FT. LYON CANAL COMPANY

WATER TRANSFER ALTERNATIVES STUDY

PHASE 1 REPORT

FOR

STATE OF COLORADO
DEPARTMENT OF NATURAL RESOURCES
COLORADO WATER CONSERVATION BOARD

BY

GRONNING ENGINEERING COMPANY
DENVER, COLORADO

June 2, 1993
(Revised)

FOREWORD

This report is authored by a multi-disciplinary team which conducted literature review, field interviews, and analysis of alternatives to large-scale transfer of agricultural water out of the Ft. Lyon Canal Company system in the lower Arkansas River Basin of Colorado. The team members are:

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This report reflects a general characterization of the study area and is intended to develop alternatives at the feasibility level of analysis. Many details of valuation, legalities, farm practices, economic and social reports, and hydrology are beyond the scope of this report. Information is presented in summary form. Further investigation of any of the issues presented may be warranted; detailed examination could result in more accurate, and perhaps different, analyses and conclusions.

STATE OF COLORADO

COLORADO WATER CONSERVATION BOARD

Department of Natural Resources

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Roy Romer
Governor

Dariee C. Lile, P.E.
Director, CWCB

August 31, 1993

Dear Interested Party:

Enclosed, per your recent request, is a copy of the Fort Lyon Canal Company Water Transfer Alternatives Study, Phase 1 Report (dated June 2, 1993). I also enclose a copy of the transmittal letter used for our initial July public distribution of the report.

Your interest in the Fort Lyon Study is appreciated and your name has been added to our mailing list for future project information. The timing for selection of an alternative for Phase 2 is subject to modification by the Board. Your comments, suggestions, and/or questions concerning the Phase 1 Report are always welcome.

Sincerely

Steve Miller
Sr. Water Resource Specialist
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SM/bj

Enclosures

bj1190.ltr

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Re: Ft. Lyon Canal Co. Water Transfer Alternatives Study, Phase I Report

Dear Interested Party:

Enclosed, for your review and comment, please find a copy of the Ft. Lyon Canal Co. Water Transfer Alternatives Study, Phase I Report (dated June 2, 1993). The report was prepared by Gronning Engineering Co. (GEC) for the Colorado Water Conservation Board (CWCB) under an authorization approved by the Colorado General Assembly (SB92-87). While the CWCB appreciates the cooperation and participation of the Ft. Lyon Canal Co. (FLCC) in providing information for the study, the views expressed in the report are those of the CWCB, its staff, and/or GEC. The FLCC has not yet taken a position as to the accuracy of the estimates contained in the report, nor as to the appropriateness of any of the proposed alternative transfer mechanisms described in the report.

The purposes of the Phase I Report are to describe the Ft. Lyon Canal Co., its facilities and operations, the surrounding communities, and then describe and assess the potential impacts of various alternatives to the usual ways in which irrigation water rights are transferred in Colorado. The results of Phase I of the study, and ensuing discussions, will be used to decide which alternatives merit further analysis in Phase II. A decision on the direction of Phase II will be made by the CWCB at its September 9-10 meeting in Alamosa.

The CWCB will consider comments on the Phase I Report and suggestions from any interested person or entity at that meeting. For the purpose of obtaining comments and suggestions the CWCB staff and GEC will hold a public meeting concerning the Phase I Report on August 11, 1993 in Las Animas. All interested persons are invited to attend the CWCB meeting in Alamosa on September 9-10 and present oral comments directly to the Board. Written comments may also be submitted to the CWCB, attention Steve Miller, any time prior to September 1, 1993. Written comments will be presented to the CWCB prior to its meeting in Alamosa and will also be included in the Final Study Report due to be completed by January 1994. Exact times and location of all meetings will be announced later.

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CHAPTER 1

INTRODUCTION

Scope and Purpose of the Study

As established by the Colorado State Constitution, water is appropriated for beneficial use. In the development of the state, water supplies have been appropriated for domestic, agricultural and industrial purposes. As Colorado has continued to grow, the demands for domestic (municipal) water supplies have created economic incentives to sell and transfer agricultural water supplies. This report, authorized by the Colorado General Assembly as a part of Senate Bill 92-87, documents a multi-disciplinary study of issues arising out of a possible large-scale transfer of water out of the Ft. Lyon Canal to alternative uses. It examines changes to be anticipated in such a water transfer and proposes alternative actions to such a water transfer. This chapter presents introductory information on the Arkansas River Basin and the area of study.

In Chapter 2, issues associated with water transfers in and around the study area are presented along with information on historic water transfers. Chapters 3 and 4 present descriptive information of the Ft. Lyon Canal Company system and the regional socio-economic characteristics. They include a physical description of the system, operational analysis, historical background, and characterization of the social, economic and environmental aspects of the study area. Chapter 5 identifies current and future demands for Ft. Lyon water, inside and outside the study area. Chapter 6 describes the methods employed in alternative analysis and identifies alternatives to potential water transfers out of the Ft. Lyon system. In Phase 2 of this report the most promising alternative(s) and proposed plans for implementation will be developed.

Basin Characteristics

The Arkansas River originates upstream from Leadville at an elevation of over 14,000 feet and exits the state near Holly at 3,400 feet. The basin is illustrated in Figure 1.1. In passing through the plains east of Pueblo to the state line, the river gradient is less than 9 feet per mile. About 25,600 square miles is tributary to the Arkansas River in Colorado. Geologically, in the plains the valley aquifer rests in a U-shaped trough, cut into cretaceous shale and limestone bedrock.

Climate in the Arkansas River Basin varies widely in both temperature and precipitation. On the plains, annual precipitation levels increase moving eastward from Pueblo, reaching an average of about 16 inches per year at the state line. Over the study area, average rainfall is 11 to 15 inches, with a high degree of areal, daily, seasonal and annual variability.

The basin's water resources consist of snowmelt, rainfall runoff and ground water development. Most of the surface irrigation systems were constructed between 1874 and 1890. As junior water rights appropriators realized that remaining natural streamflow was generally too variable to supply irrigation requirements during many years, they constructed reservoirs to capture flood flows. The estimated 30-year average annual native streamflow is 283,000 acre feet (af) measured at the Arkansas River gage below Pueblo Reservoir. An additional net 172,000 af is imported from other basins by transmountain diversion projects for use in the Arkansas River Valley (USGS and SCS 1992). Total diversions for Colorado ditches between Pueblo and the Kansas state line are

estimated to be 838,000 af (1950-1987 data). Thus, due to diversion and use of return flows, water is used about three times in the Lower Arkansas Valley before leaving the state.

Ground water levels in the valley rose after irrigation began as a result of canal seepage and deep percolation. Irrigation wells have been drilled in suitable areas and supply about 25 percent of the irrigated acres. These wells have been subject of litigation for decades.

The Arkansas River of southeastern Colorado is one of the most saline rivers in the United States, with total dissolved solids (tds) levels exceeding 4,000 ppm between Lamar and the state line. Water containing more than 2,000 ppm tds is generally considered unsuitable for irrigation, but such water has been used successfully in the lower Arkansas Valley for many years. The salinity problem is discussed by Miles (1977). Most of the salt comes from natural sources in the soil. More information on water quality of the lower Arkansas River and the study area is presented in Chapter 3.

Description of Study Area

The Ft. Lyon Canal is the largest irrigation company on the Arkansas River, stretching 120 miles and providing irrigation water to approximately 92,600 acres. The study area covered by this report includes Kiowa, Crowley, Otero, Bent, and Prowers counties of southeastern Colorado, and is noted on Figure 1.1. The immediate vicinity of the Ft. Lyon system is roughly bounded by Lamar on the east, La Junta on the south, Eads on the north, and Manzanola on the west, an area of approximately 2,500 square miles, or 2.4 percent of the state of Colorado. The five counties represent the economic region which is under direct influence of production and associated spending distribution of the Ft. Lyon Canal Company system. Most relevant data is available by county. The five county population was 43,183 in 1990. The area includes about 100 river miles of the Arkansas River and the principal towns are Lamar, Las Animas, La Junta and Rocky Ford. It is described in more detail in Chapter 4.

Concurrent Studies

Three other studies of this area are known to be pending or underway. The U. S. Geological Survey, Pueblo Subdistrict (USGS) has conducted extensive research on the Arkansas River of Colorado for many years and is now completing a hydrologic study of the Ft. Lyon System. This report contains some preliminary data from this USGS study. The Colorado Division of Wildlife (CDOW), in cooperation with the Division of Parks and Outdoor Recreation and the Lower Arkansas River Commission (LARC), is completing an analysis of water supply alternatives for a proposed Great Plains Reservoirs State Park near Lamar. A group of representatives of six southeastern Colorado counties, known as Task Force 2, is supporting a study of water resource management alternatives for the region. The study team has made every effort to include appropriate information from these studies as it becomes available and to share information with concurrent studies, as directed by the Colorado Water Conservation Board (CWCB).

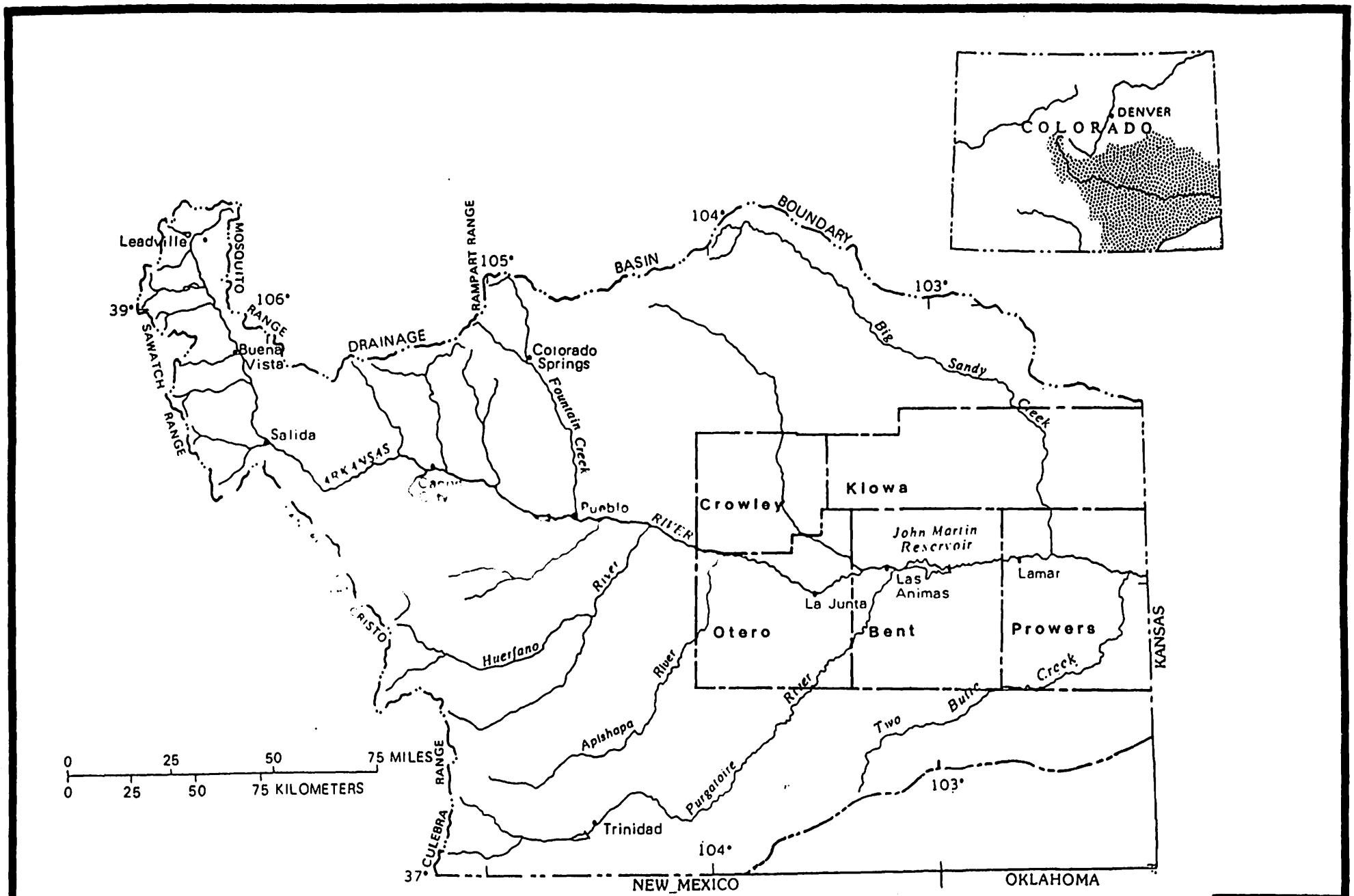

FIGURE 1.1--Location of Study Area

CHAPTER 2

ISSUE IDENTIFICATION AND HISTORICAL WATER TRANSFERS

Introduction

This Chapter includes a description of the water transfer process in Colorado by which agricultural water is moved to urban areas. The specifics of the Colorado Water Supply Company offer to purchase shares of stock in the Ft. Lyon Canal Company in December, 1991, are described as well as the response by shareholders to the offer. Issues arising from large rural/agricultural to urban/non-agricultural water transfers are summarized. Details of all significant historical Arkansas River water transfers from agricultural use to other uses in or adjacent to the study area are presented. The thirteen transfers illustrate a great variety of impacts and issues connected with water transfers. Factors which may affect the likelihood of sale of water by rural, agricultural owners in southeastern Colorado are presented. The factors are not dissimilar from factors affecting farming elsewhere in Colorado.

Water Transfer Process in Colorado

The water transfer process is basically a free market process constrained by the need to obtain governmental permits and a transfer decree from the water court. The permit and decree processes may or may not consider the impacts on third parties. Third parties are defined for this study as any individuals, organizations or elements of the physical natural environment which are not represented as a party to the transaction in a water transfer(s). Such third parties may accrue costs or benefits from the transaction which go unrecognized in the transfer process, including objectors to the transfer in water court.

Water rights may be sold with or separate from land. A buyer obtains water rights (and often associated irrigated land) by purchase from individual water rights owners, who are typically individual farmers. Unlike some other western states, water rights are seldom owned by districts or canal companies. A real estate agent or water broker often facilitates the transaction.

The purchase and sale contract entered into by the buyer and seller typically states a price per share or per acre foot of transferable consumptive yield. Often, but not always, the transaction does not close until a water court transfer decree is obtained. The seller usually must agree to "dryup" lands associated with water sold as stated in the water court decree provisions. The contract may specify other obligations of the buyer and seller, and may anticipate conditions in a water court decree. The sales contract may include allocation of liability for compliance with the decree conditions, and related transaction costs, to the buyer or seller.

Typically the buyer desires to obtain a firm water supply for municipal uses. The seller has a fluctuating water supply historically used for farmland irrigation and delivered through a mutual ditch company whose operation is controlled by all irrigators on the ditch. The buyer desires confirmation that a certain minimum quantity of transferable consumptive use water will be available, and that the water will be deliverable to its place of need. In some cases the water is to be exchanged upstream to a storage location and pipeline intake, although sometimes a downstream storage location and pipeline intake can be used.

The buyer typically prefers a water supply with senior decrees because less supply fluctuation will occur. Associated reservoir storage close to the location of diversion or use, and a low purchase cost and low transaction costs are important considerations for a buyer. Also important is a high degree of certainty that the governmental permits and water court transfer decree can be obtained with acceptable requirements. Crucial to the buyer is the ability to control the ditch company in order to prevent obstruction of its change of use of shares by changes in the company articles, bylaws, or procedures. Because of the cost of delivery facilities, the buyer usually seeks a range of supply, i.e., a large enough supply to obtain economies of scale, but not so large that the supply is excessive or the capital cost is out of reach.

All terms of the purchase and sale contract are negotiable, and contract terms are highly variable. In some cases, the buyer bears the risk of successful transfer and consumptive use determination; in other cases the seller bears that risk.

A variety of governmental permits and authorizations may be required. Because of the presence of federally operated reservoirs on many major streams, federal storage authorizations may be required. U. S. Army Corps of Engineers Section 404 permits may be required, as are rights of way over federal lands for pipelines. One of the federal actions may trigger a fish and wildlife endangered species consultation. State permits are required for rights of way over state lands for pipelines and for water treatment facilities. If water treatment results in discharge of a waste, state water quality permits for point source discharges will be necessary. Both federal and state parks and recreation areas border most major streams; changes in stream flow may require consideration by federal and/or state agencies. An additional possibility that currently no such restrictions exist in the study area. In Colorado, local governments may enact land-use codes which impose restrictions on water diversions or change in water uses, as well as zoning requirements on land use. To date, no such restrictions are in place in the five county study area.

The water rights transfer process occurs in the special water court with responsibility for the particular stream basin. Interested parties may file statements of opposition. Typically owners of other water rights, including minority shareholders in the ditch, file statements of opposition, asserting that their water rights could be adversely affected if the transfer request is granted without terms and conditions to prevent material injury to their water rights. On occasion, other interested persons or groups file statements of opposition and participate in the case. Generally the state engineer participates to assure compliance with generally accepted hydrologic analysis, compliance with state rules and regulations, and to encourage appropriate methods of administration of and accounting for water being transferred. While a water rights owner or holder clearly has standing to participate in the case, the Colorado supreme court has not resolved the standing of other third parties. The extent to which the water court may act to protect third party interests which are not related to water quantity or quality has not been tested. Typically objectors complain that some aspect of the application will adversely change the quantity of water received, especially as a result of changed return flows from historically irrigated lands, the timing of water received, or its quality. Minority shareholders on the same ditch often also desire protection from increased operating costs, or weed infestations on nearby dried up lands.

The application proceeds as normal civil litigation, with significant attention to experts' opinions as to historic use of the rights and future injury to objectors. The case is tried before a water court judge, with possible appeals directly to the Colorado Supreme Court by any of the parties. The case may be settled by a stipulated judgement at any time. The water court must grant the application

if appropriate terms and conditions can be imposed to prevent injurious effect on the owner of or persons entitled to use water under a water right (C.R.S. 37-92-305).

The water court to the extend possible, also will consider pertinent interstate water compact provisions. For example, "This compact is not intended to impede or prevent future beneficial development of the Arkansas river basin in Colorado and Kansas by federal or state agencies, by private enterprise, or by combination thereof, which may involve construction of dams, reservoirs, and other works for the purposes, of water utilization and control, as well as the improved or prolonged functioning of existing works: Provided, that the waters of the Arkansas river, as defined in article III, shall not be materially depleted in usable quantity or availability for use to the water users in Colorado and Kansas under this compact by such future development or construction." (Arkansas River Compact, C.R.S. 37-69-101, Art. IV, D)

Ark Compact

Major transfers may have twenty or more opposing parties. The experts typically employed by the parties include water rights hydrologists supplemented with groundwater geologists, surface or groundwater modelers, and water quality analysts. Experts generally, but not always, prepare written reports describing the details of the proposed transfers. Generally, conditions to prevent injury are a part of the experts' opinions and become a part of the transfer decree (Pratt, 1984).

While the water court process has been criticized as costly and time consuming, thorough preparation, active case management, and aggressive setting of deadlines can result in timely decisions in water court.[1]

Prior Transfer Interest in Ft. Lyon Canal Company Water

In 1987 a group of 65 percent of the Ft. Lyon shareholders organized FORT-CO and joined together in an effort to sell Ft. Lyon water to municipal interests. The asking price was $2,500 per acre foot or $4,210 per share based on their analysis. The offer to sell was not accepted by any municipal interest and failed. This attempt to sell may have set the stage for the 1991 offer by the Colorado Water Supply Company.

In December 1991, Colorado Water Supply Company (CWS), submitted an offer to shareholders of the Ft. Lyon Canal Company for the purchase of their shares. CWS is a sister company to Colorado Interstate Gas Company and a subsidiary of Coastal Corporation of Houston, Texas. CWS desired to purchase at least a controlling 51% interest in the company. The offer was a 43 page contract accompanied by 118 pages of exhibits, including escrow instructions, easements, deeds and assignments, covenants, proxies and lienholder's consents. In February, 1992, CWS tendered 19 pages of modifications to the contract and exhibits.

The deadline for shareholders acceptance was January 13, 1992; after the request of Colorado Governor Roy Romer for additional time to consider the impacts of the proposal, the deadline was extended to March 6, 1992. On March 13, 1992, CWS announced that this plan to acquire the

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[1] The water transfer process in Colorado is described by several authors. Refer to Browning [1992] and Vranesh [1987]. For Colorado water transfer data, refer to MacDonnell and Robinson [1990]. For an explanation of policy and procedures in the western states, refer to Colby, et al. [1989]. Studies of policy-induced transaction costs of water transfers are presented by Howe, Boggs and Butler [1990] and Colby [1990].

water was being suspended. CWS never announced what percentage of the shares had been acquired; however, the number was clearly less than the 51% sought. The CWS plan was controversial, spawning statewide press coverage, intervention by the Colorado Governor, legislative proposals, local government task forces, and state administrative agency studies.[2]

The offer documents were difficult for the potential sellers and their representatives to understand and evaluate. The apparent purchase price was $2228 per share (Master Contract, 1991, Section 3) with closing within 90 days (Section 28) of completion of certain conditions (Section 26). In summary, the conditions and requirements included:

a. A reliable yield of 1.1 acre feet after water court transfer and water treatment processes
b. A water court decree without conditions that would delay the project or increase the project costs
c. Receipt of all necessary government permits, and
d. Completion of 90 percent of any revegetation.

(A more complete explanation of the conditions is included in Appendix 2.1):

Ft. Lyon shareholders voiced a number of concerns with the CWS contract. These included loss of control of the management of the company, lack of consideration of well rights (dealt with in the proposed contract amendment), long term encumbrance of the shares during the contract, uncertainties about revegetation, the numerous reasons CWS could escape from the contract, the long time until final payment, and lack of protection for themselves and neighbors if water was ultimately withdrawn from parts of laterals, or parts of the canal in injurious fashion. The concerns were expressed at a Ft. Lyon special shareholders' meeting in February, 1992.

The $2228 per share may have been considered adequate by shareholders, absent the other questions about the offer terms. However, assuming 8 to 9 years to complete the transfer and establish revegetation, a net discount rate of 7 percent and an assumed "reliable yield" as stated in the offer, rough computations place the net present value of the offer at about $500 to $1000 per share, depending on interpretation of certain terms in the document offer. This estimate is not to be considered authoritative due to the uncertainties in definitions contained in the CWS offer.

In March 1992, shareholders of approximately 28,600 shares formed a group to respond to the CWS proposal called Fort Lyon Ownership of Water, Inc. (FLOW). The purpose of FLOW is

[2] Refer to newspaper articles: Denver Post, February 23, 1992, c-1; Pueblo Chieftain, February 27, 1992; Westward 15(26) 10; Arkansas Valley Journal, March 3, 1992; Colorado Springs Gazette Telegraph, February 24, 1992; Rocky Mountain News, March 14, 1992.

"to transact any lawful activity, and specifically activities relating to the protection of the Fort Lyon Canal Company in the viable and continued operation of the Fort Lyon Canal Company as an irrigation company or relating to the development of guidelines and provisions for any future water sales." (Articles of Incorporation of Fort Lyon Ownership of Water, Inc. Article III, March 24, 1992).

FLOW's activities slowed when the CWS offer was withdrawn, but the group pursued possible engineering studies in the summer of 1992. Those efforts were discontinued pending the outcome of the Boyle Engineering study on the Great Plains System and this study for the Colorado Water Conservation Board.

Issue Identification

There are multiple perspectives from which to describe issues and impacts related to large scale rural-to-urban and agricultural-to-non-agricultural water transfers. For a transfer of Ft. Lyon Canal Company water, issues are presented relative to the defined study area and the constituencies most affected. The following issues arise from the impacts of a water transfer: questions of how can impacts be avoided, mitigated, or offset; who should bear the burdens of the impacts; and who should decide what actions to take, are key underlying considerations in identifying issues.[3]

Issues most relevant to the study area were developed by contact with local citizens, experience of the project team and literature review. Issues are grouped in summary form and then detailed below:

A. Ft. Lyon Canal Company issues: relevant to farmers and ranchers served by the ditch company;

   1. Water supply and the individual farm business
   2. Ft. Lyon Canal Company operations and finances
   3. Environmental; and ecosystems

B. Regional issues: relevant to citizens of the larger study area, including water users not directly associated with the company;

   1. Water supply; quality, quantity and distribution
   2. Economic, financial and social; commerce, opportunity and quality of life
   3. Environmental; riparian wetlands and plains ecosystems

C. Statewide issues: of concern to all Coloradans, the State government, and the Colorado General Assembly.

[3] Issues relative to urban and industrial interests are outside the scope of this study and not included. Effects of transfers are discussed in Chapter 6. However, potential urban water demand is discussed in Chapter 5 as an influencing factor for water transfers in the study area.

