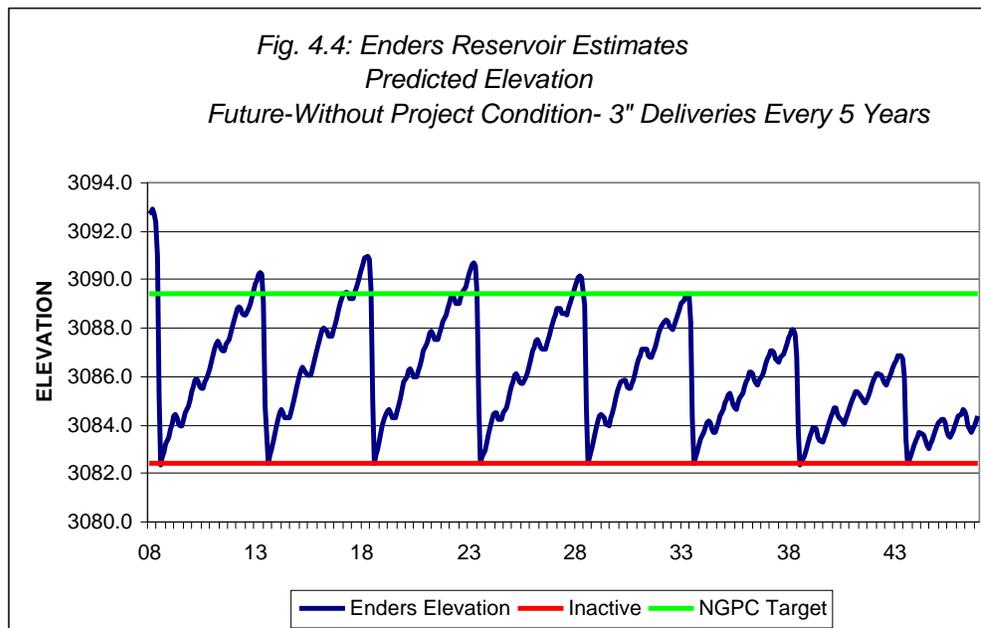
Detailed information concerning recreation activities at Enders Reservoir is summarized in Appendix D.

## 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.



## 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 versus 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 gate 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

