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).

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, 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.

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.

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.

No critical habitat has been designated for species in the Unit or at Enders Reservoir.

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

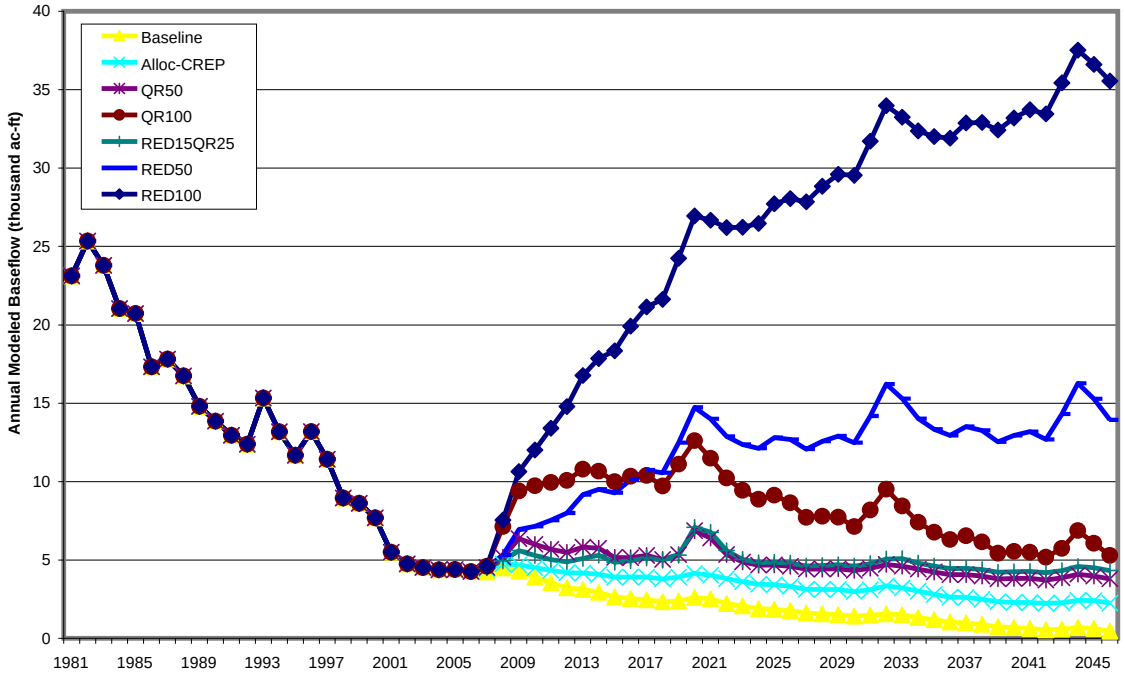
Groundwater Model

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 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 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.

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.

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

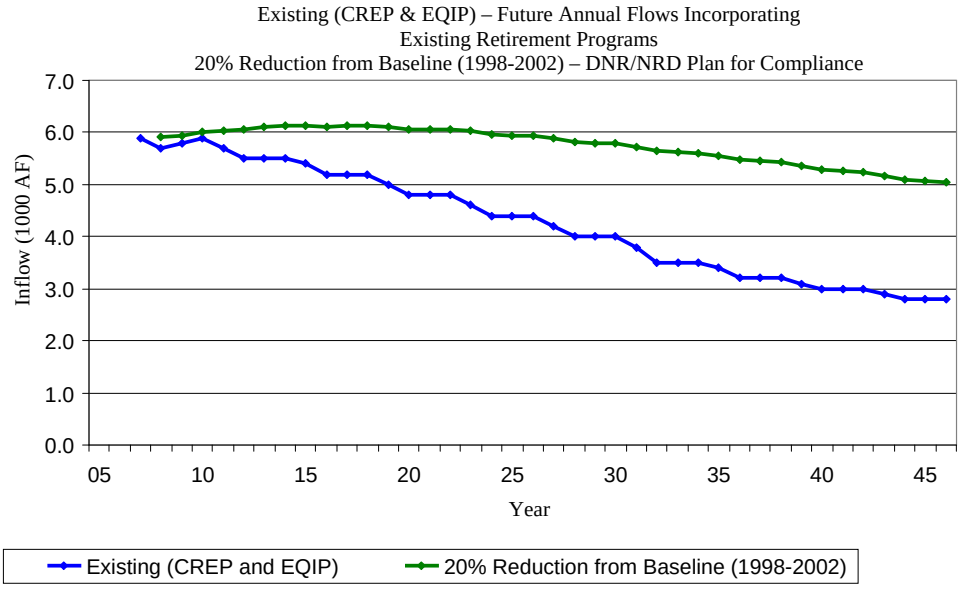


Fig. 3.3: Enders Reservoir

Predicted Average Annual Inflows

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