A. Ft. Lyon Canal Company Issues

Issues evoked by water transfers which are internal to the Ft. Lyon system revolve around two themes. These are 1) individual losses and gains of farmers related to irrigation water supply and personal finances, and 2) the ability of the ditch company to provide continuing service to shareholders. Internal issues are therefore presented from the perspective of the shareholders remaining in the system, when adjacent farms are retired from full-time irrigation. The concerns are primarily of three types - continued historic water supply, adverse changes in ditch and lateral operations, and financial impacts on farming costs and property values.

1. Water Supply and the individual farm business

Historically, water transfers have required a change in the point of diversion. Flow to the ditch is reduced. This affects the flow characteristics of the canal in several ways. The water surface is lowered and the hydraulic head required to make deliveries is not maintained. Additionally, there is an increase in seepage loss as a percentage of total flow.

The changes in flow regime within the ditch have traditionally been addressed by construction of checks or mechanisms to elevate the water surface and by requiring the sellers to leave a portion of their water in the canal to offset evaporation and seepage loss. A benefit from a transfer occurs for canals which historically have been limited in hydraulic capacity to make deliveries. The excess capacity accrues to the remaining shareholders. An alternative approach to the allowance for seepage losses is to line portions of the channel. However, lining could reduce historic return flows on which other surface water users rely, and interfere with water supplies to existing alluvial wells below the canal. Changes may also impact well usage. Incremental increases in reservoir evaporation also may occur.

Issues of on-farm water supply are: water may be delivered at different times, for different periods, and at different rates; some irrigators may have been supplied by subirrigation, waste flows off fields, or wells drawing from a water table created by seepage and historic irrigation, and will need to change their method of obtaining water; the ease of moving water among fields may change; stock watering from stock ponds or streams fed by return flows may be affected; weed infestation may increase the necessary ditch cleaning and may increase winter ice in the canals; blowing dust from barren fields may adversely affect the health of livestock; weed infestation and dust on dried up lands may require more intense cultivation on irrigated lands; revegetation with continued watering may be required. These issues are addressed by engineering analysis, application of agronomy and soil science, and improvements in farm operations, and may be the subjects of water court decree terms and conditions.

Irrigators feel financial effects. A variety of irrigators' property rights in land and water may be affected. Undue restrictions on transfers may infringe on the private property rights of individual water rights holders and reduce the value of their rights. Land and water values may change. A completed transfer may reduce the value of remaining land and water if water court decree conditions have not protected against depletions of water supply, or increased operating difficulties or costs; on the other hand, the transfer may make the remaining land and water more valuable to persons desiring to continue irrigating in the area or to other outside purchasers who will benefit from the precedents established by the initial transfer.

Costs of ditch or lateral operation may rise or fall; costs of other water delivery may change (such as well pumping costs); costs of farming (e.g. herbicide application) may increase where adjacent land is revegetated or abandoned.

2. Ft. Lyon Canal Company operations and finances

Ditch companies are generally mutual enterprises to divert and distribute water at a shared cost. Transfers will create change and can also create imbalances and inequities; maintenance requirements for laterals and the main canal may change; costs of operations and administration may change; control of the corporation (and its operating agents such as ditch superintendents and ditch riders) and control of lateral operating groups may change, delivery of water may require changes in structures such as headgates, wasteways, flumes, checks, and lateral headgates, with new or increased expenses; and operating contracts and agreements may be altered due to changes in flow regimen. Sluicing operations when sediments are washed from the ditch may be impaired, resulting in reduction in capacity.

New management responsibilities may be introduced: use and management of revegetated lands needs to be addressed; fencing and stock water will be needed where livestock grazing is planned.

Non-selling shareholders often desire to participate in water transfer court proceedings, or in negotiations with purchasers to assure protection. Legal proceedings involve the expenses of hiring and managing experts, including hydrologists, agronomists, and attorneys. Proposed water transfers out of the Ft. Lyon system have produced conflict among the shareholders over these and other matters.

3. Environmental; and ecosystems

Shareholders have concerns about the welfare of adjacent lands and the associated environmental attributes. These concerns are essentially the same as those expressed on page 2-10, **Regional Environmental.**

B. Regional Issues

Issues relevant to citizens of the five-county study area, including water users not directly associated with the company, are called third-party issues because these issues are not always directly addressed in the transfer transaction. While water rights holders have standing with the water court, some other third parties may not. Other water users bear the benefits or detriments of an increased or decreased water supply resulting from changed river regimen after a transfer. Water quantity and quality may affect farm yields and income, with widespread implications. The concept of mitigation, i.e. the off-setting or compensation, of the adverse impacts of water transfers raises additional issues such as who pays for mitigating these effects, who receives relief and who decides such questions.

1. Water supply; quantity, quality and distribution

Water transfers always affect the supply to other water users on the stream. The removal of water from historically irrigated lands eventually affects return flows to the stream, and the water supply of downstream users. Because a lesser supply to downstream users may increase their need for

other water originating further upstream users may also be adversely affected due to decreased return flows after a transfer.

To supply high quality water to their users, the metropolitan areas prefer the waters from high mountain streams and reservoirs. When this source of water is limited, denied or of high cost, agricultural water may be purchased. Water is also exchanged from the lower Arkansas River upstream to headwaters areas. The water quality of the lower Arkansas River can deteriorate because this high quality water is used before mixing with the local return flows. An off-setting factor in the water quality issue is the reduction of irrigation practice, since irrigation also degrades water quality (Miles 1977). Water quality can also affect water quantity. For example, clear water scours ditches and causes increased seepage losses, while silty water seals ditches and allows greater water delivery to fields.

Water users and others, whether agricultural, municipal, industrial or recreational, desire to protect the quantity, quality and timing of their water supplies. Effects on these users are increasingly being recognized by the courts.

2. Economic, financial and social; commerce, opportunity and quality of life

Water users are impacted by water transfers, but so are members of the local and regional communities. For example, the dollar in the farmer's pocket pays taxes and is spent with the local merchant, and the merchant in turn pays taxes. The impacts of a dollar spent can vary significantly: a dollar deposited with out of state bank works differently than the dollar paid to the local farm laborer. Transfer of water brings a one-time flow of cash to sellers; this may or may not be spent in the study area. Some (perhaps most) may be used to repay lenders, including some local bank debts, which may increase local capital supply. However, there may be little need for additional capital in the locality so it will flow elsewhere.

Transfer of water results in loss of acreage in irrigated agriculture:

a. If water is transferred outside the study area, loss of agricultural production is greatest.
b. If water is reallocated within the study area to agriculture, loss of production is lessened--and possibly no loss occurs.
c. If water is reallocated to other uses within study area (e.g., M&I, wildlife, recreation), loss of agricultural production may be offset by economic gains in other sectors.
d. If water transfer requires construction of diversion works within the study area, rather than upstream, or requires revegetation of dried up land, there will be some temporary economic benefit and job creation which will offset some of the economic loss.
e. Loss of irrigated acreage will reduce property values in the study area. Lower property values will adversely impact tax revenues of all local governments, school and special districts. Colorado constitution amendment 1 (1992) has added new restrictions on tax revenues.

Transfer of water will result in loss of farming/ranching jobs. (Howe, Lazo and Weber 1990):

a. If water is reallocated to other uses within the study area there will be some additional job growth in other sectors.
b. Substantial economic development efforts would be needed to maximize job growth if water is reallocated within the state to other uses.

Transfer of water will result in loss of agribusiness sales (farm machinery, fuel, seed, herbicides) and jobs related to processing or transporting agricultural products (Taylor & Young 1991, 296-297):

a. Loss of agricultural production and agribusiness sales will reduce retail and wholesale trade in the study area due to negative multiplier effect.

b. If and when out-migration follows loss of local jobs, there will be further reduction of retail and wholesale trade in the study area.

c. Loss of retail and wholesale trade will cause some local businesses to close or relocate outside the study area, reducing the vitality of the community and its attractiveness to new economic development.

Financial burdens are imposed upon other water users. They frequently participate in water court cases for the purpose of protecting supplies, and must bear the expense of expert advice from attorneys, hydrologists, agronomists and water quality consultants. Currently there is no provision for transfer of those expenses to applicants for a transfer, (except C.R.S. 37-92-304(3.5) as to mutual agricultural ditch shareholders) and the burden of those expenses discourages objectors from addressing their concerns in court. An argument in favor of the existing process is that it imposes less restraint on the movement of water supplies to higher economic uses. Cost protection for objectors would further restrain these changes of use.

Water transfers affect the social structure and interactions in the community. The overall quality and character of life can be undermined in areas where historical irrigation is suddenly terminated (Shupe 1989, 429); the people of the area lose their psychological and cultural "roots" (Weber 1990, 15); even in highly homogeneous communities, proposed water transfers create conflicting interpretations among residents regarding the proper relationship between the physical and social environments and the proper relationships among themselves (Greider and Little 1988, 47).

If community impacts are to be mitigated there is little consensus as to what would constitute fair and adequate mitigation, and who should judge the adequacy of mitigation. Possibilities include the courts, local government, or state government. Water courts have a limited role in third party impact mitigation (Pratt 1988). Some mitigation proposals raise issues of who pays or who receives payment. Such proposals may include payments in lieu of taxes; compensation to individuals, businesses or local governments; economic development efforts; "banking" of compensation measures; and requirements for severance-type payments.

3. Environmental; riparian wetlands and plains ecosystems

The ecology of the vicinity of a large ditch is influenced by the quantity and quality of water, and variability in supply. Water use influences the soil, plant, and microclimate characteristics of the land. Irrigated lands and related hedgerows, wetlands, and reservoirs create important ecosystems for the eastern plains. Also derived from the environment are recreation uses and aesthetic beauty, with attendant economic and social benefits.

Regional environmental issues include: dryland habitat impacts, including hedgerows and drainage corridors; wetland habitat impacts, including wetlands arising from ditch and lateral seepage, surface waste flows and drains, outcrops of underground return flows, tail water ponds, and return flow fed stock ponds; open water areas, including nesting, resting, and forage habitat for local and migratory waterfowl; possible influences upon endangered species habitat.

Recreation issues include: scenic and aesthetically pleasing areas which revert to semi-arid range lands or weedy, abandoned appearing areas; loss of cottonwoods and potential planting of replacement trees; land and water based hunting; recreational fishing; swimming and boating.

Dryup of irrigated lands remains a significant issue: revegetation of dried up lands is difficult and special plant strains and cultivation techniques may be necessary. Over a large dried up area characterized by a variety of soil and drainage types, successful revegetation either by natural succession or by intensive husbandry, depends on multiple agronomic factors. A realistic revegetation program consists of adequate allowance for costs, appropriate time period for the revegetation process, and designation of who will determine adequacy of the effort.

At certain levels of water-borne constituents, agricultural production begins to decline. Agricultural use both disposes of pollutants, adds new pollutants, and concentrates naturally occurring pollutants. The downstream riparian systems receive the upstream irrigator's wastes, although sometimes after substantial time delays. A water transfer changes the historical movement of pollutants. These environmental issues will undoubtedly receive greater attention in future water transfers due to future changes in federal and state environmental regulations and administrative policy.

C. Issues for the State of Colorado

1. Administration

The Division Engineer and his water commissioners are required to respond quickly to changes in flow due to natural or human causes, e.g., thunderstorms, foregoing of diversions. Flows change daily on the Arkansas River and a loss of a day's water to some ditches can amount to as much as 2000 acre feet or more. The natural stream system and the administration system is very sensitive to changes which occur due to water transfers. Transfers increase the importance of accurate measurement and administration of the river to assure non-injury to water supplies. Technology such as satellite monitoring and better gauges become more important.

2. Socio/Economic

Transfer of water requires transaction costs that are paid by the buyer and seller but typically benefit parties (water users, engineers, lawyers) outside the area of origin (Colby, 1990). Likewise, costs of effects water transfers are imposed mostly on the source area. (Howe, Lazo, and Weber 1990) The Colorado General Assembly and the Colorado Water Conservation Board are continuing to address the issue of basin-of-origin relating to transfers of water resources in Colorado.

3. Interstate Compact

The Arkansas River Compact "equitably divide(s) and apportion(s) between the states of Colorado and Kansas the waters of the Arkansas river and their utilization as well as the benefits arising from the construction, operation and maintenance by the United States of John Martin reservoir project for water conservation purposes." Any transfer of Ft. Lyon water rights must not be inconsistent with the provisions of the Arkansas River Compact. (C.R.S. 37-39-101, Art I, B)

Historical Water Transfers - Arkansas River Valley

Water transfers have been numerous in the Arkansas Valley. This section describes significant water transfers in the region between Pueblo and the Kansas state line. Appendix 2.2 includes details of water rights transferred to non-agricultural uses. This section does not include transfers for the same agricultural use (generally by the same owner) i.e. the Pueblo Reservoir Winter Storage Case, Colorado Canal and Holbrook historic exchanges, Ft. Lyon winter storage case, Amity Great Plains transfer to John Martin Reservoir, Las Animas storage in John Martin Reservoir, Town Ditch move upstream, changes of diversion points to wells by the Sisson, Hyde, Manvel, and Graham Ditches, and diversion from the Lamar Power Plant by the Lamar Canal Company. These ag-to-ag transfers illustrate that agricultural users have continuously improved their own uses of water by changing diversion points, using exchanges, locating storage, consolidating ditches, trading water rights, and cooperatively managing water since the ditches were first constructed in the late nineteenth century. The most cost effective water management improvements were recognized and implemented by irrigators years ago.

The following water transfers out of agriculture are of record for the Lower Arkansas River Basin:

1. Bessemer Ditch to St Charles Mesa Water District
2. Hamp-Bell Ditch to Valco cement
3. West Pueblo Ditch to Pueblo Board of Waterworks
4. Booth-Orchard Grove Ditch to Pueblo Board of Waterworks
5. Zoeller Ditch to St Charles Mesa Water District
6. Twin Lakes Reservoir Co. to Aurora, Colorado Springs, Pueblo Board of Waterworks, and Pueblo West Metropolitan District and to a minor extent towns near the historically irrigated lands
7. Colorado Canal to Colorado Springs and Aurora
8. Busk Ivanhoe System to Pueblo Board of Water Works and Aurora
9. Clear Creek Reservoir and Ewing, Wurtz and Columbine Ditches to Pueblo Board of Waterworks
10. Catlin Canal to Colorado Division of Wildlife
11. Rocky Ford Ditch to Aurora

12 Las Animas Consolidated and Extension Ditches to Public Service Company of Colorado
13 Ft. Bent Ditch to Lamar

Development of information about the historical transfers is helpful in identifying potential issues and understanding any trends which may exist in the condition of irrigated agriculture in the lower Arkansas River Valley. An attempt was made to assess the following types of impacts:

- Agricultural impacts
- Economic impacts
- Social impacts
- Environmental impacts

The main agricultural impact for all of these transfers has been or will be the loss of lands from irrigated crop production. The transfers have removed approximately 56,100 acres from production. Data from Kansas vs. Colorado indicates that from Pueblo to the state line the 1940-1985 average of land under irrigation from 25 ditch companies is 320,851 acres. Historical transfers account for 56,100/320,851 or about an 18 percent reduction thus far.

Social effects are manifested in an increased sensitivity to removal of water from the valley. Dried-up farms are easily identified by the knowledgeable observer. The level of concern and conflict is high. Public actions have begun at the grass roots level to deal with water transfer issues. Economic and environmental changes resulting from these transfers are difficult to quantify because changes in the valley are the result of several factors, including conditions in agricultural markets nationwide.

Water right sale information was obtained on six major transfers of both lower and upper Arkansas water rights and is presented in Table 2.1. The Lower Arkansas water rights of the Las Animas Consolidated Canal, Colorado Canal Companies, and Rocky Ford Ditch are comparable to the Ft. Lyon Canal system. These comparable water rights were sold in the years 1985 to 1988 at a cost which ranged from $1,570 to $3,152 per acre foot of consumptive use.

Other Upper Arkansas water rights have sold at much higher values.

Table 2.1 Historical Water Transfers		
	Year	($/acre foot C.U.)
Lower Arkansas Water Rights:		
1. West Pueblo Ditch	1978-1992	$732 to $892
2. Las Animas Consolidated Canal	1985	$2,000
3. Colorado Canal Companies	1986-1987	$1,570 to $2,500
4. Rocky Ford Ditch	1988	$3,152
Upper Arkansas Water Rights:		
1. Twin Lakes	1970-1992	$3,182 to $9,091
2. Busk Ivanhoe	1986-1987	$3,000

Factors Contributing to Water Sales

The gradual movement of water from rural/agricultural areas to urban/municipal and industrial areas results from several general factors, most of which are not unique to southeastern Colorado.

1. Water is a property right and is severable from the land.

2. Farming is always hard work, fraught with high risk of financial failure or small return on investment.

3. Farming income is sometimes less than the return on investment of water sale proceeds.

4. Agricultural incomes are not growing, especially among family farmers. (Keene-Osborn, 1992)

5. Some farmers are failing and need or want to sell.

6. Agricultural capital availability is limited.

7. Urban populations are growing while rural, agricultural communities are not growing or are declining in population.

8. Municipal and industrial users wish to obtain firm water supplies for drought years.

9. Farming accounts for most of the water consumption in the state, but accounts for only a part of the population, political base and economy of the whole state.

10. There are insufficient young farmers interested in taking over farms; and, the major capital investment required disqualifies many potential entrants.

11. Rural communities and farmers may be ambivalent or undecided on the position to take on a possible water transfer. This may be a result of a desire to retain the option for sale of their water as security for the future.

12. If a transfer occurs, farmers may not want to be "left behind", fearing greater operating problems, higher expenses, and the loss of neighbors and traditional community lifestyle.

13. There are accepted legal processes for the transfer of water and resolution of at least some of the issues arising from a proposed transfer.

14. Cost of protecting water rights and protesting water transfers is relatively high for rural communities and farmers.

Summary

The foregoing information must be summarized to present a coherent understanding of the study scope and the essential issues to be addressed. The resulting understanding will determine the emphasis of the study activities and shape the content of succeeding chapters of this report.

There are two purposes to the study. The first is to understand and characterize the Ft. Lyon Canal Company system, together with such surrounding area as may be affected by transfer of water out of the system. This is accomplished by an identification of issues, description and analysis of historical water transfers in the region, and developing knowledge of the forces underlying the motivation to buy and sell water. The physical and social systems are described in detail. The second purpose, following from the first, is to identify and analyze alternatives to a large-scale transfer. This is accomplished by seeking strategies, management tools and applications of resources which provide overall net benefit to the Ft. Lyon system and the region. Alternatives which present the possibility of hydrologic, economic, legal, social, and environmental feasibility, as compared to a large-scale out of basin transfer, should receive further attention. Those that do not should be set aside.

Basin characteristics suggest that water availability is quite variable, distribution is highly developed and that water supply systems are complex and interdependent. Water quality is marginal, mainly due to naturally occurring high salinity, and is aggravated by intense use and reuse.

Water transfers in Colorado are allowed, subject to the "no injury" rule, but can be controversial and expensive. The effects of a water transfer on third parties and the environment are not consistently addressed by Colorado law at present. Thirteen historical water transfers in the lower Arkansas Valley are identified and assessed. They have resulted in a net loss of 18 percent of irrigated land and associated production. Net impacts on the valley from these transfers are difficult to identify because most of the water has been used within the basin and imports of water by transmountain projects have increased over time.

From the discussion of issues identified, the following are major issues to serve as focal points for the Ft. Lyon study:

Ft. Lyon service area:

1. Is the on-farm operation affected by changes in ditch operations; does the dry-up of adjacent land affect non-sellers; are individual land and property values diminished; are on-farm operating costs increased?

2. Is the ditch company viability materially changed by; increase in cost for current services, decreases in the quality of maintenance and management services, increases in scope of company responsibilities?

On a regional scale, issues affecting the following:

3. Are other water rights holders injured by changes in the quality or quantity of diversions or return flows; are the Arkansas River Compact requirements violated?

4. Will local governments suffer declines in property tax base, loss of revenues and loss of services to the public.

5. Will other citizens such as community businesses and residents, suffer loss of property values; lose farm/ranch jobs or jobs related to processing or transporting agricultural products; lose sales related to agribusiness; suffer decline in the overall quality and character of life.

6. Will the region experience a decline in aesthetic beauty, recreation opportunities, dryland habitat, wetland habitat, or presence of endangered species?

From the understanding developed in this chapter, a base has been established to describe the Ft. Lyon Canal Company service area in Chapter 3 and the socio-economic region dependent upon the Ft. Lyon in Chapter 4.

CHAPTER 3

THE FT. LYON CANAL SYSTEM AND ITS ENVIRONMENT

Introduction

The Ft. Lyon Canal Company is a mutual irrigation company that supplies water for the irrigation of approximately 92,600 acres in Otero, Bent, and Prowers counties. The company obtains water from the Arkansas River through the Ft. Lyon Canal which has senior direct flow water rights, and the Ft. Lyon Storage Canal which supplies water to Horse Creek and Adobe Creek Reservoirs. The facilities of the company are shown on Figure 3.1. Topics which are covered in this Chapter include a description of the system of delivery, water rights, operations, diversion data, estimated yield, share value, soil characteristics, and a brief description of environmental and wildlife characteristics.

The Ft. Lyon Canal Company is organized pursuant to Colorado statute (C.R.S. 7-42-101). The company has approximately 93,989 shares of stock outstanding. As a mutual ditch company it has the power to make contracts and incur binding liabilities to provide water to stockholders based on their proportion of stock ownership. The operations are financed through stockholder approved assessments. (Ft. Lyon Canal Company Articles and Bylaws 1991) The company is governed by a five-person board of stockholder directors who are elected yearly.