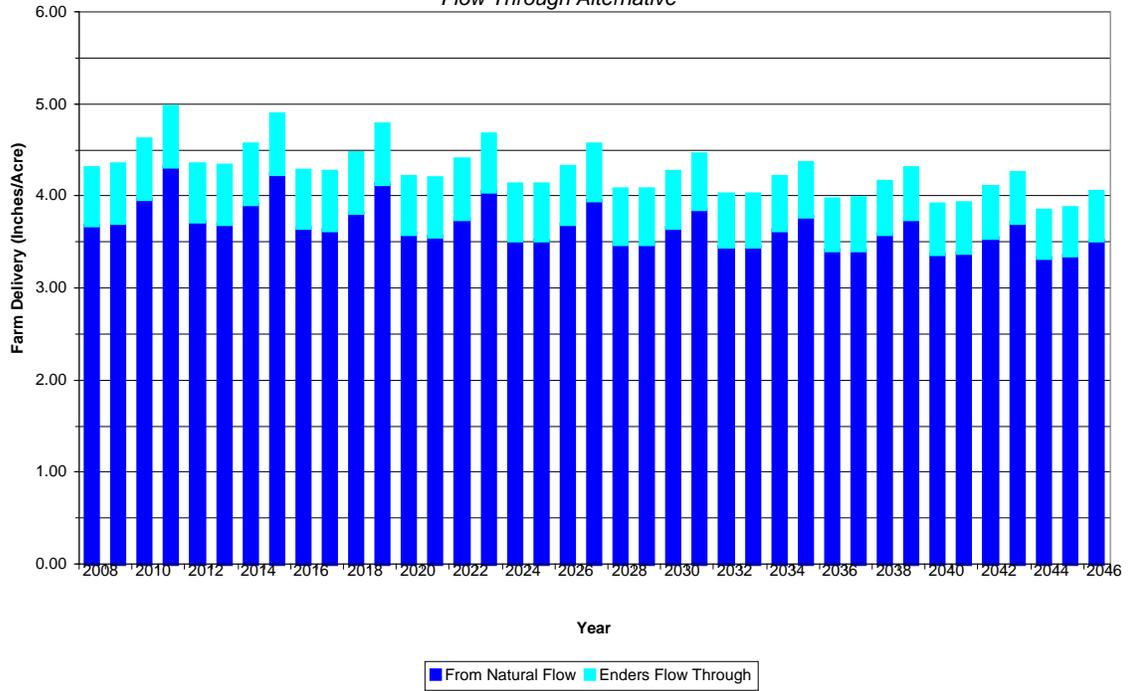
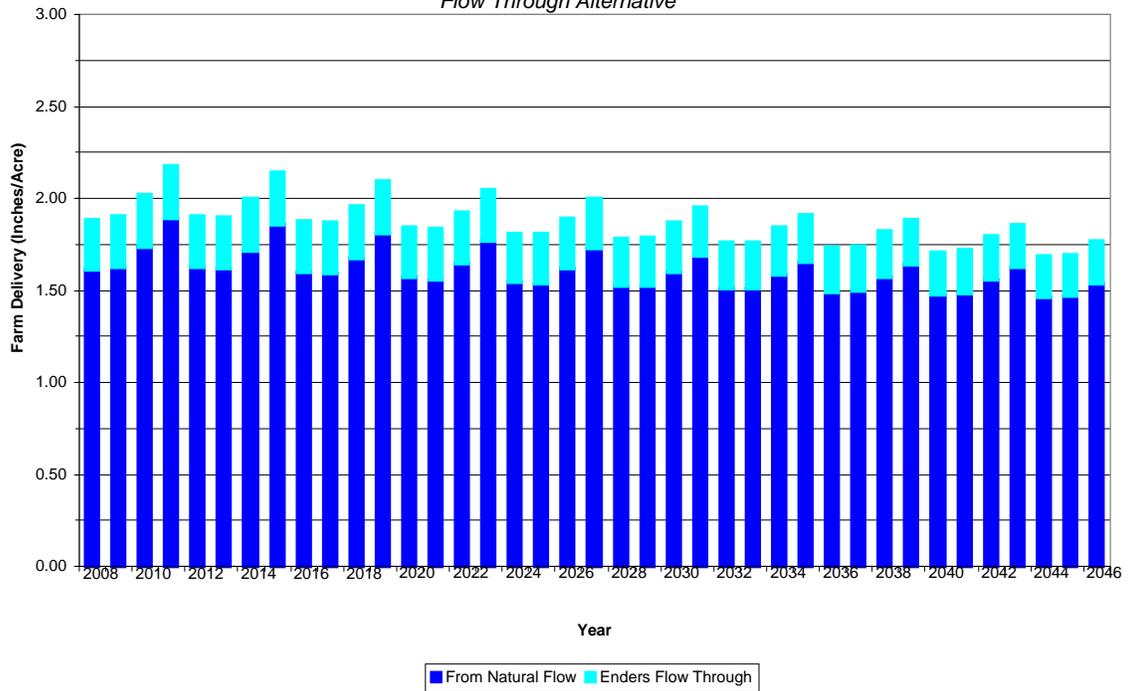


Fig. 4.6: Predicted Farm Deliveries - FVID and H&RWID  
 20% Reduction from Baseline Pumping (1998-2002)  
 Flow Through Alternative



## 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, the 2 feet 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

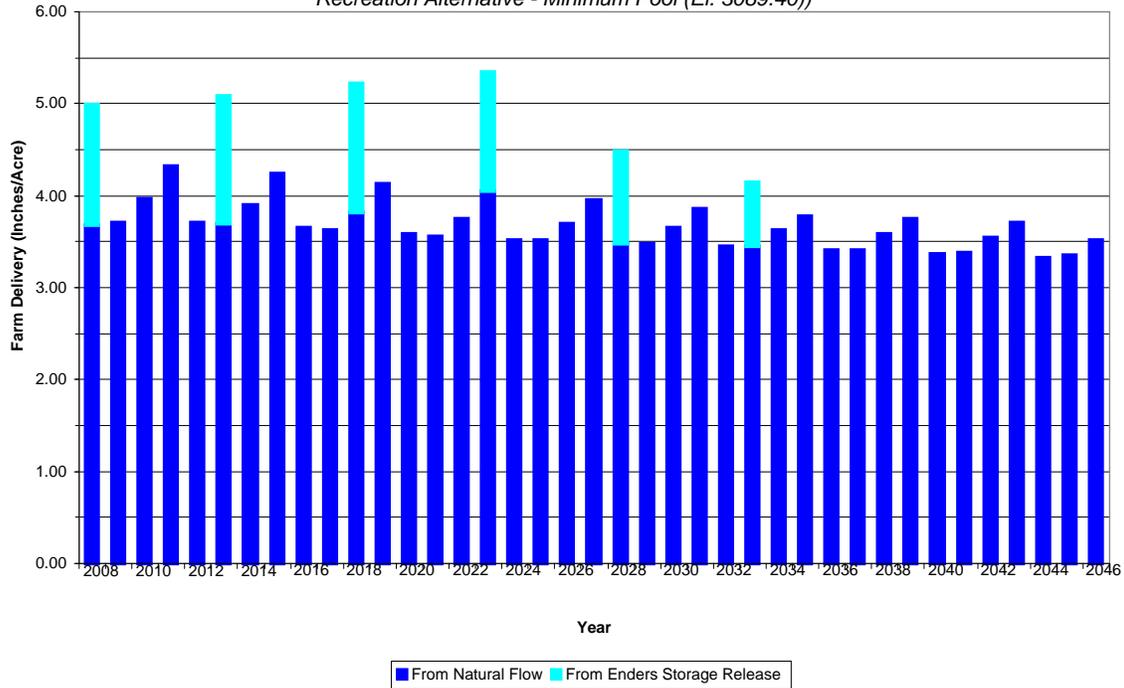
The Recreation Alternative would establish a new minimum pool at elevation 3089.4 feet in Enders to maintain the existing reservoir fishery and increase other forms of flat-water recreation. This elevation was recommended by the NGPC in their Standard Survey Summary and Workplan: Enders Reservoir, 2003-2004 (2006). The top of the inactive conservation pool is 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.

## 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 area. 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.

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 project 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 districts in the Republican and Solomon River basins, 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 in 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 in the Recreation Alternative with deliveries compared to the adopted NGPC target elevation of 3089.4 feet.

Fig. 4.8: Enders Reservoir Accounting Estimates  
 Predicted Elevations  
 Recreation Alternative - No Deliveries