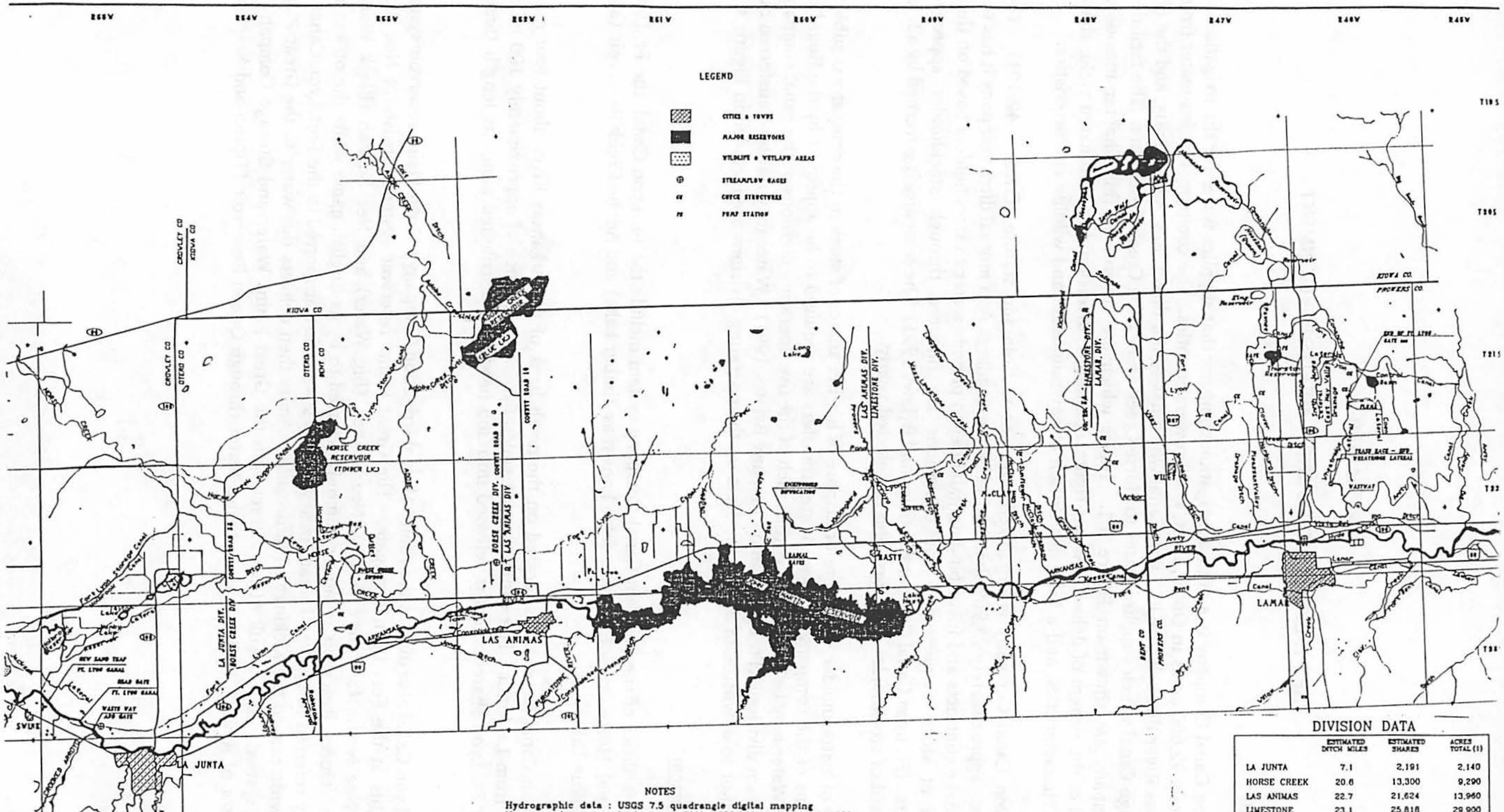
The ability of a stockholder to acquire or dispose of his/her shares of stock in the company is subject to limitations of the company bylaws. Water transfers are required to be approved by the Board of Directors. Water may be transferred within each of the five operating divisions of the canal company or to upstream divisions (Ft. Lyon Canal Company Bylaws 1991). Water may not be transferred out of the ditch or to downstream divisions. Data on the operating divisions are included in Figure 3.1.

Physical System

The major facilities of the Ft. Lyon Canal Company system include the Ft. Lyon Canal, the Ft. Lyon Storage Canal, Horse Creek Reservoir (also known as Timber Lake) and Adobe Creek Reservoir (also known as Blue Lake).

The Ft. Lyon Canal headgate is located on the north bank of the Arkansas River about four miles upstream from La Junta. The canal extends generally east a distance of approximately 100 miles. Water for Ft. Lyon shareholders is released into 365 headgates distributed along its length (Smith 1993).

The Fort Lyon Canal also diverts the Amity Mutual Irrigation Company's Great Plains reservoir system water rights at the Fort Lyon headgate. The Great Plains reservoir system consists of Nee Skah (Queen) Nee Noshe (Standing Water), Nee Grande (Big Water) and Nee So Pah (Black Water) reservoirs. Queen Reservoir is most commonly referred to by its English name while the others are commonly referred to by their Indian names. Amity's water is transported in the Fort Lyon Canal 45 miles downstream to the Kickingbird bifurcation. Amity then delivers this water to the Great Plains reservoir system. As a result of a contract with the Great Plains Water and Storage Company (a predecessor of Amity) Ft. Lyon also obtains water through Queen Reservoir (Tipton and Kalmbach 1987).



NOTES

Hydrographic data : USGS 7.5 quadrangle digital mapping
Names and man-made features: BLM 1:250,000 series 1976-1982
All towns and highways, approximate location only.
Mapping system: AUTOCAD 12.0

DIVISION DATA

	ESTIMATED DITCH MILES	ESTIMATED SHARES	ACRES TOTAL (1)
LA JUNTA	7.1	2,191	2,140
HORSE CREEK	20.6	13,300	9,290
LAS ANIMAS	22.7	21,624	13,960
LIMESTONE	23.1	25,818	29,900
LAMAR	27.2	31,098	36,380
	100.7	93,989	91,670

(1) USGS 1990

FT. LYON CANAL COMPANY
WATER TRANSFER ALTERNATIVES STUDY

GROWING ENGINEERING COMPANY
12050 NORTH PECOS STREET, SUITE 100
DENVER, COLORADO 80234

FT. LYON SYSTEM MAP
FEBRUARY 1993

FIGURE 3.1

The capacity of the Ft. Lyon Canal above the Kickingbird bifurcation has been reported to be approximately 1,800 cfs. Downstream from the bifurcation structure the capacity has been reported to range from approximately 1,500 cfs to approximately 600 cfs. A Parshall measuring flume has been constructed on the Ft. Lyon Canal about two miles downstream from the diversion dam. The flume measures diversions that are both Ft. Lyon direct flow priorities and diversions for the Great Plains Reservoir system (Tipton and Kalmbach 1987). In its 1989-1990 investigation of the Fort Lyon Canal system, the USGS calculated the flow rates of the Ft. Lyon Canal at several locations. Although their data are not conclusive, it appears that the present capacity of the Ft. Lyon Canal is less than stated in prior engineering reports. (Dash 1993)

The Ft. Lyon Storage Canal delivers water from its headgate located on the north bank of the Arkansas River about three miles east of Manzanola to Horse Creek Reservoir and Adobe Creek Reservoir. The capacity of the canal has been reported to be approximately 2,000 cfs. The distance from its point of diversion at the Arkansas River to Horse Creek Reservoir is approximately 33 miles and the canal length to Adobe Creek Reservoir is approximately 45 miles. In addition, water for storage may be obtained from both Horse Creek and Adobe Creek. Water in Horse Creek Reservoir is released into the Horse Creek Outlet Canal and delivered to the Ft. Lyon Canal at a point approximately 16 miles downstream from the Ft. Lyon Canal headgate. Water is released from Adobe Creek Reservoir into Adobe Creek through the Adobe Creek Outlet Canal approximately 2.5 miles in length and then enters the Ft. Lyon Canal approximately 23 miles downstream from the headgate. The storage water is used to supplement water delivered under the direct flow priorities. (Tipton and Kalmbach 1987)

Losses in the system have been estimated to be 17% for the Fort Lyon storage canal, 30% for the Fort Lyon Canal and 10% for the laterals. A portion of these losses do not return back to the stream system. (Woodward-Clyde 1981)

The Ft. Lyon Canal Company also has constructed Thurston Reservoir (near the lower end of its system) which has a decreed capacity of 1,515 acre-feet. This structure originally was used to deliver water to Amity with Ft. Lyon receiving water from Amity by exchange. In 1984 the Ft. Lyon Canal Company constructed a pump and pipeline on Thurston Reservoir so that the water could be pumped from the reservoir back into the Ft. Lyon Canal. Thurston Reservoir is a minor source of additional supply to the company. (Tipton and Kalmbach 1987).

In 1983 the company developed a Feasibility Report for the Rehabilitation and Betterment of the Fort Lyon Canal System (Tipton and Kalmbach 1983). The report was initiated in part to obtain 50% funding for the recommended improvements through the Colorado Water Conservation Board. The recommended improvements and betterments were projected to cost $2,700,000 and consist of the projects outlined in Table A3.1 of Appendix 3. Although the Fort Lyon stockholders did not approve the company's matching share (Annual Reports 1984) some of the improvements were constructed. These include the Thurston pumping plant, headgate improvements and cleaning and shaping the Fort Lyon Storage Canal. Maintenance projects are ongoing in accordance with the funding levels provided by the annual assessments. However, the Canal system continues to need considerable rehabilitation and repair.

Water Rights and Water Storage

The Ft. Lyon Canal Company has direct flow water rights which allow a total diversion of 933 cfs as outlined below.

Table 3.1

Ft. Lyon Canal Company Direct Flow Water Rights

Priority Date	Amount cfs
April 15, 1884	164.64
March 1, 1887	597.16
August 31, 1893	171.20
Total direct flow water rights	933.00 cfs

The direct flow water rights are subject to delivery of approximately 16 cfs, free of any assessments or charges, as a result of the acquisition by the company of the right of way in 1883. These water rights are delivered for agricultural use in the La Junta Division. (Schuyler 1910)

Horse Creek Reservoir has a total decreed capacity of 28,000 acre-feet from the Arkansas River through the Ft. Lyon Storage Canal or from Horse Creek. The decreed rights are presented in Table 3.2.

Table 3.2

Horse Creek Reservoir Water Rights

1. Priorities for its original construction (11,400 acre-feet) are:

Priority Date	Flow Rate	Source
August 14, 1900	2,000 cfs	Horse Creek
January 25 1906	840 cfs	Arkansas River
March 1, 1910	1,466 cfs	Arkansas River

2. For the first enlargement (15,487 acre-feet), the priorities are:

Priority Date	Flow Rate	Source
January 25, 1906	840 cfs	Arkansas River
December 20, 1907	5,000 cfs	Horse Creek
March 1, 1910	1,466 cfs	Arkansas River

3. For the second enlargement (1,113 acre-feet):

Priority Date	Flow Rate	Source
June 12, 1908	5,000 cfs	Horse Creek
June 12, 1908	840 cfs	Arkansas River
March 1, 1910	1,466 cfs	Arkansas River

Adobe Creek Reservoir. Total decreed capacity of 87,000 acre-feet which can be supplied from the Arkansas River through the Ft. Lyon Storage Canal or from Adobe Creek. These rights are presented in Table 3.3.

Table 3.3

Adobe Creek Reservoir Water Rights

1. Priorities for its original construction (61,575 acre-feet) are:

Priority Date	Flow Rate	Source
January 25, 1906	8,631 cfs	Adobe Creek
January 25, 1906	840 cfs	Arkansas River
March 1, 1910	1,466 cfs	Arkansas River

2. For the first enlargement (25,425 acre-feet), the priorities are:

Priority Date	Flow Rate	Source
December 29, 1908	8,631 cfs	Adobe Creek
December 29, 1908	840 cfs	Arkansas River
March 1, 1910	1,466 cfs	Arkansas River

The Fort Lyon Canal Company as a part of the winter water storage program may also store its water rights in Pueblo Reservoir, John Martin Reservoir or other off-stream storage facilities owned by the winter storage program applicants.

Fort Lyon's storage in John Martin Reservoir is authorized under Section IIIB of the 1980 Operating Plan for John Martin Reservoir. Ft. Lyon may store up to 20,000 acre feet of water in John Martin for agricultural purposes under the Pueblo winter storage plan and may use water in this account for exchange with existing priorities. In the event the water is not used by the end of each compact year (October 31) the water becomes conservation storage which accrues to Colorado Water District 67 ditches or the State of Kansas. (Arkansas River Compact Administration 1980)

As a result of its contract with Amity, Fort Lyon receives 5,483 acre feet of water from Queen Reservoir. In recent years a portion of the Fort Lyon 5,483 acre feet has been delivered to the Ft. Lyon Section III account in John Martin Reservoir where is has been used by exchange. (Colorado Division of Wildlife 1993)

The Ft. Lyon System also receives supplemental irrigation water supplies from the Fryingpan-Arkansas (Fry-Ark) project operated by the Southeastern Colorado Water Conservancy District. Ft. Lyon Fry-Ark allocations are presented in Table 3.4.

Table 3.4

Fort Lyon Canal Company
Fryingpan-Arkansas Project Allocations
(acre-feet)

1972-82	1983-87	1988	1989	1990	1991
63,871	0	28,000	45,600	15,040	22,560

Source: Southeastern Colorado Water Conservancy District, 1991 Annual Report

Operations

As a mutual irrigation company, water is delivered in proportion to share ownership into 365 stockholder headgates distributed along the length of the canal. The canal company is divided into five divisions and delivers water on a rotational basis. The five divisions of the company are shown on Figure 3.1 and include the La Junta Division, which begins at the headgate and extends to Gate 21D; the Horse Creek Division, which extends to Gate 77; the Las Animas Division, which extends to Gate 149; the Limestone Division, which extends through Gate 202D; and the Lamar Division, which extends through Gate 259. (Rules and Regulations, December 1983)

The present ownership of Ft. Lyon shares and delivery of water by division and also by county is shown below (Smith 1993):

Canal Division	Principal County	Share Ownership and Delivery Percentage
La Junta Division	Otero County	2%
Horse Creek Division	Bent County	14%
Las Animas Division	Bent County	23%
Limestone Division	Bent County	28%
Lamar Division	Prowers County	33%

Of the 365 stockholder headgates, there are approximately 18 major headgates which serve multiple users, some of which have been organized as lateral companies. There is no distinction made by the Ft. Lyon Canal Company in its prorated delivery of water to either individual stockholder headgates or to lateral headgates. The company has no responsibility for shareholder delivery beyond the channel of the Ft. Lyon canal.

The canal company's standard practice is that deliveries of water to shareholders begin in the upstream division of the canal. When delivery has been made to all laterals in a division, delivery is then shifted to the next lower division. Once water has been delivered to all divisions a run has been completed.

During each run a shareholder receives a release of approximately 0.015 cfs per share into his lateral for 48 hours. This is also known as a 150% delivery. When there is reduced flow in the canal, the ditch riders extend the delivery time to allow the full allotment to be released. The delivery times for the reduced flow is as follows (Fort Lyon Canal Company 1983):

150%	no extra at 48 hours
125%	10 minutes per hour (8 hours over on 48 hours)
100%	20 minutes per hour (16 hours over on 48 hours)
75%	30 minutes per hour (48 hours over on 48 hours)

When the Ft. Lyon Canal is restricted to its most senior direct flow water of 165 cfs, it requires approximately one month to complete a run. When the canal is running its full 933 cfs, shareholders usually receive water two days out of every four. (Tipton and Kalmbach 1987)

The operations of the canal company are financed through assessments of the shareholders. The 1991-1992 assessments were $11.75/share and the 1991-92 operating budget for the company was $1,136,630. Included within the budget were assessments of $1.00/share for water purchase and $1.00/share for special projects. The 1991-92 assessment description and operating fund budget is included as Table A3.2 of Appendix 3.

Historical Diversions and Water Supply

Boyle Engineering with the assistance of Duane Helton compiled the historical diversions and water supply yield for the Ft. Lyon Canal Company as a part of the Kansas vs. Colorado litigation. Their summaries which were developed for the Arkansas Basin utilized four stream reaches. The Ft. Lyon Canal and its irrigated land lie within Reach 3 (Pueblo Dam to John Martin Dam) and Reach 4 (John Martin Dam to the Colorado-Kansas stateline) of the Boyle study area. The data is summarized for the entire Ft. Lyon system. As described previously Ft. Lyon Canal Company receives water from the Arkansas River, Horse Creek Reservoir, Adobe Creek Reservoir and Queen Reservoir. The average annual yield of these diversions for the years 1950-1985 from the Boyle study are presented in Table 3.5.

Table 3.5

Fort Lyon Canal Company Historical Diversions

Source	Average Annual Diversions Acre-Feet 1950-1985
Arkansas River direct flow rights	190,991
Horse Creek Reservoir [1)]	7,573
Adobe Creek Reservoir [1)]	11,443
Queen Reservoir [1)]	1,590
TOTAL ALL SOURCES	211,597

1) Delivery to Fort Lyon Canal

Monthly tabulations of the water supply for the Ft. Lyon Company system from the Arkansas River, Horse Creek Reservoir, Adobe Creek Reservoir, and Queen Reservoir are presented in Table A3.3 of Appendix 3. Fryingpan-Arkansas project water allocation as well as any minor sources of supply such as annual leases are included in the direct flow water right tabulation. An annual summary of water supplies available by source is shown in Table 3.6. The average system yield in Table 3.4 is 211,597 acre-feet and the total surface supply ranges from 94,145 to 383,056 acre feet annually over the 1950 to 1985 period.

For the purpose of determining yield, data in the surface column of Table 3.6 is analyzed in an emperical distribution with 36 data points. The result is presented in Figure 3.2. The probability, also termed reliability, of divertable yield is determined. For example, the ninety percent (P = 1.0 - .90 = 0.1) reliable annual flow is about 110,000 af per year; i.e., a minimum flow of 110,000 af annually should be available 90 percent of the time.

Groundwater Supply

Groundwater is used as a supplemental source of water supply by individual shareholders under the Ft. Lyon Canal. Total monthly pumping under the Ft. Lyon Canal within Reach 3 and Reach 4 has been summarized and is included in Table A3.4 of Appendix 3. Ground water pumping presented in Table 3.6 averaged 26,347 acre-feet annually and adds 12% to the total water supply of the system.

At the present time ground water pumping is extensively regulated by the State Engineer's Office. Rules and regulations promulgated by the State Engineer's Office require full augmentation of all wells installed subsequent to July 1, 1972. For wells installed prior to this date pumping is allowed only 3 of every 7 days provided other appropriators are not adversely affected. Temporary substitute supply plans are utilized to allow the wells constructed prior to July 1, 1972 to pump on additional days. (Order of the State Engineer 1972) The Colorado Water Protective and Development Association is the temporary plan for the reach of the Arkansas River from Pueblo Reservoir to John Martin Reservoir. The Lower Arkansas Water Management Association is the temporary plan for the reach of the river from John Martin Reservoir to the Colorado/Kansas state line. (Witte 1993)

Historical Consumptive Use and Return Flows

A calculation of the average water consumption and return flows for the Ft. Lyon Canal Company system was developed by Duane D. Helton of Helton & Williamsen, PC and is included as Table A3.5 of Appendix 3. These calculations were based on data and analyses which were prepared as a result of the Kansas vs. Colorado litigation. The Helton analysis was prepared for the compact years 1950 through 1985. The crop consumptive use and soil evaporation for water from Queen Reservoir were calculated using the same efficiency as the direct flow diversions. (Helton 1993). The average crop water consumption for the study period for the Ft. Lyon Canal Company system is summarized below.

Table 3.6

Ft. Lyon Canal Company Water Supplies
(acre feet)

Year	Direct Flow	Horse Creek [1]	Adobe Creek [1]	Queen [1]	Total Surface Water	Total Groundwater Pumped
1950	191,398.	2,837.	22,647.	2,640.	219,522	4,544
1951	185,223.	6,430.	9,810.	1,076.	202,539	5,763
1952	215,406.	0.	2,450.	687.	218,543	6,224
1953	176,873.	0.	40.	0.	176,913	8,135
1954	94,145.	0.	0.	0.	94,145	15,241
1955	138,720.	3,669.	0.	0.	142,389	18,392
1956	135,469.	0.	0.	0.	135,469	18,533
1957	269,395.	991.	546.	3,635.	274,567	11,780
1958	131,274.	18,740.	28,485.	3,491.	181,990	11,002
1959	183,131.	2,984.	18,851.	3,293.	208,259	17,228
1960	176,956.	2,214.	0.	0.	179,170	17,815
1961	226,179.	447.	1,608.	1,344.	229,578	14,251
1962	229,622.	11,475.	5,387.	3,300.	249,784	16,159
1963	132,228.	1,677.	0.	889.	134,794	39,557
1964	129,997.	0.	0.	0.	129,997	41,246
1965	234,325.	0.	15,786.	0.	250,111	20,858
1966	152,269.	8,654.	19,166.	3,342.	183,431	26,550
1967	197,422.	11,061.	16,330.	3,160.	227,973	25,262
1968	218,094.	0.	5,623.	2,006.	225,723	26,571
1969	237,907.	0.	5,650.	1,626.	245,183	20,310
1970	234,321.	11,594.	10,504.	3,325.	259,744	19,205
1971	193,845.	4,294.	20,072.	3,393.	221,604	27,137
1972	169,379.	0.	9,346.	11,411.	190,136	35,774
1973	211,675.	1,538.	16,762.	3,197.	233,172	22,607
1974	131,445.	0.	15,052.	3,741.	150,238	40,956
1975	207,613.	0.	0.	0.	207,613	47,767
1976	124,117.	11,850.	0.	0.	135,967	60,786
1977	108,057.	11,529.	0.	0.	119,586	57,301
1978	157,468.	0.	0.	0.	157,468	50,039
1979	190,557.	23,245.	0.	0.	213,802	35,278
1980	197,993.	38,165.	21,847.	0.	258,005	27,486
1981	97,973.	21,170.	43,120.	0.	162,263	47,111
1982	252,692.	20,057.	1,900.	0.	274,649	32,906
1983	298,975.	23,274.	36,530.	888.	359,667	24,415
1984	337,336.	0.	43,188.	0.	380,524	27,294
1985	306,195.	34,822.	41,239.	800.	383,056	27,042
Average 1950-85	190,991	7,573	11,443	1,590	211,597	26,347

Source: Boyle Engineering Corporation 1990

1) Delivery to Fort Lyon Canal

Delivery
(211,597 + 26,34) ÷ 91,670 acres irrigated
by canal system (pp 6-16 and 6-2

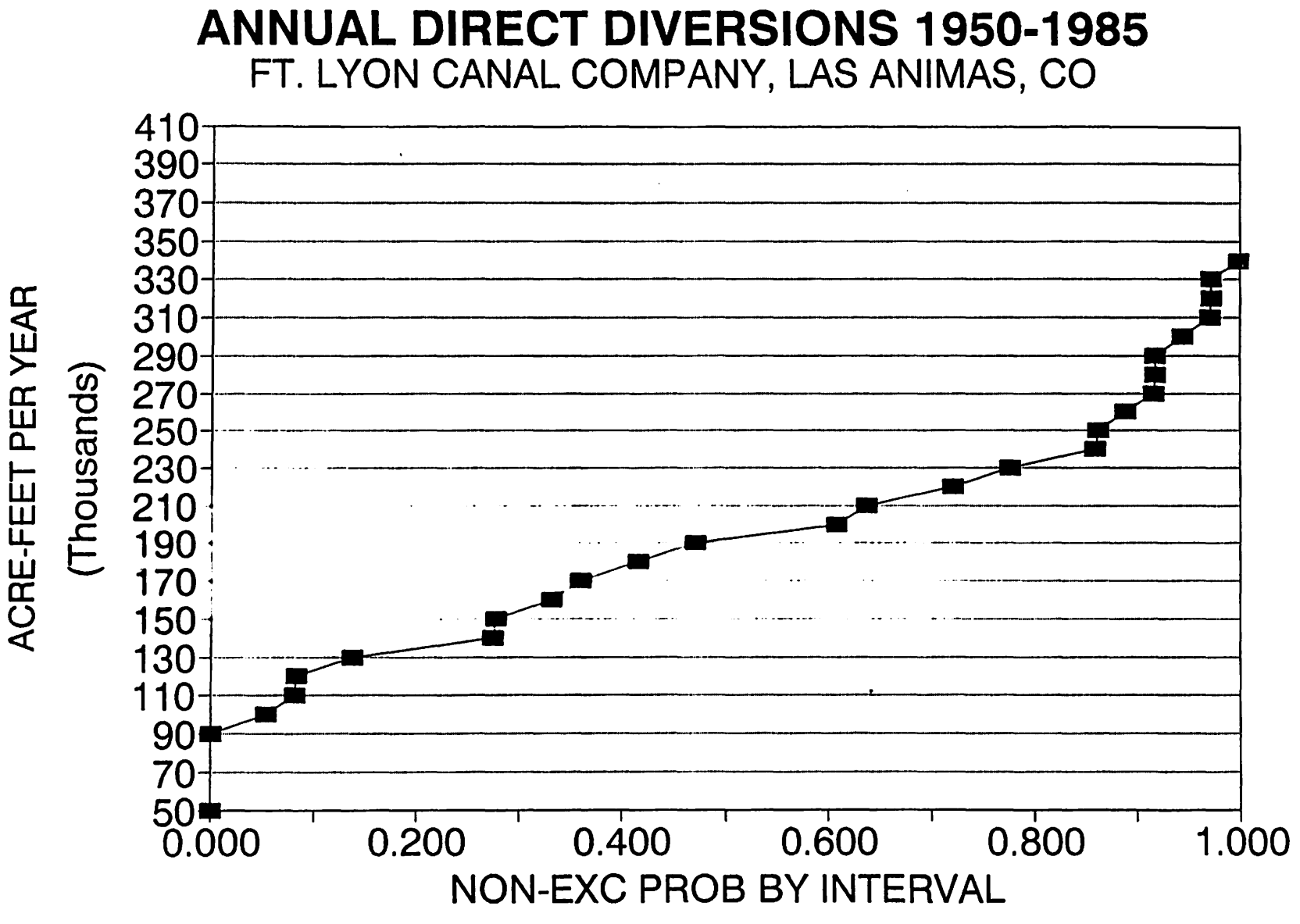


Figure 3.2 ANNUAL DIRECT FLOW FREQUENCY ANALYSIS

Source of Supply	Crop Consumptive Use and Soil Evaporation
Ft. Lyon direct flow water rights	138,196 a.f.
Ft. Lyon storage system	24,768 a.f.
Releases from Queen Reservoir	1,151 a.f.
Total average crop consumptive use and soil evaporation	164,115 a.f.

This calculation of average crop water consumption and soil evaporation does not reflect the amount of consumptive use that might be transferred from the land in a water court transfer proceeding. No allowance has been made for leaving water in the main canal or in laterals to protect remaining shareholders from injury due to changes in ditch operations. In addition, Fryingpan-Arkansas project water delivery would not be transferrable and should be deleted from the water yield analysis. The calculation of the average water consumption and return flow is shown in Appendix 3.

A preliminary estimate of the Ft. Lyon canal transferrable yield as shown on Table 3.7 is 119,460 acre feet or approximately 1.27 acre feet/share. A more detailed analysis is required to develop definitive criteria to mitigate injury to remaining shareholders. This analysis would include detailed field investigations of the canal and laterals to determine operational impacts including losses at varying flow rates; investigations of the specific land from which water is to be transferred to determine transferrable depletions; modeling to determine both the timing and location of return flows; and investigation of potential water quality impacts. The results of the analysis would form the basis for the terms and conditions to protect the water rights of the remaining shareholders as well as other water right owners in the Arkansas River Basin.

Irrigated Soils

Soils under the Fort Lyon system are predominately deep soils, consisting of moderately fine textured clay loams and silty clay loams. Soil Survey reports for Otero, Bent, and Prowers counties show that these kinds of soils occur on about 95 percent of the lands currently being farmed and irrigated. (U.S. Soil Conservation Service 1966, 1971, 1972) The most common soil series are Rocky Ford, Numa, and Nepesta. Over the years since irrigation water was first applied, the soils have been changed by the addition of clay and silt particles deposited by muddy irrigation water. Some soils have become wet or saline due to seepage from the canal and ditches and from excessive application of irrigation water.

In Soil Survey reports, soils are placed in groups called capability classes that show in a general way their suitability for farming. Groupings are based on limitations of the soils and on their response to use and management. While the system used nationwide consists of eight broad classes, soils under the Fort Lyon canal fall into four classes--classes I, II, III, and IV. The acreage of class I soils is negligible and is ignored in this discussion. About [illegible] percent of the soils are Class II, and the remaining 8 percent is split about evenly between Class III and Class IV.

Class II soils are the deep clay loams and silty clay loams occurring on gentle slopes of 0-3 percent. These soils are said to have moderate limitations for farming. Limitations are caused by the clay component of the soils which places restrictions on timing of tillage practices relative to soil moisture content. Tillage when soils are too wet or too dry results in formation of hard clods. However, these

Table 3.7

Preliminary Estimate of Fort Lyon Canal Transferrable Yield

Total Headgate Diversions	
Fort Lyon Canal	190,991 a.f.
Fort Lyon Storage Canal [1]	31,622 a.f.
Queen Reservoir	1,590 a.f.
	224,203 a.f.
Less Returns to River	-60,088 a.f.
Preliminary Estimate of Stream Depletion	164,115 a.f.
Less:	
Depletions assumed non-transferrable	
Canal losses	-35,115 a.f.
Lateral losses	-8,256 a.f.
Depletions resulting from Frying Pan-Arkansas waters	-1,284 a.f.
Preliminary Estimate of Fort Lyon Canal Transferrable Yield	119,460 a.f.
Estimate of Transferrable Yield/Share (based on 93,989 shares)	1.27 a.f./share

1) As measured at headgate, Tables 3.5 and 3.6 show deliveries from Adobe and Horse Creek Reservoirs to Fort Lyon Canal.

Table 3.8

Fort Lyon System Soil Classification Estimates by Division
(Acres)

Division	Irrigated Acres[1]	Percentage Capability Class		Acres of Capability Class[2]	
		Class II	Class III & IV	Class II	Class III & IV
La Junta	2,140	94%	6%	2,012	128
Horse Creek	9,290	92%	8%	8,547	743
Las Animas	13,960	93%	7%	12,983	977
Limestone	29,900	90%	10%	26,910	2,990
Lamar	36,380	93%	7%	33,833	2,547
TOTALS	91,670	92%	8%	84,285	7,385

[1] From USGS Preliminary Data; differences in total irrigated acres may be due to precision of measurement methods.

[2] Estimates based on analysis of USDA, SCS Soil Survey Reports for Otero, Bent, and Prowers Counties.

soils are productive and are capable of producing top yields of all crops adapted to the lower Arkansas Valley.

Class III soils are said to have severe limitations for farming. Those soils occurring on Fort Lyon lands have one or more of the following characteristics: excessive slopes (3-5%), salinity due to seepage, subsoil of sand or clay, high water table, and droughtiness due to coarse soil texture. Class IV are, for the most part, shallow soils over a limestone substratum which results in poor soil drainage, and often a perched water table. This report refers to these lands as "marginal lands".

Soils of the various capability classes are distributed throughout the area under the Canal and are not generally grouped in any one area, although the Limestone Division has more of the class IV soils than the other divisions. Table 3.8 shows the distribution of capability classes by canal division. Class III and IV soils are combined into a single column since they have similar predicted crop yield values and represent a low percentage of the total acreage.

Capability class is not a valid basis for crop yield predictions on lands under the Fort Lyon canal. This is because yields are influenced to a great extent by the availability and application of irrigation water, and water availability varies from one part of the system to another. However, based on a composite of crop yield information contained in the Soil Survey Reports, it is estimated that the Class III and IV soils have a yield index of approximately .65, compared to a yield index of 1.0 for the Class II soils, assuming an adequate water supply. These findings of soil productive capability and distribution of classes of soil types are applied to estimates of income and change in land values in Chapter 6.

Description of Wildlife and Fisheries

Wildlife

Wildlife resources in the Arkansas Valley are characterized by healthy populations of species normally associated with short-grass prairie and riparian habitat (LARC 1992, 7). Threatened and endangered species which inhabit, visit, have historically occurred, or are believed to inhabit this area of the state include the Arkansas darter, bald eagle, peregrine falcon, interior least tern, piping plover, lesser prairie chicken, and the black-footed ferret. Many species of mammals and migratory and upland birds are also present. Mammals include mule deer, white-tailed deer, Pronghorn, fox, jackrabbit and many small mammals (LARC 1992, 7).

Other species on the U.S. Fish and Wildlife Service's candidate list for threatened or endangered listing also occur in this area of the state including the mountain plover, snowy plover, long-billed curlew, white-faced ibis, Texas horned lizard, and the swift fox (LARC 1992, 8). The eagles and falcons, as well as other raptors utilize the cottonwoods sustained by ditches and laterals as habitat. Game birds include Canadian and snow geese, numerous duck species, ring-necked pheasant, and bobwhite quail (LARC 1992, 7). This report does not include site-specific analysis of species habitats. Additionally, the report does not attempt to verify the occurrence of any of the above species in the specific area served by the Ft. Lyon Canal Company. The Division of Wildlife has stocked turkey in the area and predicts a turkey season beginning in 1993. Private groups such as Pheasants Forever have stocked other birds (Desilet 1993).

Migratory Wildfowl

A significant portion of the Central Flyway's High Plains Canada goose flock has traditionally wintered in the lower Arkansas River and nearby reservoirs (LARC 1992, 7). The geese now use the corn, milo and winter wheat stubblefields in the Fort Lyon system as feeding grounds.

The Adobe Creek, Horse Creek and other plains reservoirs attract geese and ducks. Some drawdown of the reservoirs during the months that these birds migrate through the area may actually attract more birds which prefer sandy, beach-like areas (Kubeczko 1989, 32-33).

Lake Fisheries

Numerous aquatic wildlife species, including walleye, wiper, crappie, largemouth bass, white bass, catfish and bluegill, support a strong warm water fishery in the river, creeks and reservoirs in the area (LARC 1992, 7). The Division of Wildlife stocks several reservoirs in the area with walleye, wipers, catfish and other species (Desilet 1993).

Water quality preferred for fishing is TDS of less than 3,000 mg/l. Above that level fishery vitality diminishes. At 10,000 mg/l TDS and above, little fishery remains (LARC 1992, 28). Bass and walleye are relatively sensitive to water quality, while crappie, wipers and minnows are more tolerant (Kreiger 1993). Water quality is an important factor in determining the success of a fishery; poor water quality diminishes fishery capability.

Existing characteristics tending to make the fishery at Adobe Creek and Horse Creek Reservoirs (and other plains reservoirs) suitable include water in the reservoir from a fertile rather than a barren watershed, terrestrial vegetation which contributes debris to the water and allows many nutrients to

be leached from the soil into the water, a basin with a gently sloping side, shallow mean depth, and a relatively high water temperature (Kubeczko 1989, 26).

Extreme water level fluctuation due to reservoir drawdown during the irrigation season is the key impediment to a high quality fishery at the reservoirs, as well as low winter water levels in some years. Effects of drawdown include stunting of growth or loss of fish due to the loss of spawning habitat, reduction of food organisms by the damaging of the substrate, loss of riparian vegetation cover, loss of young through the spillway, winterkill, and oxygen depletion (Kubeczko 1989, 32). Some summer drawdown of reservoirs is beneficial to fisheries, allowing revegetation of the shore, which encourages micro-organism growth and spawning habitat in shoreline areas (Desilet, 1993).

Wetlands

The seepage and waste runoff from the Fort Lyon canal, its laterals, drains and irrigated lands support a disbursed group of wetland areas. Areas must have these conditions to be classified as wetlands: (1) hydric soil, (2) evidence of hydrophytic vegetation or be capable of supporting hydrophytic vegetation, and (3) the area is inundated (permanently or periodically), or the soil is saturated to the surface during a significant part of the growing season in years of normal precipitation. A wetlands inventory of the study area was conducted using remote sensing techniques by the U.S. Fish and Wildlife Service from 1972 photography. These data are available on 7.5 minute quadrangle sheets. The data were reviewed for this study, but only at the reconnaissance level. The significance of wetlands impacts by changes to Ft. Lyon Canal operations, if any, must be reviewed on the ground by agency personnel on a case by case basis.

The extensive irrigation and return flows, both underground and surface affect the Arkansas River channel ecology. In addition to sustaining river channel wetlands, the return flows bring nutrients to the river fishery. The river bottom-lands are home for the full range of plains wildlife. The river bottom-lands provide recreational, fishery, and scenic benefits to the community. The quantification of wetlands can be addressed in Phase 2 as needed.

Aesthetics

Prior to the canal construction, the area of the Ft. Lyon system was undoubtedly the same arid, high plains as now exist north of the canal. Close to the river there would have been typical plains river bottom ecology. That the construction of the irrigation ditches, laterals, and reservoirs would result in seepage which would nourish fruit, ornamental and other trees and shrubs was recognized from the beginning, and was a justification for the construction of the system (Colorado State Engineer 1898).

Since the construction of the Ft. Lyon system, stately cottonwoods parade along the ditch, and congregate where the waters are available. Farmsteads have planted evergreen and deciduous vegetation for wind protection, to control soil erosion and for scenic purposes. The typical plantings of grasses, alfalfa, corn and wheat supported by irrigation make the countryside bloom and remain green nearly year round.

Water Quality

Water quality in the lower Arkansas River generally deteriorates as it travels downstream primarily due to the use and reuse of the water supplies for agricultural purposes. Average dissolved solids loading and water quality data at stream gauge stations on the Arkansas River are presented in Figure

3.3. While state water quality standards are not applicable to ditch systems, standards do exist for lakes, including Adobe Creek and Horse Creek Reservoirs, John Martin Reservoir, and the Great Plains Reservoirs. Standards also exist for the Arkansas River mainstem and its tributaries in the Ft. Lyon area. The Current classifications which have been established by the Colorado Water Quality Control Commission are:

Arkansas River: Recreation Class 2, Aquatic Warm Water Class 2, Water Supply, and Agriculture

Horse Creek: Recreation 2, Aquatic Warm 2, Agriculture

Horse Creek Reservoir: Recreation 2, Aquatic Warm 1, Agriculture

Adobe Creek: Recreation 2, Aquatic Warm 1, Agriculture

Adobe Creek Reservoir: Recreation 1, Aquatic Warm 1, Water Supply, Agriculture

Thurston Reservoir: Recreation 2, Aquatic Warm 1, Agriculture
Great Plains Reservoirs - Nee Sopah and Nee Noshe: Recreation 1, Aquatic Warm 1, Water Supply, Agriculture

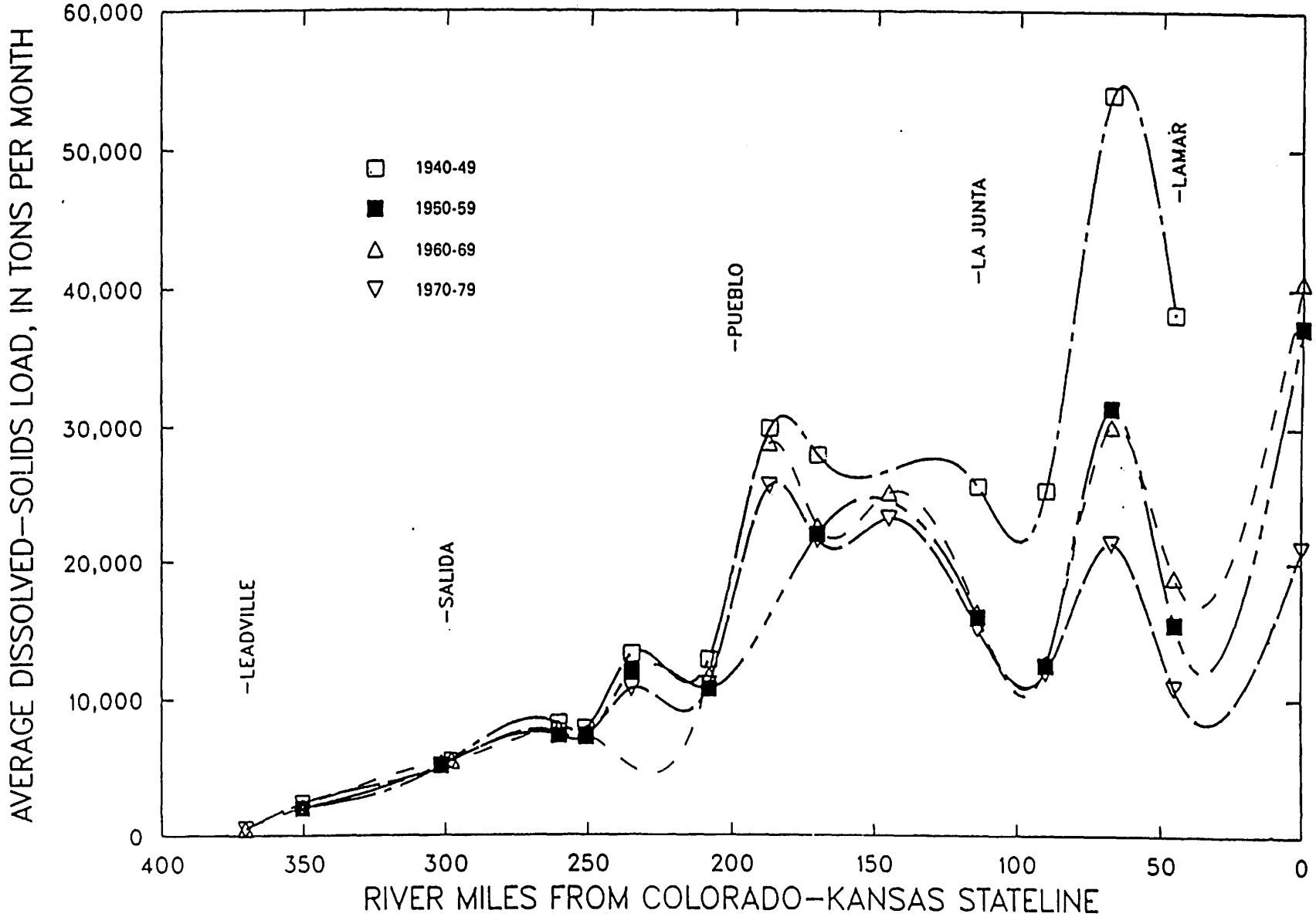
John Martin Reservoir: Recreation 1, Aquatic Warm 1, Water Supply, Agriculture

Other tributaries of the Arkansas River: Recreation 2, Aquatic Warm 2, Agriculture

Adobe Creek Reservoir, Great Plains Reservoirs, and John Martin Reservoirs are also designated High Quality Class 2 waters which subjects permits affecting the waters of those reservoirs to anti-degradation review and special protection under state water quality rules (5 CCR 1002-8 Section 3.2.0)

Water quality is a factor in the treatment of Arkansas River water for other uses. The type of treatment required for municipal use depends on the location from which it is diverted. In the Ft. Lyon Canal Treatability Evaluation performed by Richard P. Arber and Associates, the water quality parameters from the Catlin Canal were utilized to develop treatment processes and cost for operation of the water treatment systems. Average concentrations of several water quality parameters exceed drinking water criteria. These parameters include dissolved solids, hardness, sodium, sulfate, iron and manganese. Gross alpha concentrations also exceed the criteria but are regulated only if radium 226 and 228 both exceed their restrictive criteria. Arber reported that uranium may also be regulated at 10 pCiL or approximately 15 μgL. Since 14 μgL of uranium was detected uranium was also considered in the development of treatment schemes. Arber noted that data were not available to determine a level of organic compounds and therefore were not considered in the treatment recommendations. (Arber undated)

Arber proposed water treatment processes which include conventional treatment (including flocculation, sedimentation and filtration) softening, and sulfate removal. Ion exchange may be required through reverse osmosis. Arber estimated that total annualized treatment costs range from $142 per acre foot to $547 per acre foot, not including costs for reverse osmosis. The addition of reverse osmosis could increase treatment costs to $1,467 per acre foot or approximately 10 times the cost of conventional treatment.



--Average dissolved-solids load, by decade, along the Arkansas River, 1940-79.

FIGURE 2
[Burns, 1989]

Figure 3.3 - Average Dissolved--Solids Load, in Tons per Month (USGS 1989, Figure 2)

Value of Ft. Lyon Shares

The estimated value of Ft. Lyon Canal Company shares is developed using two approaches. The first is an analysis to determine the estimated present market value of Ft. Lyon Canal Company shares in agricultural use within the system. To develop this value, 28 land sales were analyzed. Eleven sales included both Ft. Lyon shares and supplemental well irrigation rights. The remaining seventeen sales included the land with Ft. Lyon shares only. A summary of these seventeen sales is presented in Table 3.9. Sources data is presented in Table A3.6 of the Appendix.

Table 3.9
Summary of Sales Without Supplemental Wells

	Price Per Share
Minimum	$238
Maximum	$960
Average	$722

The value of shares range from $239 to $961 per share and averaged $723. This analysis provides an indication of the value of these shares used for agricultural purposes.

In Chapter 2 thirteen historic water transfers were presented and discussed. Of these thirteen transfers, four lower Arkansas transfers occurred of water rights comparable to the Ft. Lyon Canal system. The value of these water rights in the years 1985 to 1988 ranged from $1,570 to $3,152 per acre-foot C.U. As described earlier in this chapter, a preliminary estimate of the transferrable yield of the Ft. Lyon Canal Company system is 1.27 acre-foot per share. Using these preliminary data it is estimated that the value of the Ft. Lyon shares transferred outside of the lower Arkansas Valley may range from $1,994 to $4,003 per share. It is estimated that the value of the Ft. Lyon shares for municipal purposes may be at the lower end of this range due to water quality concerns and other issues relating to transfer of water from the lower Arkansas Valley. The differential in the valuation of the Ft. Lyon shares for municipal use of $2,000 per share versus that for agricultural use of $720 per share is a significant factor leading to potential water sales from the Ft. Lyon Canal Company system.

Summary

Major findings of this description of the Ft. Lyon Canal Company system and its environment are as follows:

1. Stockholders' ability to acquire additional stock in the company is subject to limitations by the company bylaws. Water may be transferred within a division, water may not be transferred out of the ditch or to downstream divisions. Water transfers within the system for agricultural or other uses have been infrequent.

2. The average annual yield of the Ft. Lyon system is 211,597 acre-feet and ranges from 94,145 to 383,056 acre-feet annually. Ninety percent of the time, the system may deliver up to 110,000 acre-feet/year.

3. Ground water pumping is extensively regulated by the State Engineer's Office. It is estimated that ground water pumping under the Ft. Lyon system adds 12% to the water supply of irrigated acres served by the canal.

4. Total losses are estimated to be 17% for the Ft. Lyon Storage Canal, 30% for the Ft. Lyon Canal and 10% for the laterals. Both canal and lateral loss significantly affect the quantity of water delivered to shareholders.

5. The physical description of the land under the Ft. Lyon Canal is characterized mainly by highly variable soil characteristics and disbursed wetland areas created by drainage and seepage. Soil quality is predominantly good. Wetland areas are disbursed across the system, vary in size and type, and must be evaluated on a case-by-case basis.

6. Environment and wildlife are typical of the high plains with sustained irrigation as a source of water to support habitat, a diverse population of many species of flora and fauna exist. The area also supports migratory birds which use area reservoirs and feed on crop residuals in the cultivated fields.

7. Water quality of lower Arkansas River water is poor but the water is still productively used. The cost for treatment of Ft. Lyon water for municipal purposes may be as much as 10 times that of conventional water treatment systems and varies from $142 to $1,467/af, depending upon location and water quality requirements.

8. The value of Ft. Lyon shares for use outside of the Valley is approximately $2,000/share or approximately 2.8 times the $720/share value of water for agricultural use within the Valley. This significant difference in the valuation of the water supply is a major factor contributing to potential future sales.

CHAPTER 4
FT. LYON SERVICE AREA AND SURROUNDING COMMUNITIES

Introduction

The purposes of Chapter 4 are: (a) to provide descriptive material and statistical data on the economic, sociological and demographic characteristics of the Ft. Lyon study area; (b) to analyze current trends; and (c) to prepare economic and sociological baselines of the study area, from which future impacts can be measured.

This chapter contains considerable detail and statistical data. Readers interested primarily in the policy aspects may wish to skim through the earlier sections of the chapter and concentrate more on the summaries of the present economic profile, the present sociological profile, the demographic projections and the potential sociological impacts of additional water transfers which conclude the chapter (pages 4-38 to 4-44).

Summary Description of Study Area

The study area covers five counties of southeastern Colorado which lie in the Lower Arkansas Valley and which are influenced by the Fort Lyon Canal System: Bent; Crowley; Kiowa; Otero; and Prowers. (See Figure 1.1 and refer to more details in Chapter 1.) The study area has a lengthy history of agriculture, predominantly irrigated agriculture, and associated economic endeavors.

The area has a population (1990 Census) of 43,183 plus another 2,126 persons who are institutionalized, living in group quarters, e.g., boys ranch, hospitals and prisons. Although the population is only 1.3 percent of Colorado's total, the area generates about one-twelfth of the State's agricultural products, contains 6.7 percent of its land area (U.S. Bureau of the Census 1988), and has a disproportionately large influence on Colorado's affairs. The area is the driving force in the economy of southeastern Colorado and rural portions of adjacent states. It has produced several strong legislative leaders and Colorado's current Governor.

As is true of other agricultural areas of the state, the Lower Arkansas Valley is relatively poor in economic income, has been losing population for several decades, and faces threats to the continuation of irrigated agriculture which is the basis of its economy. There is concern and controversy over the potential loss of more of its irrigation water, through sale and transfer out of the Arkansas Valley. Issues arising from these concerns are fully developed in Chapter 2.