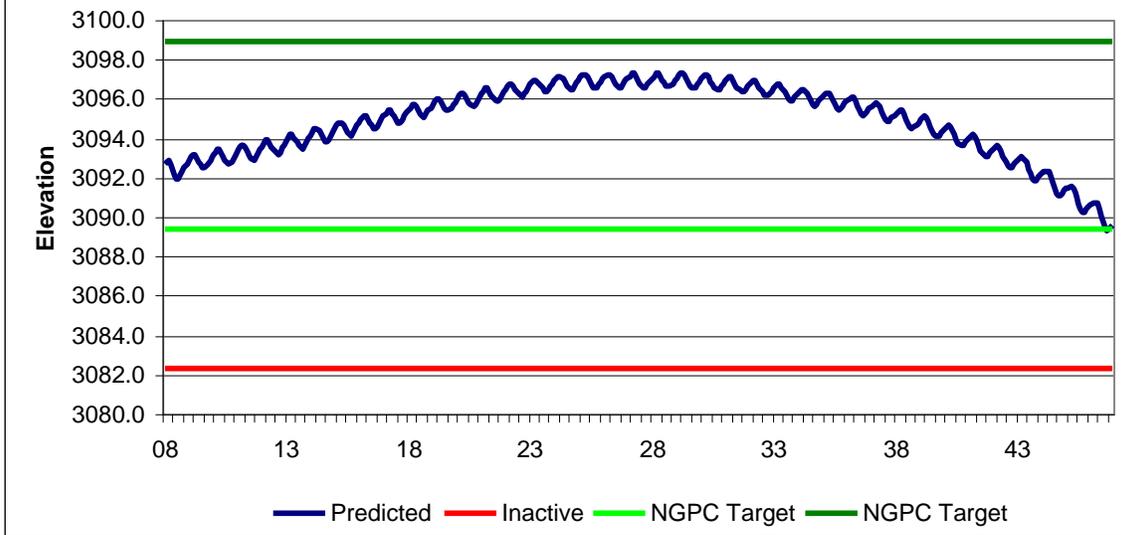
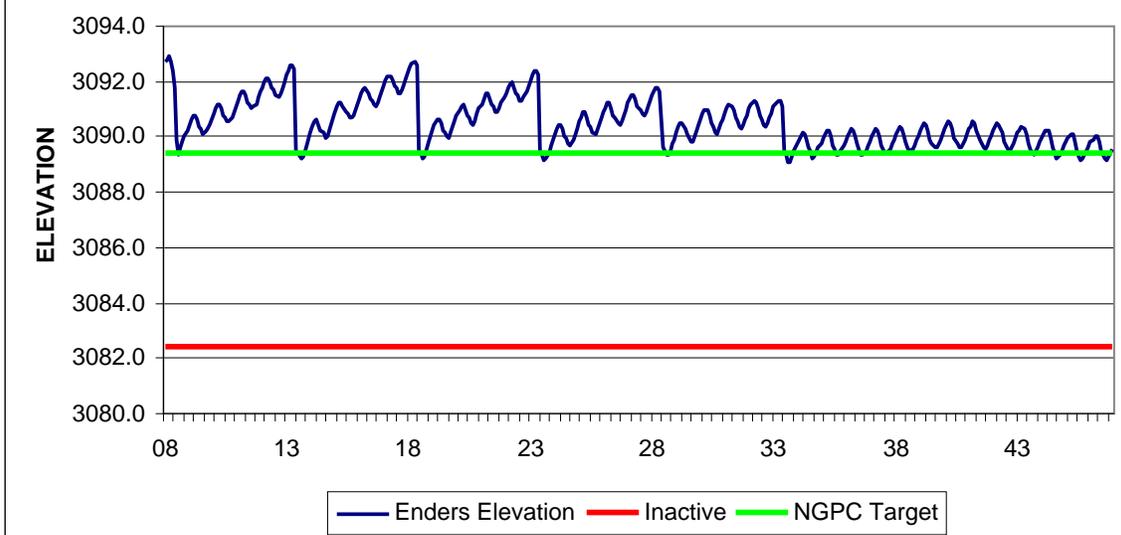


Fig. 4.9: Enders Reservoir Accounting Estimates  
 Predicted Elevations  
 Recreation Alternative - With Deliveries



## **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 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/later system, the diverted flows are being used for irrigation (by area 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 be pending 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 would be protected by the repayment of contracts (existing or revised) 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 deliveries 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 have a junior natural flow right, receive 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 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 1<sup>st</sup> 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. 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 project water 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.

## **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 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 showed 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. Due to existing conditions, the drastic measures needed and the expense to achieve this goal caused this alternative to be dropped from further consideration.