Historical Background

The study area was populated by Plains Indians, the Cheyennes, Arapahoes, Kiowas, Comanches and a small band of Apaches before and during the first half of the 19th century. Early American explorers along the Arkansas River included James Pursley (1802), and Zebulon Pike, Lewis and Clark (1804). The Arkansas was the boundary between the United States and Mexico until 1848, when the peace treaty of Guadalupe Hidalgo ceded lands north of the Rio Grande to the U.S. (Bowman 1881).

In 1826, a firm of trappers, Bent, St. Vrain and Co., founded Bent's Fort just north of the Arkansas in what became Otero County. They traded with the Indians, traveling annually to St. Louis for supplies and to sell buffalo robes (Bowman 1881). Col. William Bent, who was then proprietor of the Fort, burned it in 1852, angered by the Government's inadequate cash offer for its purchase (Taylor 1963).

However, he constructed a new fort 40 miles east of the first, north of the present town of Prowers (Bowman 1881). The trading route along the Arkansas became known as the Santa Fe Trail, and during the 1840s regular trading developed between Independence, Missouri and Santa Fe (McCullough 1992). Earlier, in 1844 a large grant of land was made by the Mexican Governor to Cornelio Vigil and Ceran St. Vrain. This Vigil and St. Vrain grant included most of the land south of the Arkansas, west of the Purgatoire, and included the present cities of Trinidad, Walsenburg, La Junta and Las Animas. After the land was ceded to the U.S. in 1848, the U.S. Government honored the Mexican grant but reduced the size from over 4 million acres to 97,391 acres (Hafen 1948). Several attempts were made to establish farms in the Arkansas Valley during the 1850s but Indian hostility drove out these pioneers (Hafen 1948).

In 1859, William Bent attempted to sell his second fort (Bent's New Fort, north of the present town of Prowers in eastern Bent County) to the U.S. Government, but the deal was not completed. Instead, the government built a new fort nearby and it was named Fort Lyon (Moore 1993). In 1867, Fort Lyon was moved to its present location north of the Arkansas River, and a settlement began nearby south of the river. This settlement became the town of Las Animas (Hafen 1948).

In 1873, the Santa Fe Railroad reached west to the eastern border of Colorado and founded the town of Granada, where its railhead remained for two years due to financial constraints. Also in 1873, the Kansas Pacific Railroad extended a branch line to West Las Animas (later called Las Animas). Both Las Animas and Granada became lively centers for the production and shipping of cattle, and an active rivalry developed between the towns. However, by 1875, both railroads extended their lines to La Junta, which became a very active center for trade, while Granada and Las Animas declined (Hafen 1948).

Although small irrigation ditches were built by individual farmers during the 1850s and 1860s, the 1870s saw cooperative community building of larger ditches to supply larger districts of farm land. The 1880s were characterized by the building of even larger irrigation projects by corporations. In the Arkansas Valley, great irrigation development occurred. The Fort Lyon Canal was begun in 1884. It is the longest canal in Colorado and is capable of irrigating 120,000 acres (Bowman 1881) although this was later reduced to 92,600 acres. Also in 1884, the 48-mile Catlin Ditch was built to carry water to the Rocky Ford region. The Amity Canal, with its headgate near Prowers in eastern Bent County, and the Bessemer Ditch near Pueblo, were begun in 1887 (Hafen 1948). The Bessemer Ditch was superseded by a new ditch that began in 1894 (Sherow 1990).

Rocky Ford, which began as a merchandise store in 1868, was moved to its present location in 1876 after the Santa Fe Railroad extended its line to the west. Settlers arrived and found that the rich soil produced abundantly under irrigation, particularly of melons. Large irrigation canals were built and by 1887 a flour mill and a canning factory were established (Hafen 1948).

Lamar was founded as a land promotion in 1886, with town lots sold by auction to a crowd which arrived in one day on the Santa Fe Railroad. Several real estate offices and saloons opened in the first week. By 1889, Lamar was the county seat of the newly formed Prowers County, and the riotous land boom was replaced by more stable growth based on irrigated agriculture. The Fort Lyon Canal, Amity Canal, the Fort Bent Ditch, the Lamar Canal and several smaller canals gave Prowers County one of the largest irrigated areas in Colorado, and this led to a flour mill (in 1892), a sugar beet industry, alfalfa meal mills and other agribusinesses upon which growth has continued (Hafen 1948). From 1886 to 1889, farmers moved in and towns mushroomed along the railroads of eastern Colorado, and eight new counties were formed, including Kiowa (Abbott 1976).

The Missouri Pacific Railroad began an ambitious canal project in 1889, diverting Arkansas River water into a system to irrigate a million acres of land between Pueblo County and the Kansas line. In abbreviated form, this project became the Colorado Canal, serving 40,000 acres in Crowley County. Several decades later, in 1935, the project built a transmountain diversion to gather 40,000 acre-feet of water from the Roaring Fork River and convey it 220 miles to Crowley County (Taylor 1963). However the mid-1930s brought drought, and the "dust bowl" in the eastern plains saw five consecutive years of towering dust storms that ravaged the land (Abbott 1976).

Irrigators in the study area have faced numerous problems, including: increased salinity, primarily from natural salt sources and from concentration caused by river use and evaporation, with an estimated 14 percent of salt loading attributed to irrigation and about 8 percent from municipal and industrial use (Miles 1977); insufficient water to dissolve and remove salt concentrations from the soil; loss of water through evaporation and seepage from ditches and from phreatophytic vegetation, including cottonwoods; and choking of canals by silt and weeds. Subsequent sales of water rights of Arkansas River water to urban centers along Colorado's front range have added to these problems (Sherow 1990).

Demographic Analysis

Demographic analysis is based mainly on county level data obtained from the U.S. Census. The analysis compares the five counties in the study area to: the state; the larger region of the sixteen counties which constitute the eastern Colorado plains; and to each other. Data were compiled by Weber (1991) which go as far back as 1890 to discern past demographic trends. For more detailed analysis, the focus is upon the most recent two decades, using data from the U.S. Census for 1970, 1980, and 1990 (U.S. Bureau of the Census 1972, 1983, 1992).

A new prison was built and opened in Crowley County in 1987. The 1990 Census counted 3,946 persons living in Crowley County. This figure includes the prisoner population-- 1,031 persons identified as "living in group quarters", 100 percent of whom were institutionalized. To portray more accurately the population of Crowley County for the purposes of this study, the institutionalized population was eliminated from the numbers whenever possible. Thus, the population of Crowley County for study purposes was 2,915 in 1990. In a few cases, it was not possible to divide out the prison population and this is noted wherever it appears.

Population Growth and Decline

The study area has been declining in population for over sixty years. Weber provided a detailed demographic history of Otero County from 1889 to 1987 (Weber 1989a), and a similar analysis of all eastern Colorado plains counties between 1890 and 1990 (Weber 1991). By 1890 all but one of the eastern Colorado counties (Crowley) had been formed and Anglo (non-Hispanic white) settlement was well established (Weber 1991, 33). The irrigation-based economies developing in the Arkansas Valley study area boomed during the first two or three decades of the twentieth century, fueled largely by the introduction of sugar beet production and refining facilities. The study area's population size peaked in 1930, with a total of 58,006 people in the five counties (see Table 4.1)

Table 4.1 Population by Decade, Five Study Area Counties

COUNTY	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
Bent	1313	3049	5043	9705*	9134	9653	8775	7419	6493	5945	5048
Crowley				6383*	5934	5398	5222	3679	3086	2988	2915
Kiowa	1243	701	2899	3755	3786*	2793	3003	2425	2029	1758	1688
Otero	4192	11522	20201	22623	24390	23571	25275*	24128	23523	22567	20185
Prowers	1969	3766	9520	13845	14762	12304	14836*	13296	13258	13070	13347
TOTAL	8717	19038	37663	56311	58006*	53719	57111	50947	48389	46328	43183

* Peak Population
Source: Weber 1991.

Weber demonstrated that the population of the entire eastern Colorado plains counties has been "urbanizing". County seats and other towns in the region show steady and almost continuous numerical increases to peaks in 1980 followed by declines in 1990 (Weber 1991, 34). This is probably due to several factors. As children of farm families reach adulthood and cannot all stay on the farm, those that do not move to large cities to find work probably find work in the nearby towns. Also, as smaller farms have consolidated some families are displaced from the land and retire or find other work in the area's towns.

Weber's study showed that the population of the sixteen eastern counties has been declining since approximately 1920. This same trend is apparent for all study counties except Prowers and Otero. In Prowers, the population size has remained relatively stable (with significant fluctuations) since that time: 13,845 in 1920, 13,347 in 1990. Otero County's population didn't peak until 1950 and has been declining since then.

As is true for the entire eastern plains region, the demographic trends for the study area run counter to those of the state as a whole. This is especially true for the last several decades. Net out migration between 1950 and 1960 from the sixteen eastern Colorado counties averaged 23.6 percent. In the same period, the state of Colorado had a net in migration rate of 10.3 percent (Weber 1991, 35).

Between 1970 and 1980 the State's population grew by 31 percent, as shown in Table 4.2. Between 1980 and 1990, the state grew another 11 percent. By contrast, the general pattern for the study area is one of population decline. Population decline is caused by several factors, e.g., mechanization, changing job market, urbanization. Water transfers probably accelerate or exacerbate this trend. Between 1970 and 1980 the range of population loss was -1.42 percent to 8.44 percent. Between 1980 and 1990, the range of percent change was 2.44 to 15.0. In the last decade most counties were experiencing double digit percentage loss of population. The exception to this pattern is Prowers County which is somewhat different from the rest. The degree of change in each decade is quite small and it is the only one of the five counties to actually gain population between 1980 and 1990. Prowers lost only 1.42 percent between 1970 and 1980 but gained 2.12 percent between 1980 and 1990.

Table 4.2 Population Change 1970-1990 for Study Area Counties and State of Colorado

	Total Population Size			Percent Change	
	1970	1980	1990	1970-1980	1980-1990
Colorado	2,207,259	2,889,964	3,214,922	+30.93	+11.24
Bent County	6,493	5,945	5,048	- 8.44	-15.09
Crowley County	3,086	2,988	2,915*	- 3.18	- 2.44
Kiowa County	2,029	1,936	1,688	- 4.58	-12.81
Otero County	20,508	19,239	16,736	- 6.19	-13.01
Prowers County	13,258	13,070	13,347	- 1.42	+ 2.12

Sources: 1990 Census of Population. General Population Characteristics: Colorado, Table 79. 1980 Census of Population. Vol. 1, Characteristics of the Population: Colorado, Table 46 (U.S. Bureau of the Census 1983, 1992).

* Excludes prison population for purpose of comparability.

Age of the Population

Tables A4.1 through A4.7 (in Appendix 4.1) show the relative growth and decline in age groups for the state and each of the five counties. The counties differ somewhat from each other but, generally, there has been a significant loss of young adults in the age groups between 20 and 29 years old throughout most of the study area. The decline in the size of this group, which is just entering the labor force, reflects the lack of economic opportunities in the area.

The population of Colorado has been aging since 1970, due to lower birth rates and in migration of older persons. But the population of the study area has been aging much longer, and is generally older, on average, than that of the state. The median age for 1950, 1970, 1980, and 1990 for the state and each county in the study area is provided in Table 4.3. With the exception of Prowers, the population in each of the counties in the study area was older than the state as a whole in 1970, 1980, and 1990.

Table 4.3 Median Age by Year for Colorado and the Five Study Area Counties

	Median Years of Age			
	1950	1970	1980	1990
Colorado	29.9	26.2	28.6	32.6
Bent County	29.8	35.0	33.1	39.0
Crowley County	26.0	37.4	37.8	36.3
Kiowa County	27.0	32.1	41.2	37.2
Otero County	27.0	28.3	30.3	34.9
Prowers County	25.9	26.5	28.8	32.1

Source: Weber 1991 p. 35; 1980 Census of Population, Vol. 1, General Population Characteristics: Colorado, Table 46; 1990 Census of Population, General Population Characteristics: Colorado, Table 79 (U.S. Bureau of the Census 1983, 1992).

The aging of the population is one of the consequences of population decline and extensive out migration of young adults. For instance, in 1950 the study area counties ranked among the state's youngest counties. By 1980, they were among the more elderly.

Other evidence that young adults are migrating out and the population is older in the study area can be found by comparing the percentages in a specific age group (see Table 4.4). For example, in Colorado the 1990 population of young adults, 20-24 years of age, constituted 6.8 percent of the total population. In Bent County this age group was only 3.4 percent, in Crowley 4.1 percent, and in Kiowa 2.8 percent. On the other hand, the older age group, between 60 and 64, constituted 3.7 percent of the total state. In Bent County this same figure was 5.9 percent, in Crowley 5.8 percent, in Otero, 4.7 percent.

Table 4.4 Selected Age Groups as Percentage of Population in Colorado and Five Study Area Counties

	Colorado	Bent	Crowley	Kiowa	Otero	Prowers
20-24 Age Group as Percent of Population	6.8	3.4	4.1	2.8	6.0	5.4
60-64 Age Group as Percent of Population	3.7	5.9	5.8	4.6	4.7	4.1

Sources: 1990 Census Table 46; 1980 Census Table 79 (U.S. Bureau of the Census 1983, 1992).

The aging of the population of the study area is clearly evident when the age structure is graphically represented in the age pyramids presented in Figures 4.1, 4.2, and 4.3. Viewing the pyramid's structure from 1970 through 1990 it is apparent that as the baby boom cohort entered young adulthood by 1980, it migrated out of the study area in great numbers. This resulted in the age pyramid for the area in 1990 being much wider at the top (ages 50 and older) and much narrower in the middle (ages 25-49) than that for the state.

The demographic conditions describe above are symptomatic of an area in economic stagnation or decline. Prowers alone among the five counties in the study area does not fit this description. Two indicators of the economic condition of the population will be examined next.

Dependency Ratio

One demographic indicator of the social and economic "health" or vitality of an area is the dependency ratio. The dependency ratio estimates the number of "dependents" (normally defined as people under the age of 15 and over the age of 65) per 100 people in the working ages (i.e., 15-64). Of course, in the study area many people work and remain productive past age 65. In 1990, the dependency ratio for the state of Colorado was 48.0 (see Table 4.5) This means that every 100 people "supports", in a sense, another 48 people. The lower the dependency ratio the healthier the population in economic and sociological terms. Table 4.5 shows that the 1990 dependency ratios for each of the five counties, and for the study area combined, are quite high, ranging from 64.4 to 77.7.

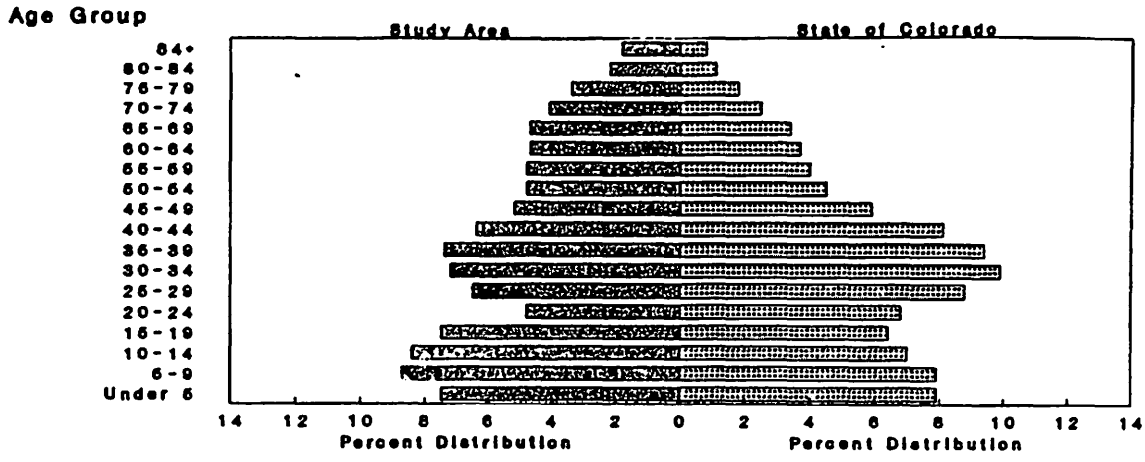


Figure 4.1 1990 Age Distribution for Study Area and State Populations

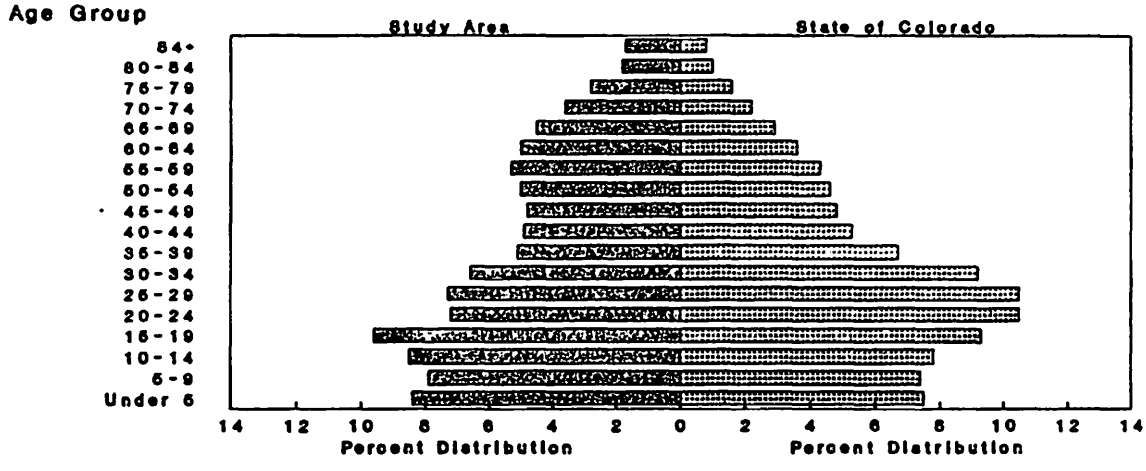


Figure 4.2 1980 Age Distribution for Study Area and State Populations

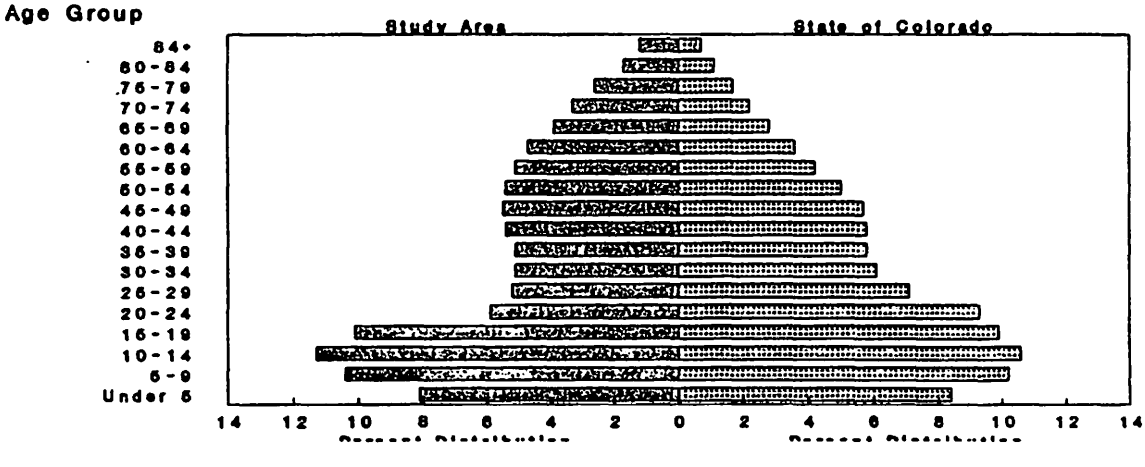


Figure 4.3 1970 Age Distribution for Study Area and State Populations

Table 4.5 Dependency Ratios for Colorado and the Five Study Area Counties, 1970-1990

	1970	1980	1990
Colorado	60.5	45.5	48.0
Bent	68.0	63.2	68.8
Crowley	75.7	68.8	75.2
Kiowa	65.6	52.6	77.7
Otero	76.7	65.6	70.0
Prowers	73.3	63.2	64.4
Study Area Total	74.0	64.2	68.6

Source: 1980 Census of Population, General Population Characteristics, Table 46; 1990 Census of Population, General Population Characteristics, Table 79 (U.S. Bureau of the Census, 1983, 1992).

The dependency ratio for each county fluctuates between 1970, 1980 and 1990, as it does for the state as a whole. Still, in every case the dependency ratio for each county in the study area is higher than that for the state.

The figures for the state reflect a highly urbanized population and a wage economy. Therefore, it is useful also to compare the study area to an acknowledged economically "healthy" agricultural area, Weld County. The dependency ratios for Weld County were 60.0 in 1970, 49.0 in 1980, and 53.1 in 1990. Again, in every case, a ratio for each county in the study area is higher than that for Weld County. The ratios for Weld County are similar or close to those for the state as a whole, indicating that even for an agricultural area, the lower Arkansas Valley is at a socioeconomic disadvantage in terms of its age distribution. The figures for Weld County illustrate that an economically vital agricultural area can support and keep the bulk of its working age population.

Income

Weber (1991, 36) provided data on median family income for these as well as other eastern Colorado counties (see Table 4.6). (Note: Family income is the total income of all family members regardless of family size. Median family income is the income of the average family, i.e., half of the county families receive less income and half receive more.) In the 30 year period between 1950 and 1980 (the latest published data), the mean county median family income for the 16 eastern plains counties dropped from 84.1 percent to 72.2 percent of the comparable figure for the state, a decrease of 14.1 percent. Each of the five study area counties dropped significantly in median family income: Bent County dropped 18.1 percent; Crowley 14.5 percent; Kiowa 29.9 percent; Otero 21.7 percent and Prowers 10.3 percent.

Table 4.6 County Median Family Income as Percent of State Median Family Income, 1950 and 1980

	1950	1980	Percent Change
Bent	82.1	67.2	-18.1
Crowley	65.4	55.9	-14.5
Kiowa	98.3	68.0	-29.9
Otero	84.0	65.8	-21.7
Prowers	81.9	73.5	-10.3

Source: Weber 1991, p. 36 as derived from U.S. Census.

Another measure of relative economic condition is per capita income, i.e., the total income of all persons divided by the population. Table 4.7 presents census data on per capita income for 1979 and 1989. Where per capita income in Colorado had increased 85 percent in that ten-year period, it increased only 57 percent in Bent, 49 percent in Crowley, and 60 percent in Kiowa. Per capita income in Prowers County did somewhat better during this period, increasing 71 percent. Only Otero County experienced an increase comparable to the state average, with its per capita income growing 87 percent. Still, the 1990 per capita income of Otero County, $9,573, was only 65 percent of the average for the state.

The net result of the population characteristics examined so far, is a picture of an area finding itself declining in population size, aging as the result of the significant out migration of young adults, and in an increasingly weakening income position.

Additional income data showing the average annual wage by county and by major economic sector are presented in Table 4.16.

Education

Although the median years of school completed appears to show little variation from the state (see Table 4.7), other indicators of educational level demonstrate that there are significant differences in educational attainment. The level of education in the study area varies slightly by county but, overall, is significantly lower than for the state as a whole. For the state and each of the study area counties, Table 4.7 shows the percentage of the population 25 years of age and older which have graduated from high school. In 1990, the percentage of high school graduates in Colorado was 84.4 percent. In the study area this number varies from a low of 64.9 in Otero County to 72.7 in Bent County. The high figure for Bent County reflects the relatively large proportion of the population there that are professionals employed at the Ft. Lyon Veterans' Hospital.

Another indicator of educational condition is the proportion of high school age people (16-19) who are neither enrolled in school nor have yet graduated. This provides an estimate of the "drop-out" rate. For the state that figure is 9.77 percent (see Table 4.7). In the study area the highest rates are 15.2 percent in Bent County, followed by 10.12 percent in Prowers. The school drop-out rates for the other three counties are lower than the state's figure, with Kiowa County being the lowest at just under four percent. These lower figures may be the result of the out migration of people this age but

examination of the percentages of each county's population in this age group indicates this does not seem to be the case (see Tables A4.1 through A4.7). There seems to be high variability among the study counties with respect to the ability to keep children in school.

Mobility and Length of Residence

Using two estimates of mobility, it can be inferred that the population of the study area is relatively stable. For example, of the total population of Colorado in 1990, less than half, 45.3 percent, were born in Colorado (see Table 4.7). This implies, obviously, a high degree of in-migration to the state. In comparison, more people in the study counties were born in the state: between 58 percent in Crowley and almost 68 percent in Otero, suggesting that the vast majority of the area residents were probably born in the valley.

The degree of residential mobility in the study area is also quite low compared to the state as a whole. The majority of Coloradans (54.8 %) were living in a different house in 1990 than in 1985 (see Table 4.7). Except for Crowley County, where the data are misleading because of the inclusion of the prison population, the figures for the study area counties are considerably lower (between 32.2% in Kiowa and 43.7% in Prowers). We can comfortably assume that most residents of the study area have lived there a long time and many probably were born and reared in the area.

Ethnicity

The population of the study area is predominately non-Hispanic white. Using ethnic categories provided in the U.S. Census, Table 4.8 presents the ethnic and racial breakdown of the population of the state, the five-county study area, and each of the counties separately. Compared to the state as a whole, the study area has more than twice the percentage of Hispanics (28.4 % vs. 12.9% in Colorado). In contrast, the study area has considerably fewer Blacks (1.0 %) than are found in the state as a whole (3.9%). The data for Crowley County, in this case, include the prison population. Since racial makeup of the prison population is different from the rest of the population of the area, Crowley County incorrectly appears unlike any of the other counties shown.

Kiowa County has the highest percentage of non-Hispanic whites ("Anglos"), 96 percent. Otero County has the highest percentage of Hispanics (35.2%). The proportions of Native Americans, Asians, Blacks and "Others" in the study area counties are so low as to be negligible.

Table 4.7 Socioeconomic Characteristics of the Population of Colorado and Five Study Area Counties, 1980-1990

	Colorado		Bent		Crowley		Kiowa		Otero		Prowers	
	1980	1990	1980	1990	1980	1990	1980	1990	1980	1990	1980	1990
Median school years completed	12.8	-	12.3	-	12.3	-	12.5	-	12.3	-	12.4	-
% High School Graduates of population 25 years +	79.4	84.4	60.9	72.7	55.9	70.3	71.5	69.8	60.0	64.9	65.4	70.2
% of pop 16-19 years not enrolled in school and not High School graduates	12.73	9.77	9.19	15.2	15.4	5.37	8.47	3.95	13.77	6.24	15.68	10.12
% Born in Colorado	41.7	45.3	54.8	58.9	59.8	58.1	52.8	62.2	59.2	67.8	56.5	65.5
% Living in different house five years ago	39.8	54.8	50.2	43.3	35.5	52.2*	40.1	32.2	44.2	42.0	45.7	43.7
Per Capita income in 1979 and 1989 $	7,998	14,821	5,811	9,170	4,675	6,978	6,452	10,305	5,123	9,573	5,641	9,662
% of all families in below poverty level 1979-1989	7.4	8.6	10.5	15.4	14.1	19.8	13.4	11.7	16.3	19.6	15.1	16.9

- = not yet available in 1990 Census data.
* = includes prison population.

Table 4.8 Ethnic and Racial Composition of Arkansas Valley Counties and State of Colorado, 1990 Census

	STATE		AREA TL*		BENT		CROWLEY		KIOWA		OTERO		PROWERS	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
TOTAL	3,294,394	100%	44,214	100%	5,048	100%	3,946	100%	1,688	100%	20,185	100%	13,347	100%
NH WHITE	2,658,945	80.7%	30,672	69.4%	3,588	71.1%	2,694	68.3%	1,621	96.0%	12,698	62.9%	10,071	75.5%
HISPANIC	424,302	12.9%	12,544	28.4%	1,371	27.2%	912	23.1%	55	3.3%	7,104	35.2%	3,102	23.2%
NH BLACK	128,057	3.9%	433	1.0%	32	0.5%	254	6.4%	0	0.0%	109	0.5%	38	0.3%
NH INDIAN	22,068	0.7%	299	0.7%	32	0.6%	57	1.4%	11	0.7%	119	0.6%	80	0.6%
NH ASIAN	56,773	1.7%	189	0.4%	23	0.5%	29	0.7%	0	0.0%	101	0.5%	36	0.3%
NH OTHER	4,249	0.1%	77	0.2%	2	0.0%	0	0.0%	1	0.1%	54	0.3%	20	0.1%

*Area total population includes those in group quarters.

Source: 1990 Census of Population
Summary Population and Housing Characteristics, Colorado
1990 CPH 1-7, Issued July, 1991
Table: 3

Poverty

Three of the five study area counties are among the ten poorest in Colorado (1990 Census of Population; Newcomer 1993). These are Crowley, Otero and Prowers. Bent County follows closely behind. For the study area, only in Kiowa County does the poverty rate (13.8%) come close to the State's average (11.7%). The poverty line in 1990 was defined as $12,675 in annual income for a family of four. All but one of the study area counties (Kiowa) ranked among the top one-fourth of the nation's poorest.

The rate of poverty by age and race for Colorado and each of the study counties is provided in Table 4.9. Poverty rates are shown for the population aged 65 and over, under 18 years of age, Anglos, Blacks, Hispanics, and Others (Asians, Pacific Islanders, American Indians, Eskimos and Aleuts). The table also shows the percentage of the total population of each county that is living below the poverty line. Each county's rank among the 3,141 U.S. counties for poverty level residents is provided in the last column. For example, Otero County is rated as the 498th poorest in the nation.

Table 4.9. Percentage of Population Living Below Poverty Line, 1990

County	>65	<18	Anglo	Black	Hispanic	Other	Total	Rank
Bent	18.7	25.8	18.5	33.3	29.1	39.8	20.4	792
Crowley	18.7	32.4	22.7	75.0	40.9	37.4	23.8	506
Kiowa	24.2	10.7	13.9	0.0	16.1	8.5	13.8	1849
Otero	18.1	33.3	19.8	56.9	40.8	43.3	23.9	498
Prowers	19.3	27.3	18.6	25.0	35.4	35.4	21.0	726

Total Poverty Rate for Colorado = 11.7%
Total Poverty Rate for the U.S. = 13.7%
Total Number of U.S. Counties = 3,141

Source: Newcomer 1993, p. 10, as derived from the U.S. Census of Population and Housing, 1990.

Crop Production

The five-county study area is rich in agricultural production. It produces over $93 million of field crops annually, which is equal to 8 percent of the state's production of all field, fruit and vegetable crops. No county data are available on fruit and vegetable production in the study area. (Colorado Agricultural Statistics 1992)

Crop	Acreage	Production	Est. Value
Winter wheat	293,900	8,632,000 bu	$28,485,600
Spring wheat (Prowers only)	300	6,000 bu	19,200
Corn for grain	41,100	5,570,000 bu	13,646,500
Corn for silage	9,100	87,900 tons	1,758,000
Barley	3,300	125,000 bu	375,000
Oats	800	58,800 bu	94,100
Sorghum for grain	93,200	4,228,000 bu	9,343,900
Dry beans	3,000	49,500 cwt	643,500
Alfalfa hay	113,500	497,500 tons	35,322,500
Other hay	27,200	56,400 tons	4,004,400
		Total	$93,692,700

Data on crop production from the Ft. Lyon Canal system are available for 1990, in a study of the Ft. Lyon Canal Company prepared by the U.S. Geological Survey and presented in summarized form in Appendix 6.6 of Chapter 6:

Crop	Acreage	Production	Est. Value
Alfalfa	57,753	219,338 tons	$16,450,350
Corn	7,948	1,021,400 bu	2,553,500
Sorghum	11,389	831,090 bu	1,953,062
Wheat	5,720	354,850 bu	1,277,460
Barley	520	23,840 bu	53,640
Pasture, fallow, etc.	8,340	--	552,422
		Total	$22,840,434

Although the comparison is inexact, i.e., 1991 vs. 1990 crop production, it appears that the Ft. Lyon Canal system produces about 44 percent of the entire alfalfa production of the five-county study area, 18 percent of corn for grain, 20 percent of sorghum, 4 percent of wheat (most wheat grown is dryland wheat), and 19 percent of barley.

Only incomplete data are available on the livestock production in the five-county study ara. However, annual livestock sales in La Junta alone exceed $103 million, which is greater than the field crop production in the entire study area (see Appendix 4.2).

Farming and Ranching Profiles by County

Bent County. Cattle and sheep are major sources of income in Bent County. Sorghum, corn, melons, onions, tomatoes, potatoes, alfalfa, and small grain are the principal irrigated crops. Sorghum and wheat are the principal dryfarmed crops.

Approximately 86 percent of Bent County is used as range. Most of the livestock are cows and calves. Most ranchers rely on native forage supplemented with cake or bundle feed, i.e. grain sorghum or forage sorghum, most of which is grown outside the study area. On rangeland that has been heavily grazed, the vegetation consists predominately of buffalograss and sodbound blue grama. Tamarisk covers large acreages on the bottom land along the Arkansas River and its tributaries. Range production varies as much as 100 percent, both from year to year and from site to site within the same growing season, because of differences in the kinds of vegetation and seasonal variations in precipitation.

Agriculture remains a mainstay of the local economy. The problem with this is that the agricultural sector is basically a raw material producer. Relatively low value raw materials are sent elsewhere for processing which adds value. The attraction of local development of one or more processing operations is a clear target of local leaders. This would enhance the existing agricultural base as well as provide year around employment for others.

Otero County. Otero County is an area of primarily irrigated farmland and dry pasture ranching. The agricultural operations in the area are very diverse and range from labor intensive produce operations to feed crop operations and from cattle ranching to finished feedlots. Agriculture related businesses are the base of Otero County's economy. Businesses located in Otero County include two of the nation's most active livestock auctions, a canning company with a variety of chili and pickle products produced from locally grown commodities and an active melon produce industry.

About 79,500 acres of the soils in Otero County are irrigated. Most of the irrigation water is obtained by diverting water from the Arkansas River. The supply of irrigation water varies from year to year. The irrigated soils are used to produce cultivated crops, and grasses and legumes for hay and pasture. The principal cultivated crops are alfalfa, corn, grain sorghum, and small grains. The other crops grown are onions, pinto beans, melons, and potatoes. Specialty crops such as zinnias for seed production and tomatoes for canning are grown under contract.

Crowley County. Crowley County lies north of the Arkansas River. Topography for the grazing land and dry crop farmland ranges from nearly level to broad rolling hills. The majority of the irrigated land lies just north of the Arkansas River and has the proper slopes needed for flood or furrow irrigation. The early history of Crowley County is based upon an agricultural economy with approximately 50,000 acres of irrigated crop land, 35,000 acres of dry crop farm land and the vast

majority of the remaining 434,680 acres used as grazing land. The irrigated farm land and operations have undergone major changes in recent history starting with the closing of the beet sugar factory in the early 1960s which was located in Sugar City. More recently, nearly all of the Twin Lakes transmountain water rights (sold in 1971) and 87 percent of the Colorado Canal Company irrigation water (sold in 1984 and 1987) were purchased by Pueblo, Pueblo West, Colorado Springs and Aurora for municipal and industrial uses. (Refer to Appendix 2.2 for details of water transfers.) Because of the sale of the transmountain water earlier, the cropping programs of the area changed to nearly 100 percent feed crops such as alfalfa, corn and milo from some of the more risky and profitable produce crops. Additionally, the Conservation Reserve Program has removed approximately 18,000 acres of the more highly erodible non-irrigated land from dry crop production.

The dry crop farm land is commonly used to grow bundle feed, grain sorghum, pinto beans or sunflowers for oil. There is not sufficient moisture normally to make this area a good wheat producing location. The irrigated farm land in Crowley County as well as Otero County, which lies just south of Crowley County, offers a ready supply of feed for the area's livestock operations as well as large acreages of aftermath pasture which is normally available between late October and early March.

Crowley County has undergone major changes in the make up of its agriculture. The sale of irrigation water rights and the Conservation Reserve Program have reduced the number of farmable acres. The majority of this land would return to grazing land if revegetation programs underway are successful.

Prowers County. The relatively mild winters and length of the growing season lends itself well to a wide variety of crops. Some of the factors which control crop production for the individual farm or irrigation canal include the amount of water available on a per acre basis (decree), when the water is available (priority), quality of soils and operator desires. The crops range from feed crops to fresh fruits and vegetables. Production under drycrop farming ranges from feed crops and forage for livestock to edible beans and sunflowers for oil production.

The primary factor affecting the total amount of drycrop farmland is the Federal Government and its agricultural policies. The most current government policy to affect this segment of the area has been the Conservation Reserve Program (CRP).

Irrigation development under the Arkansas River primarily took place in the 1890s and 1900s. The end result was an over-appropriated river. Water for irrigation is taken from three main sources in this county. These are the Arkansas River; storage reservoirs, which in turn, receive water from the Arkansas River; and wells. The area contributes to the growth and development in the livestock industry, by providing a dependable high quality source of feed for livestock, and the area also is known for high quality seeds, fruits and vegetables. All of the grain crops, such as corn, wheat and barley, are marketed locally through cooperative grain elevators, private grain elevators, or area feedlots.

Kiowa County. The soils in Kiowa County are generally [illegible]. However, agriculture is limited by the sporadic rainfall pattern. About 59 percent is dryfarmed land. There also is some irrigated farm land using wells. The rest is range. Wheat is the dominant crop; grain sorghum, forage sorghum, and millet also are grown. Much of the dryfarmed land is subject to severe soil blowing. Crop failures are common during years of below average precipitation.

Farming is the primary industry of Kiowa County. Dryfarming is the largest enterprise, followed by ranching and some irrigated farming. The climate is the principal limiting factor to dryfarmed crop

production. Low, erratic precipitation in combination with high wind velocities make dryfarming a risk. The dominant irrigated crops are corn, alfalfa, and wheat. Irrigation water from wells is limited and the number of acres being irrigated is decreasing.

Ranching operations involve just less than half of the land of Kiowa County. Ranches are intermingled with land being cropped. The cow-calf-yearling operation is the dominant type. The success or failure of farming and ranching is determined by the amount of precipitation. On many of the ranches, forage produced on rangeland is supplemented by wheat pasture. During the winter months, the native forage is supplemented by a protein supplement, generally cottonseed cake. Creep feeding of calves and yearlings is practiced on some ranches. This land is ideally suited to the grazing of livestock. Where climate and topography are similar, differences in kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Chapter 3 includes a description of the irrigated soils of the Fort Lyon Canal System and data on the acreage of each class of soil by Division of the system.

Agribusiness and Other Economic Activities

While heavily dependent on irrigated agriculture, the study area has developed several other areas of economic activity and continues with some success to enlarge and diversify these other economic sectors.

Cattle Feeding. Alfalfa and other cattle feed grown in the study area supports a large cattle feeding industry within the area and also is sold to ranchers and feeders in a broader area of southeastern Colorado. Supplemental feed, called bundle feed, is from outside the study area. The study area grew 553,900 tons of alfalfa hay in 1991, 13.6 percent of Colorado's total production (Colorado Agricultural Statistics 1992). In La Junta's two sales barns, which conduct two weekly cattle sales, more cattle are sold than anywhere else in Colorado. In Lamar, three major feedlots (Colorado Beef, Four States, and Beef City) have a combined capacity of 95,000 cattle. Livestock prices are relatively strong (Colorado Agricultural Statistics, 1992), and cattle sales are a primary driver of the study area economy. See Table A4.8 in the Appendix 4.2 for detailed information on the volume and economic value of livestock in the study area.

Food Processing. Traditionally, portions of the study area (known as the Melon Capital of the World) have produced excellent fruits and vegetables, e.g., cantaloupe and other melons, onions, tomatoes, etc. This has supported a food processing industry to harvest and ship produce. Despite a reduction in row crop production caused partly by a shortage of harvesting labor, a cannery (Greenbay Packing, near La Junta) has announced a $4 million capital improvement. However, packing of melons and vegetables has declined significantly from its peak volume and Greenbay is now going outside the study area to buy pickles. Also sugar beet production formerly supported five sugar refineries (in Holly, Las Animas, Sugar City, Swink and Rocky Ford). The last of these in Rocky Ford closed in 1977) is extinct (Colorado Agricultural Statistics, 1992). Reasons for the demise of the sugar industry were obsolescence of the factories and economic pressures from competitive sugar producing areas. By its nature, food processing is seasonal, and most workers are laid off during the autumn and winter months, when many receive unemployment compensation or welfare assistance. Retail employment also declines during the autumn/winter seasons, as shown in Figure 4.9.

Manufacturing. Imaginative economic development planning together with certain natural advantages of labor force availability, climate and transportation, have succeeded in attracting durable goods manufacturing to the study area. Neoplan, a 300-employee manufacturer of mass transit buses, came

to Lamar in 1981. Other Lamar manufacturers are Altech (wiring harnesses), Ranch Manufacturing (belly-dump loaders) and WHO (tub grinders). La Junta has attracted two relocating industries employing 150 persons: Lewis Bolt and Nut; and DeBourgh (a steel locker manufacturer) which arrived in 1988, occupying the brass pipe fittings factory abandoned by NIBCO, which closed in 1987 eliminating 325 jobs.

Nevertheless, total manufacturing jobs in the study area have declined from 1704 in 1980 to 1458 in 1991. This drop is likely to have occurred because of a reduction in food processing employment rather than in durable goods manufacture, but the data from the Colorado Department of Labor and Employment do not distinguish between these for the counties in the study area.

Wholesale trade. Although the study area is the service center for a large region, extending some 90 miles north of the Arkansas River, east into Western Kansas and south into northern Oklahoma, it has been declining in wholesale trade, i.e., sales to other licensed dealers for the purpose of resale. This may be due to the overall population decline, to the relocation of wholesale suppliers from the study area, and possibly due to the competition from Pueblo and Colorado Springs.

Table 4.10 shows the dollar amount of wholesale sales, by county, from 1982 to 1992 (Colorado Department of Revenue 1983-1993). Figure 4.4 illustrates the percentages of wholesale sales by county. Table 4.11 and Figure 4.5 show these sales in constant (1982-1984 average) dollars. Sales declined more than 50 percent in real (constant) dollars during the 1982-1992 period. Curiously, however, the total study area employment of persons engaged in wholesale trade has remained relatively constant, from 747 in 1980 to 760 in 1990. (Source: Colorado Department of Labor and Employment). A remarkable increase in wholesale sales occurred in Otero County during the last half of 1992, which a Department of Revenue statistician attributed to wholesale gasoline sales outside Colorado. Crop production is not included in wholesale trade. Crop data is presented separately on page 4-16.

Table 4.10 Study Area Wholesale Sales by County

YEAR	BENT	CROWLEY	KIOWA	OTERO	PROWERS	5 - COUNTY TOTAL
1982	$2,198,560	$558,521	$2,060,620	$60,675,925	$25,336,235	***$90,829,861***
1983	2,163,163	521,339	2,716,285	57,739,702	29,788,624	***92,929,113***
1984	1,166,372	456,857	2,618,800	31,296,179	39,171,714	***74,709,922***
1985	2,833,923	604,938	3,616,523	59,478,900	36,619,346	***103,153,630***
1986	1,955,110	327,781	2,401,286	61,028,478	28,304,129	***94,016,784***
1987	1,755,400	802,255	1,372,025	53,655,935	49,469,750	***107,055,365***
1988	2,442,236	836,049	4,190,478	56,632,907	44,520,719	***108,622,389***
1989	2,495,556	724,434	2,624,769	31,626,257	39,898,489	***77,369,505***
1990	2,015,858	667,205	1,626,654	26,601,336	40,150,268	***71,061,321***
1991	1,603,373	481,243	2,229,506	23,095,917	27,387,210	***54,797,249***
1992	1,441,069	540,746	1,018,220	80,637,548	43,985,890	***127,623,473***

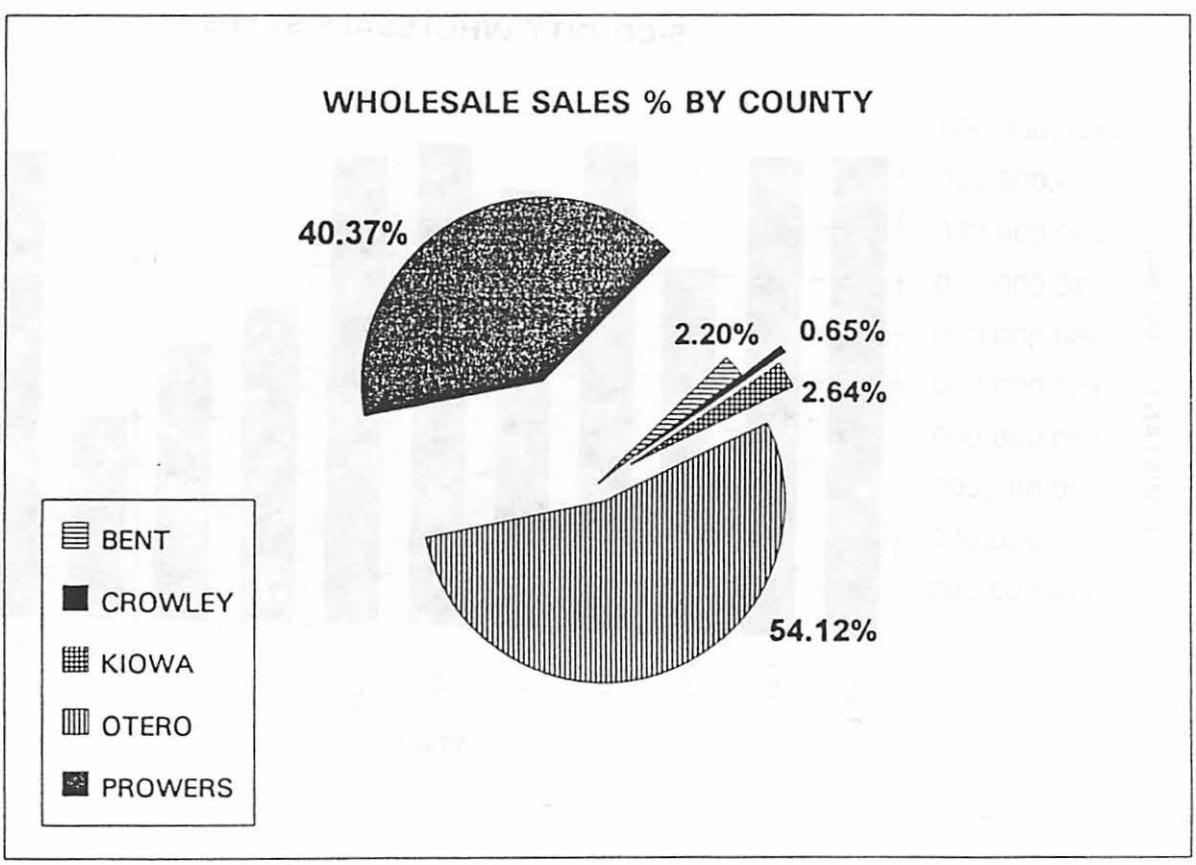


Figure 4.4. Percentage of Wholesale Sales by County, 1992

Table 4.11 Five-County Wholesale Sales in Constant Dollars

YEAR	CPI-U, ALL ITEMS U.S. ANNUAL AVERAGE (1982-84 = 100)	DEFLATION FACTOR 100 ÷ CPI - U	5 - COUNTY WHOLESALE SALES (CURRENT $)	5 - COUNTY WHOLESALE SALES (1982 - 84 AVG. $)
1982	96.5	1.036	$90,829,861	***$94,124,208***
1983	99.6	1.004	92,929,113	***93,302,322***
1984	103.9	0.962	74,709,922	***71,905,603***
1985	107.6	0.929	103,153,630	***95,867,686***
1986	109.6	0.912	94,016,784	***85,781,737***
1987	113.6	0.880	107,055,365	***94,238,878***
1988	118.3	0.845	108,622,389	***91,819,433***
1989	124.0	0.806	77,369,505	***62,394,762***
1990	130.7	0.765	71,061,321	***54,369,794***
1991	136.2	0.734	54,797,249	***40,232,929***
1992	140.3	0.713	127,623,473	***90,964,699***

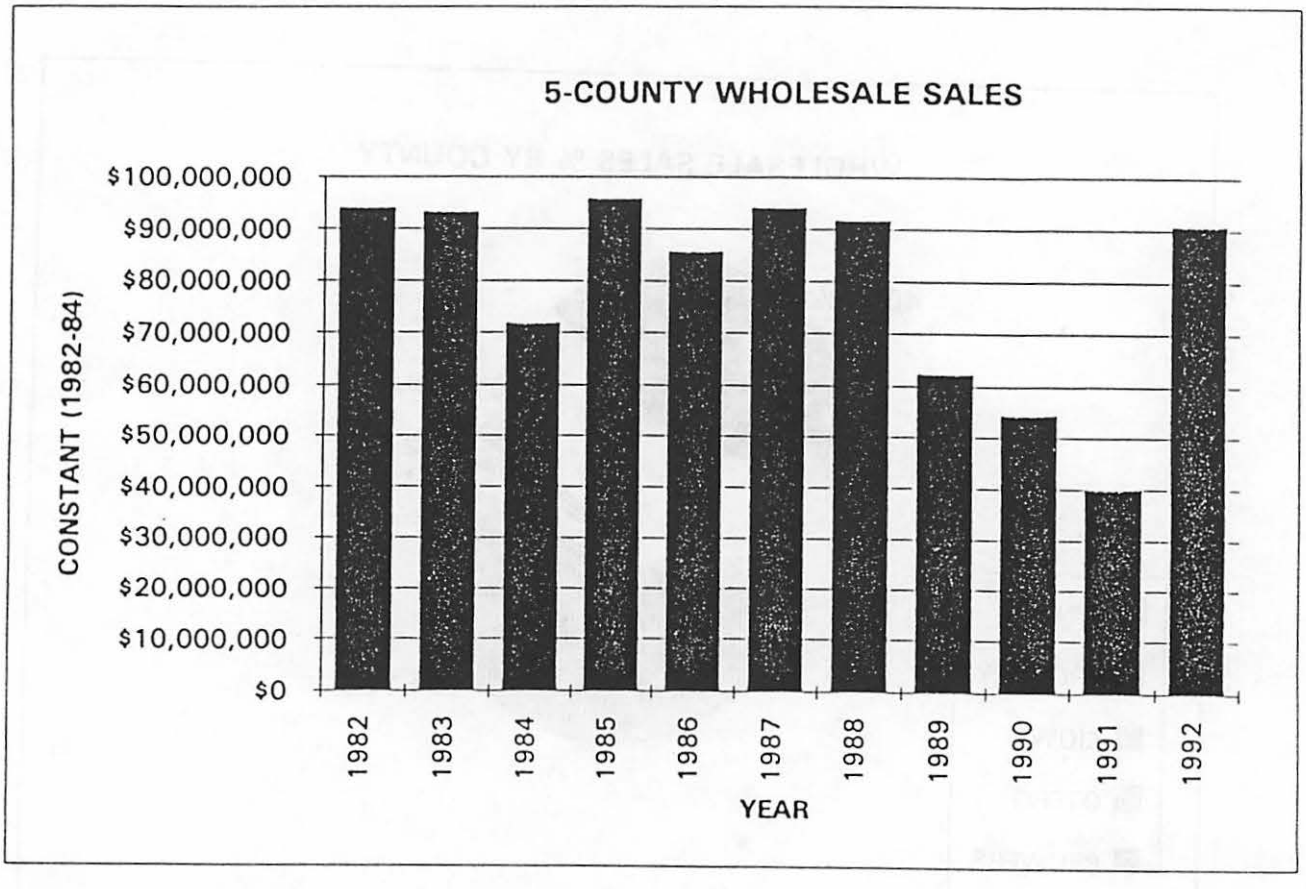


Figure 4.5. Five-County Wholesale Sales in Constant Dollars

Retail trade. The study area's retail sales have fluctuated in the past eleven years and have dropped since the early 1980s, but have remained essentially the same in real (constant) dollars since 1988. Table 4.12 and Figure 4.6 show the retail sales by county from 1982 to 1992. Table 4.13 and Figure 4.7 show the sales in constant (1982-1984 average) dollars. (The unusual jump in Prowers County's 1983 sales is a statistical anomaly, attributed to Neoplan bus sales outside Colorado.) (Colorado Department of Revenue 1983-1993)

Table 4.12 Study Area Retail Sales by County

YEAR	BENT	CROWLEY	KIOWA	OTERO	PROWERS	5 - COUNTY TOTAL
1982	$22,257,281	$10,942,961	$9,037,779	$141,002,010	$168,353,122	***$351,593,153***
1983	21,604,485	8,362,552	10,337,939	155,728,376	460,893,219	***656,926,571***
1984	20,868,485	8,809,197	9,756,947	153,920,232	263,750,788	***457,105,649***
1985	20,468,228	9,104,747	9,285,724	169,070,688	251,092,890	***459,022,277***
1986	17,350,564	8,443,112	9,305,862	173,972,888	215,817,279	***424,889,705***
1987	17,440,327	9,838,218	9,019,631	172,761,644	227,707,032	***436,766,852***
1988	21,174,281	12,832,474	9,094,978	169,579,993	165,254,912	***377,936,638***
1989	21,285,173	15,100,461	9,736,248	174,094,526	170,158,021	***390,374,429***
1990	19,421,038	12,364,183	11,269,960	194,856,094	199,900,758	***437,812,033***
1991	19,671,992	12,516,265	9,237,999	224,095,270	183,926,411	***449,447,937***
1992	19,260,621	14,650,510	9,939,734	241,949,448	207,011,347	***492,811,660***

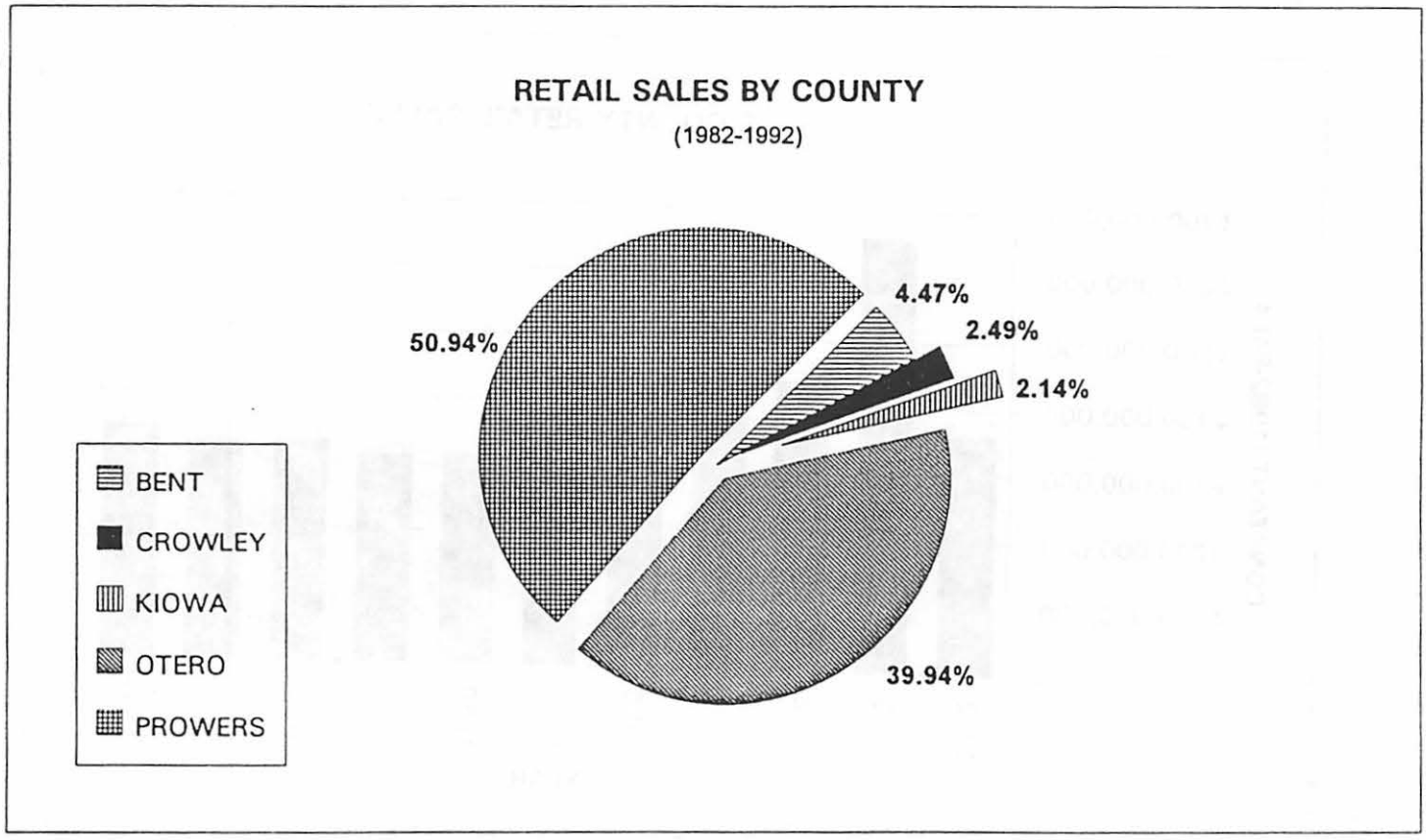


Figure 4.6. Percentage of Retail Sales by County, 1992

Table 4.13 Five-County Retail Sales in Constant Dollars

YEAR	CPI-U, ALL ITEMS U.S. ANNUAL AVERAGE (1982-84 = 100)	DEFLATION FACTOR 100 + CPI - U	5 - COUNTY RETAIL SALES (CURRENT $)	5 - COUNTY RETAIL SALES (1982 - 84 AVG. $)
1982	96.5	1.036	$351,593,153	***$364,345,236***
1983	99.6	1.004	656,926,571	***659,564,830***
1984	103.9	0.962	457,105,649	***439,947,689***
1985	107.6	0.929	459,022,277	***426,600,629***
1986	109.6	0.912	424,889,705	***387,673,089***
1987	113.6	0.880	436,766,852	***384,477,863***
1988	118.3	0.845	377,936,638	***319,473,067***
1989	124.0	0.806	390,374,429	***314,818,088***
1990	130.7	0.765	437,812,033	***334,974,777***
1991	136.2	0.734	449,447,937	***329,991,143***
1992	140.3	0.713	492,811,660	***351,255,637***

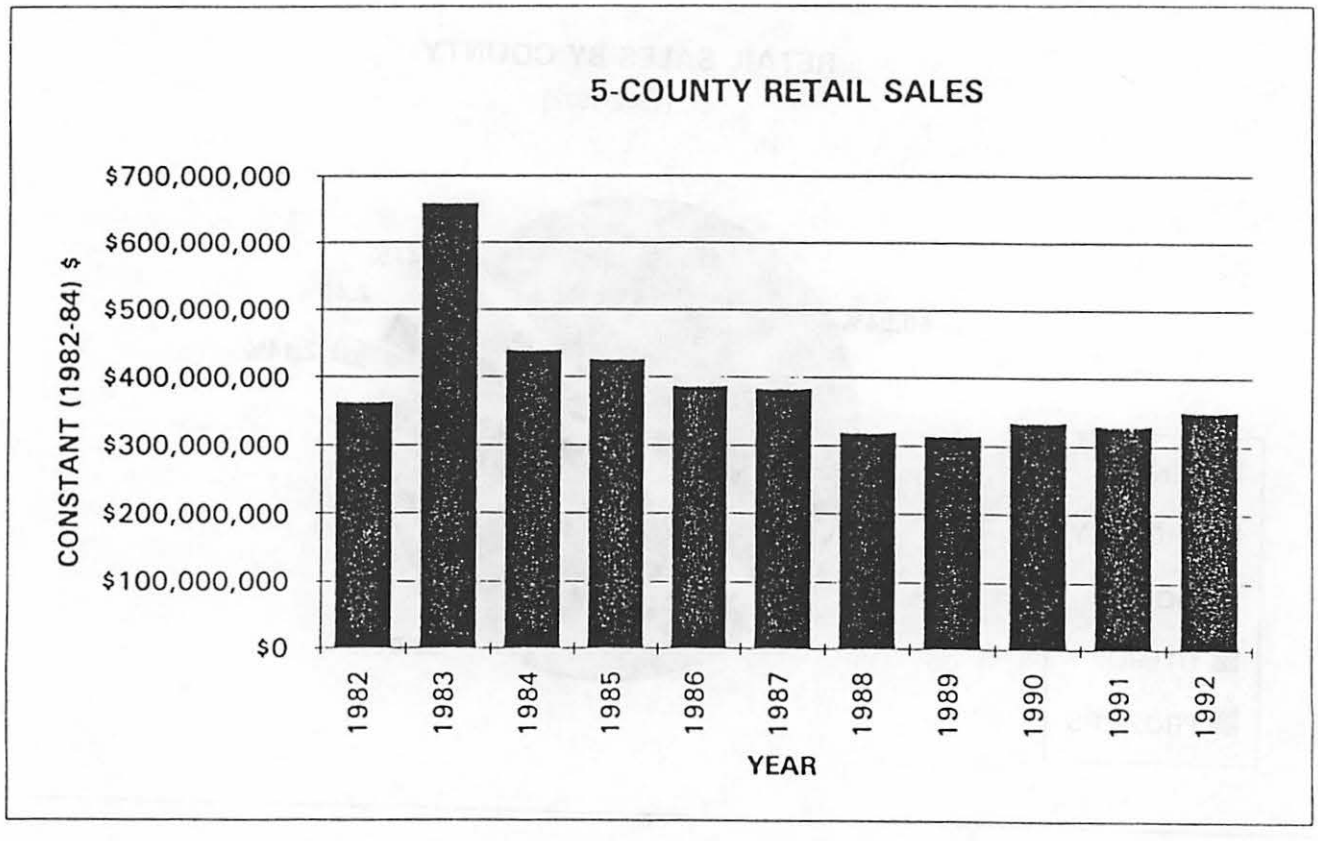


Figure 4.7. Five-County Retail Sales in Constant Dollars

Employment in retail trade in the five counties has remained steady, from 2,537 in 1980 to 2,509 in 1991, according to the Colorado Department of Labor and Employment. Approximately one-third of retail trade employment is in eating and drinking places.

With a declining population, retail trade is competitive and dynamic. La Junta successfully attracted a WalMart store which serves much of the study area, and WalMart's entrance caused some smaller stores in La Junta and Rocky Ford to close or relocate. Yet, after WalMart's arrival, La Junta's Gibson's and Safeway both remodeled and expanded to remain competitive. Retail trade in Otero and Crowley Counties has grown in the past decade while Bent and Prowers show declines.

Recreation and Tourism. The five-county study area has some recreational attractions in hunting, fishing and boating, notably in John Martin Reservoir. See Appendix 4.4 for details of these attractions. No state park exists in the area. Current tourism is predominantly based on persons from southern Colorado who seek outdoor recreation, plus tourists passing through on Highway 50, to or from Colorado's other attractions.

Service Industries. The study area has a well-developed service sector and has successfully sought to increase services as a spur to economic development. The Santa Fe Railroad has long been a major influence in the study area, and remains a major asset despite extensive employee layoffs.

Health care plays an important role in the study area's economy. The Ft. Lyon Veterans' Hospital serves veterans within and beyond the study area and is a stimulus to the Bent County economy. Other health facilities include:

Arkansas Valley Regional Medical Center (and Nursing Care Center), La Junta
Fowler Health Care Center, Fowler
Fowler Manor, Fowler
Pioneer Health Care Center, Rocky Ford
Bent County Memorial Nursing Home, Las Animas
Crowley County Nursing Center, Ordway
Prowers County Medical Center, Lamar
Sandhaven Nursing Home, Lamar

Not only does this health care network serve the residents of the area and its extended service region (including a sizeable senior population) but it also is considered a tool of economic development in attracting new residents seeking an attractive, secure and lower-cost retirement community.

The "FIRE" (finance, insurance, real estate) sector also has continued to play an important role in the study area. There are 20 banks, including three branches of banks in neighboring counties, in the five-county area as well as Farm Credit Services in La Junta, financing farmers, ranchers, residential and business customers. Lenders lent too much money during the 1970s and early 1980s, which led to numerous foreclosures during the 1986-89 period. Now, lenders are more cautious. Farming requires a heavy financial investment and it is difficult for new persons to obtain the capital to enter farming.

Government. Fully one-third of all "covered" employment in the study area is in the government sector. ("Covered" employment does not include self-employment, such as family farmers and ranchers, who do not pay unemployment insurance premiums. Only covered employment is reported by the Colorado Department of Labor and Employment.) Moreover, government employment is by far the highest paid, averaging $20,015 annually compared with $14,056 for private sector jobs in 1991. Most

government employees in the study area (2,822 in 1991) work for local governments such as schools, counties and towns. Another 875 persons work for the federal government and 890 work for Colorado state government. Federal and state employees are highest paid of all (see Table 4.16 on pages 4-33 to 4-34).

The Veterans' Hospital at Fort Lyon is the largest federal employer in the study area and is a valued amenity for veterans in the region, as well as a stable source of professional employment in the study area. The 1987 creation of a state prison in Crowley County has helped significantly to sustain Crowley's economic health, following a severe drop in irrigated agriculture. The Crowley County labor force, i.e., total employed (and unemployed) persons living in Crowley County, grew about 45 percent after the 1987 prison construction. However, many prison employees live outside the county, in Rocky Ford or Pueblo, and contribute little to Crowley's economy.

The Bent County Commissioners have sponsored construction of a private prison in Las Animas which is nearly complete and is currently recruiting staff, primarily from the study area. There also is talk of creating a community corrections center in La Junta, but no definite plans have been prepared and there is an evident lack of enthusiasm for prisons among La Junta residents.

Economic Development Activities. Four of the five study area counties (Bent, Crowley, Otero and Prowers) have an economic development office, and Lamar has two good community development organizations. The city governments also are active in attempting to attract new business and industry, with some success (see Manufacturing, page 4-19 above). Yet the study area economy is rather fragile and is subject to severe shocks when a major employer closes (e.g., the sugar factory, NIBCO) or lays off workers (e.g., the Santa Fe Railroad).

The Chambers of Commerce in the study area are supportive of the county and city efforts to attract new businesses but, as in the case of the La Junta Chamber, concentrate primarily on keeping existing businesses active and viable. This is an important role, and also one that avoids conflict, because some new businesses that are sought by cities, e.g., WalMart, are serious competitors of existing businesses and Chamber members. It is difficult for businesses to survive in a declining population. Some years ago, Las Animas supported a Ford, a General Motors and a Chrysler dealer. No franchised automobile dealers now remain.

Labor Force and Employment Trends

Size and occupational diversity of labor force. The Colorado Department of Labor and Employment calculates that the five-county study area had an average of 13,639 persons employed in "covered" jobs during 1991, including about 600 in agriculture. Because "covered" jobs exclude most self-employed, notably in family-owned farms and ranches, the State's figures undercount true employment. The U.S. Census of Agriculture for 1987 shows agricultural employment, i.e., farm operators, in the study area to be 1,808. Thus true total employment is approximately 15,500 or more, depending on how many family members are actively employed in farming and ranching.

Tables A4.9 to A4.14 (in Appendix 4.3) show the covered employment in Colorado, as well as in each of the five counties, sub-divided by sector, for 1991 (Source: Colorado Department of Labor and Employment, Labor Market Information Section). Several of the sectors are marked "D", indicating that disclosure is suppressed to avoid revealing wage data, since the number of employees in those

sectors is quite small. The larger counties, Otero and Prowers, have a substantial diversity of employment except for mining (limited to a small amount of oil and gas extraction) and manufacturing which is limited to certain subsectors. Bent, Crowley and Kiowa counties have a simpler, less diversified economy dominated by agriculture and government, with some food processing, retail trade and services.

Unemployment. Table 4.14 shows the size of labor force (again excluding self-employed persons), unemployment and unemployment rate, by county, from 1980 to 1992. Otero and Prowers counties have the highest unemployment rates and Kiowa has the lowest. Bent, Otero and Prowers, the three largest counties having the greatest degree of employment diversification, all show a drop in labor force over the past 12 years. This probably mirrors a loss in population. Kiowa's labor force fluctuates but shows no trend of growth or decline. Crowley County shows employment growth since 1987, reflecting the impact of the state prison.

Table 4.15 and Figure 4.8 compare the unemployment rates of the five-county study area with that of Colorado. The study area unemployment rate is about one percentage point greater than the State's over the past 13 years.

Seasonality of Employment. The study area experiences a seasonal variation in employment and in the size of its labor force. The labor force varies by about 10 percent from its low in December to its peak in June. The unemployment rate is highest in March (8.2 percent) and lowest in September (4.2 percent) based on averages for 1991 and 1992 (Colorado Department of Labor and Employment, Colorado Labor Force Developments, January 1991 to December 1992).

Figure 4.9 shows the 1991-92 average unemployment rate in the study area, by month. Unemployment grows gradually in the late fall and winter when agricultural and food processing employment is low and peaks in March. In April, some agricultural jobs open, as does construction and some other employment. Unemployment rises again in May as youth leave school to search for work. Throughout June, July and August, there are many more jobs in agriculture and food processing. Although the size of the labor force is highest during these summer months, unemployment is lower. In September, after youth return to school, the number of unemployed is at its low point. Agriculture and food processing slow after September and the unemployment rises monthly to its March peak,

On-farm employment remains relatively strong through the planting, growing and harvesting seasons. Although farm families also have work to do in the winter, some family members may seek outside employment during the winter months. Ranching and cattle feeding employment is relatively steady year-round.

Food processing jobs are quite seasonal. In past years, migrant workers entered the local labor force when jobs opened in the late spring and moved away (south) after the canning and packing season ended. More recently, many of the former migrants remain in the area all year, relying on unemployment compensation and welfare payments when off-season jobs cannot be found.

Table 4.14 Study Area County Labor Force, Unemployment and Unemployment Rate, 1980-1992 (1992 data are preliminary and unpublished)

UNEMPLOYMENT (ANNUAL AVERAGE)

	BENT			CROWLEY			KIOWA		
YEAR	TOTAL LABOR FORCE	TOTAL UNEMPLOYMENT	% UNEMPLOYMENT	TOTAL LABOR FORCE	TOTAL UNEMPLOYMENT	% UNEMPLOYMENT	TOTAL LABOR FORCE	TOTAL UNEMPLOYMENT	% UNEMPLOYMENT
1980	2,429	89	3.7	1,107	55	5.0	795	13	1.6
1981	2,402	100	4.2	1,116	62	5.6	782	19	2.4
1982	2,290	122	5.3	1,095	93	8.5	784	37	4.7
1983	2,384	96	4.0	1,205	104	8.6	1,015	18	1.8
1984	2,461	107	4.3	1,169	69	5.9	1,029	17	1.7
1985	2,365	128	5.4	1,142	71	6.2	1,011	23	2.3
1986	2,193	119	5.4	1,086	112	10.3	965	29	3.0
1987	2,271	140	6.2	1,292	96	7.4	1,008	51	5.1
1988	2,249	143	6.4	1,583	97	6.1	984	36	3.7
1989	2,007	100	5.0	1,551	89	5.7	900	43	4.8
1990	2,070	95	4.6	1,648	62	3.8	925	22	2.4
1991	2,019	100	5.0	1,573	70	4.5	855	33	3.9
1992	1,926	81	4.2	1,555	68	4.4	829	38	4.6

	OTERO			PROWERS			5-COUNTY TOTAL		
YEAR	TOTAL LABOR FORCE	TOTAL UNEMPLOYMENT	% UNEMPLOYMENT	TOTAL LABOR FORCE	TOTAL UNEMPLOYMENT	% UNEMPLOYMENT	TOTAL LABOR FORCE	TOTAL UNEMPLOYMENT	% UNEMPLOYMENT
1980	10,189	817	8.0	6,749	364	5.4	*21,269*	*1338*	*6.3*
1981	9,858	771	7.8	6,851	432	6.3	*21,009*	*1384*	*6.6*
1982	9,750	1080	11.1	7,133	557	7.8	*21,052*	*1889*	*9.0*
1983	9,113	826	9.1	7,022	470	6.7	*20,739*	*1514*	*7.3*
1984	9,118	714	7.8	6,848	422	6.2	*20,625*	*1329*	*6.4*
1985	9,048	658	7.3	6,876	406	5.9	*20,442*	*1286*	*6.3*
1986	8,819	871	9.9	6,530	517	7.9	*19,593*	*1648*	*8.4*
1987	8,709	995	11.4	6,618	455	6.9	*19,898*	*1737*	*8.7*
1988	8,608	785	9.1	6,516	551	8.5	*19,940*	*1612*	*8.1*
1989	8,153	709	8.7	6,063	423	7.0	*18,674*	*1364*	*7.3*
1990	8,445	634	7.5	6,047	328	5.4	*19,135*	*1141*	*6.0*
1991	8,296	564	6.8	5,739	327	5.7	*18,482*	*1094*	*5.9*
1992	8,282	638	7.7	5,669	331	5.8	*18,261*	*1156*	*6.3*

Source: Colorado Department of Labor and Employment, Labor Market Information Section, Colorado Labor Force Review, Data Supplement 1992 and earlier years

Table 4.15 Comparison of Unemployment Rates, Five-County Study Area vs. Colorado

UNEMPLOYMENT RATE (ANNUAL AVERAGE)		
YEAR	5-COUNTY AREA (BENT,CROWLEY,KIOWA, OTERO,PROWERS) %	COLORADO
1980	6.3	5.9
1981	6.6	5.5
1982	9.0	7.7
1983	7.3	6.7
1984	6.4	5.6
1985	6.3	5.9
1986	8.4	7.4
1987	8.7	7.7
1988	8.1	6.4
1989	7.3	5.8
1990	6.0	4.9
1991	5.9	5.0
1992	6.3	5.8

Source: Colorado Department of Labor and Employment

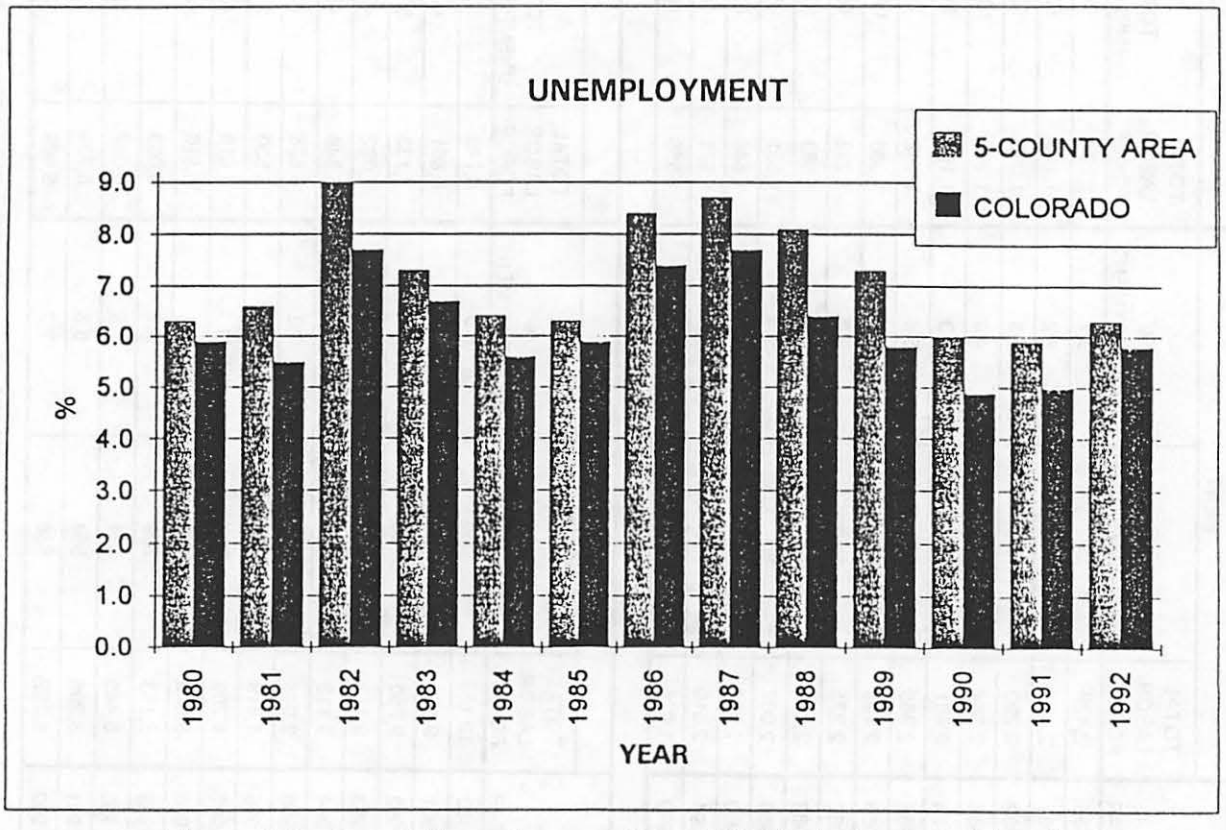


Figure 4.8. Annual Unemployment Rates (%), Study Area vs. Colorado

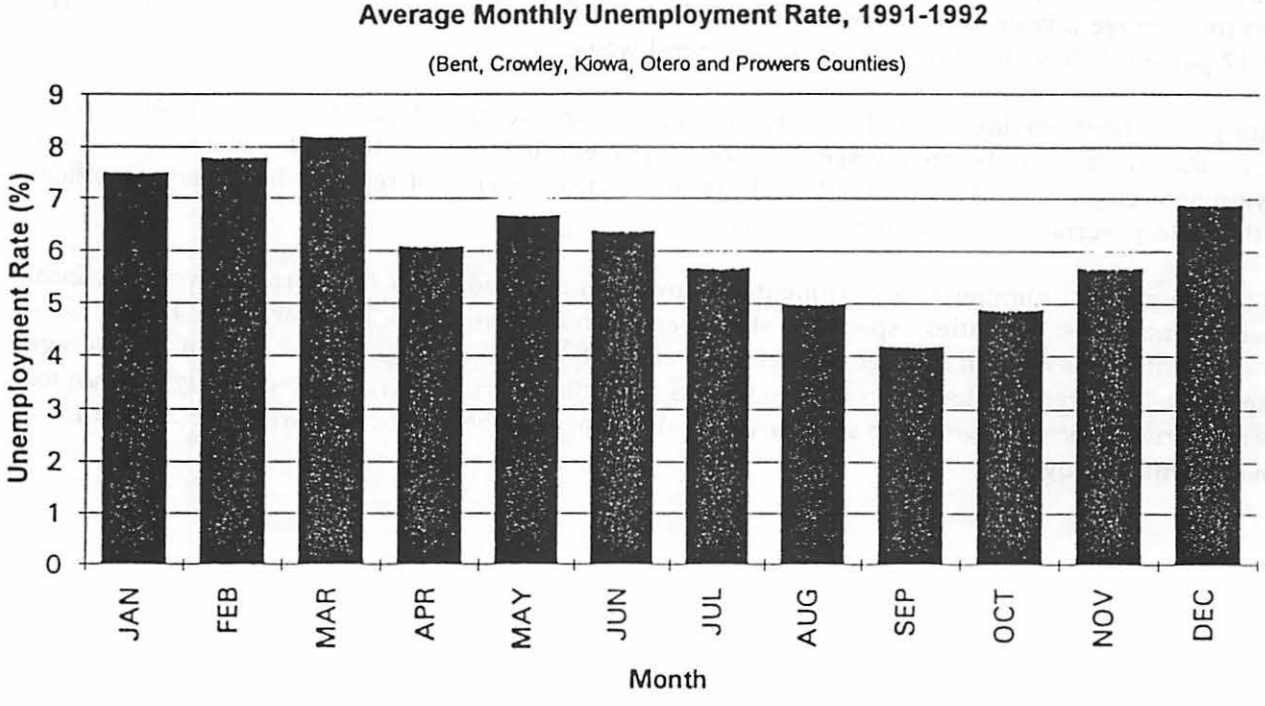


Figure 4.9. Average Monthly Unemployment Rate in Study Area, 1991-1992

Average annual wage. Table 4.16 shows the average annual wage for 1991, by county and by major economic sector. The Table also shows the average annual wage for 1991 for the entire state, by major economic sector. For all industries, i.e., employment in all economic sectors, the study area had a 1991 average wage of $16,060, only two-thirds as great as the statewide average of $23,979. As mentioned earlier, employment and wage data are for covered employment only and omit most self-employed persons.

In the private sector, study area workers fall even farther below the statewide average in wages, earning an average of only $14,056 in 1991, or 59.6 percent of the Colorado average private sector wage of $23,606.

In the government sector, where one-third of the study area covered employment occurs, the average annual wage for 1991 was substantially (42 percent) higher than the average private sector wage and also closer to the statewide average government wage: $20,015 compared with a statewide average of $25,701.

Within the government sector, significant differences exist. The highest average annual wage for the study area in 1991 is paid to federal government workers who averaged $26,711, or 90 percent greater than the average private sector wage. Nevertheless, the federal government wage in the study area fell 17 percent below the statewide average federal wage.

State government employees in the study area earned an average of $23,377 in 1991, 46 percent above the average study area wage but still 7 percent below the statewide average for state government employees. This evidently reflects the relative absence of regional headquarters offices of the state government within the study area.

By far the greatest number of government employees in the study area (62 percent) work for local government: cities, counties, special districts and school districts. They are the lowest paid government sector with an average annual wage of $16,879 in 1991, slightly higher than the average wage for all covered employees in the study area. Although this wage is 20 percent higher than the average private sector wage in the study area, it falls 28 percent below the statewide average for local government employees.

Table 4.16 Average Annual Wage 1991, By County and Major Economic Sector

ALL INDUSTRIES	AVERAGE ANNUAL EMPLOYMENT	WAGES PAID	AVERAGE ANNUAL WAGE
BENT	1,348	$27,637,418	$20,503
CROWLEY	768	15,535,973	20,229
KIOWA	411	5,810,119	14,137
OTERO	6,578	97,860,224	14,877
PROWERS	4,534	72,201,899	15,925
5-COUNTY TOTAL	13,639	$219,045,633	$16,060

Average In Colorado = $23,979

PRIVATE SECTOR	AVERAGE ANNUAL EMPLOYMENT	WAGES PAID	AVERAGE ANNUAL WAGE
BENT	317	$4,145,901	$13,079
CROWLEY	290	3,560,938	12,279
KIOWA	186	2,460,259	13,227
OTERO	5,006	68,582,074	13,700
PROWERS	3,253	48,485,392	14,905
5-COUNTY TOTAL	9,052	$127,234,564	$14,905

Average in Colorado = $23,606

GOVERNMENT	AVERAGE ANNUAL EMPLOYMENT	WAGES PAID	AVERAGE ANNUAL WAGE
BENT	1,031	$23,491,517	$22,785
CROWLEY	478	11,975,035	25,052
KIOWA	225	3,349,860	14,888
OTERO	1,572	29,278,150	18,625
PROWERS	1,281	23,716,507	18,514
5-COUNTY TOTAL	4,587	$91,811,069	$20,015

Average in Colorado = $25,701

Source: Colorado Department of Labor and Employment

Table Continues

Table 4.16 (Continued) Average Annual Wage 1991, By County and Major Economic Sector

STATE GOVERNMENT	AVERAGE ANNUAL EMPLOYMENT	WAGES PAID	AVERAGE ANNUAL WAGE
BENT	16	$425,216	$26,576
CROWLEY	306	9,390,768	30,689
KIOWA	5	154,574	30,915
OTERO	291	5,714,003	19,636
PROWERS	272	5,120,942	18,827
5-COUNTY TOTAL	890	$20,805,503	$23,377

Average In Colorado = $25,046

LOCAL GOVERNMENT	AVERAGE ANNUAL EMPLOYMENT	WAGES PAID	AVERAGE ANNUAL WAGE
BENT	353	$5,004,583	$14,177
CROWLEY	156	2,218,359	14,220
KIOWA	200	2,823,075	14,115
OTERO	1,160	20,306,174	17,505
PROWERS	953	17,281,190	18,133
5-COUNTY TOTAL	2,822	$47,633,381	$16,879

Average in Colorado = $23,562

FEDERAL GOVERNMENT	AVERAGE ANNUAL EMPLOYMENT	WAGES PAID	AVERAGE ANNUAL WAGE
BENT	662*	$18,061,718	$27,284
CROWLEY	16	365,908	22,869
KIOWA	20	372,211	18,611
OTERO	121	3,257,973	26,925
PROWERS	56	1,314,375	23,421
5-COUNTY TOTAL	875	$23,372,185	$26,711

Average in Colorado = $32,196

**Primarily Fort Lyon VA Hospital*

Source: Colorado Department of Labor and Employment

Public Sector Finance.

Local governments in the study area, counties, towns, school districts and other special districts (fire, library, water conservancy, drainage, cemetery, sanitation) are supported by property taxes. Four counties and 10 cities also levy sales taxes. In the case of La Junta, the sales tax is the primary source of funding; the property tax is a negligible 2 mills (interviews with La Junta officials). Sales tax rates are:

Bent County	1%	Otero County	1%
Las Animas	2%	La Junta	3%
		Rocky Ford	3%
Crowley County	2 %	Manzanola	2%
		Fowler	2%
Ordway	2%		
		Prowers County	1 %
Kiowa County	None		
		Lamar	3%
Eads	5%	Holly	1%
		Granada	2%

The study area experiences a decline in population. Even so, local governments have fixed costs and need a reasonably steady income to provide services and keep pace with inflation. Property tax revenues, the primary or sole support of most local governments, are threatened by a decline in property assessments. Of great concern is the lowering of assessments on irrigated agricultural lands when water rights are sold, particularly when transferred outside the study area. When this occurs, there is likely to be a subsequent drop in assessments of properties that depend upon agriculture, e.g., food processing, or which provide services to agriculture.

As population declines, and farm income declines, retail sales inevitably suffer. Sales tax revenues fall in direct proportion to retail sales, unless the jurisdiction can obtain local support to raise the amount of the sales tax levy.

With the 1992 passage of Constitutional Amendment 1, local governments face a stern challenge. Except by a special election, governments can no longer: (a) stabilize property tax revenues by increasing mill levies to compensate for declining assessed valuations; (b) increase mill levies to compensate for losses in tax revenues caused by increase in refunds and abatements made to certain taxpayers; or (c) spend increased revenues from sales or property taxes, if they exceed the formula based on Denver's inflation rate and the rate of local growth. These constraints are particularly onerous on local government officials in an area of shrinking population and economic decline.

Sales tax revenue. Retail sales in the five-county area have been declining in real dollars, as shown in Table 4.13 and Figure 4.7, above Thus in the study area as a whole, sales tax revenues are declining in purchasing power. La Junta is an exception to this decline, probably because of its recent annexation of WalMart and Gibson's. La Junta's 3 percent sales tax revenues have grown as follows since 1988, prior to WalMart and Gibson's (figures are rounded).

1988	$1,400,000
1990	1,938,000

1991 1,947,000
1992 2,025,000 (estimated)

Although La Junta's sales tax revenues are growing slightly, they do not exceed the rate of inflation since 1990. Even so, the overall decline in retail sales means that other local governments in the study area are facing a greater erosion of sales tax revenues.

Property tax valuations. The assessed valuations of property in the five counties of the study area show fluctuations, but except for Otero County reflect an overall decline.

In Bent County, the assessed valuation on irrigated land has grown from $5,612,300 in 1989 to $6,111,830 in 1992, yet the total county valuation has dropped from $29,482,500 in 1989 to $28,722,370 in 1992. When inflation is considered, the jurisdictions that depend on property taxes have lost ground (Bent County Abstract of Assessment and Levies of Taxes 1989-1992).

In Crowley County, the assessed valuation on irrigated land has dropped from $2,064,080 (1975) to $1,300,880 (1978) to $1,244,960 (1982), then rose to $2,363,850 (1985). It dropped steadily to $1,125,390 (1990) and rose to $1,455,230 in 1991. However, the overall trend is a decline over the past 16 years. The total county property valuation has grown from $10,536,080 in 1975 to $14,984,770 in 1991, an increase of 42.2 percent (Crowley County Abstract of Assessment 1975-1991). Meanwhile, the U.S. Consumer Price Index (CPI-U) increased by 153.2 percent between 1975 and 1991 (U.S. Bureau of Labor Statistics 1992). The various taxing entities in the county appear to have raised their mill levies slightly over the past 16 years, but their property tax revenues have increased by much less than the rate of inflation, implying that they have economized. The school districts, however, have benefitted from equalization funding from the State of Colorado, under the School Finance Act. It should be noted that State school funding is to be substantially less in 1993 because of Amendment 1 and other funding demands. Eight school districts in Otero, Crowley and Bent Counties are expected to lose $1.9 million, or 6.9 percent of their 1993 state school aid (Amos 1993).

In Kiowa County, the assessed valuation of irrigated land dropped from $328,490 in 1984 to $228,620 in 1992. Dry farm land, which is far more common, dropped from $10,531,210 in 1984 to $8,994,090 in 1992. The total county valuation remained reasonably stable in current dollars: $34,775,210 in 1984 to $33,574,420 in 1992 (Kiowa County Abstract of Assessment 1984-1992). However, this 3.5 percent drop in assessed valuation occurred during a period when inflation (CPI-U) grew by 35.0 percent (U.S. Bureau of Labor Statistics 1992; BLS 1993).

Otero County's assessed valuation for irrigated agricultural land grew from $4,999,400 in 1981 to $6,300,940 in 1986 but declined to $6,050,570 in 1989. Later assessments (1989-91) do not report the value of irrigated land. The assessed valuation of all agricultural land grew from $7,341,930 in 1987 to $9,652,560 in 1991. (Otero County Abstract of Assessment 1981, 1986, 1987, 1989-1991).

In Prowers County, the assessed valuation of irrigated land fluctuated from $12,648,940 in 1989 to $11,953,050 in 1990 to $12,271,050 in 1991 to $12,[illegible] in 1992, although the 1992 acreage is 1.2 percent greater than in 1989 (Prowers County Abstract of Assessment 1989-92).

Basic economic activity and multiplier effect. The five county study area is considered as an economic unit, separate from the rest of Colorado and the nation, for purposes of this analysis. The unit includes basic employment such as the growing of agricultural crops and livestock, the production of manufactured goods, and wages paid to local employees by businesses primarily located outside the

study area, such as railroads. It also includes secondary employment dependent on the basic employment. Examples are cattle feeding, processing of food crops (such as canning and packing), and agribusiness (sale of seed, herbicides and fertilizer, tractors, etc.). A service sector also exists, which includes wholesale and retail businesses, bankers, physicians, lawyers, local government and schools, etc. The economic unit also makes transfer payments outside the study area, such as state and federal taxes, donations to national charities, etc., and in return receives transfer payments: federal and state payments for social security, welfare (unemployment benefits, aid to families with dependent children, food stamps, etc.), and wages paid to federal and state employees living within the study area. (Whether the study area pays more or receives more in transfer payments is unknown, and beyond the scope of this study.)

The economic health and growth of the study area depend on the size of the area's economic multiplier. In simplest terms, the multiplier represents the number of rounds or turns of spending within the study area itself, before the money is spent outside the area. For example, if a farmer spends his entire income on purchases outside the study area, and in income tax payments, his multiplier would be 1.0. A rancher who spends 25 percent of his income on income taxes but spends the balance on purchases of goods and services within the study area would have a multiplier of 1.75. In turn, the wholesale and retail businesses in the study area might spend half of their receipts on local wages and local property taxes but spend the other half in buying supplies from outside the study area. These businesses would have a multiplier of 1.5. Each round of spending, from the basic employee to each of the successive sellers, is aggregated and a composite economic multiplier for the study area economic unit is compiled. The larger and more self-sufficient the economic unit is, the greater the multiplier. Thus the State of Colorado would have a relatively large multiplier, the Denver metropolitan area also would have a large multiplier, but a small county probably would have a multiplier in the range of 1.5 to 2.1.

In economic theory, the determination of a multiplier requires an economic base study of the economic unit. That is, the "input and output" of representative firms is determined from financial records, i.e., whom they buy from and whom they sell to, and which of these are within the economic unit being analyzed. No such economic base study is known to exist for the five-county study area.

Conducting an economic base study and developing an economic model of the five-county study area are clearly out of the scope of our present research. Therefore, four existing studies that deal with economic impacts in the study area were reviewed for guidance. None of the four covers the same five counties as our study, and their economic models are not directly applicable to our analysis. Further, the publications describing the results of their economic models do not contain details of their economic assumptions, such as the magnitude of economic multipliers. Three of the studies (Howe, Lazo and Weber 1990, Taylor and Young 1991, and Nielsen 1986) will be discussed in Chapter 6 of this report as they relate to the economic impacts of potential future water transfers.

Frick and Steicher (1990a) developed for the Colorado Division of Wildlife a complex and detailed economic model in which economic multipliers were estimated for each of Colorado's counties. These were as follows for the study area counties:

Bent County	1.76
Crowley County	2.03
Kiowa County	1.70
Otero County	2.25
Prowers County	2.07

The five-county study area would have a higher multiplier than any of its counties, because of the inter-county spending within the study areas, e.g., a resident of Bent County shopping in La Junta. We estimate the multiplier for the five-county study area to be 2.6. This means that the average dollar of basic spending is respent 1.6 times before the money completely "leaks" from the area to firms and tax agencies outside the economic unit. The multiplier is applied in Chapter 6.

Summary of Present Economic Profile

The five-county study area's economic profile is that of a traditional farm and ranch economy largely based on irrigated agriculture, cattle feeding and related businesses such as vegetable canning, alfalfa feed mills, and melon packing. The economy is heavily dependent on crop and livestock prices. It maintains a local wholesale and retail sector to support agriculture and the local population, although for some major purchases the population depends on Pueblo and other Front Range cities. A long-term slow decline in population continues, and the area has a lower per capita income and a higher unemployment rate than the Colorado average.

The agricultural sector faces increasing costs for capital investment in equipment, increasing costs of labor and increased regulatory costs such as mandatory upgrades for migrant housing. Few if any inefficient farm operators remain, and even some efficient operators have found that agricultural land does not provide regular cash flow. As farmers and ranchers reach retirement age, some pass their holdings to children wishing to continue a farm-based life. Those who inherit are about the only new entrants to a farming occupation. Other retiring farmers have strong inducements to sell: to pay off bank debt; and to recover a lifetime's investment in the form of cash.

The likelihood of farm and water sales increases as farm operators grow older. The following table shows that the average age of farm operators has increased in all five counties between 1978 and 1987.

Table 4.17
Average Age of Farm Operators by Study Area County

Year	Bent	Crowley	Kiowa	Otero	Prowers
1978	49.4	49.6	49.2	49.8	47.7
1982	49.9	50.0	48.7	49.2	47.7
1987	50.6	52.7	50.0	51.2	50.5

Source: U.S. Census of Agriculture, 1982 and 1987. (U.S. Bureau of the Census 1984, 1989).

The labor force is industrious and there have been some successes in attracting diversification (e.g., light manufacturing, health care facilities, prisons) to the area. Future economic stability or growth depend on the area's success in building on its strengths. These include: ample land; an underemployed but diligent labor force and relatively low wage rates; adequate water for industrial or recreational purposes, if reallocated from local agricultural use; a junior college (Otero) which can provide training in needed vocational skills; and a high level of community cohesiveness probably based on the population's long-term residence in the Valley.

Evident weaknesses in the area include: overdependence of the economy on agriculture which leaves it vulnerable to downturns in agricultural prices and to seasonal (late fall, winter, early spring) unemployment increases; a historic out-migration of the young resulting in a relative shortage of those age 20-39; geographical remoteness from major population centers, made more difficult by lack of a four-lane highway to Pueblo and very limited aviation service; and municipal water systems which, although safe, are noted for their hardness and salinity.

Overall, the study area's economy faces a continuation of slow decline, punctuated by occasional crises in farm prices, unless and until the area is successful in creating a more diversified economic base utilizing the area's recognized advantages. If this is achieved, it is quite possible that some of its weaknesses (e.g., out-migration of the young and needed improvements in infrastructure -- municipal water and highways) will be overcome.

Sociological Baseline and Current Trends

Social demography: aging and decline of population. We have seen that the population of the study area has gradually declined and gotten older over the years. As children become young adults they leave the valley to seek higher education, employment and greater economic opportunities than are available in the local area. The older population remains in the area and some former residents return when they retire. Thus the older age groups constitute a larger and larger proportion of the total population.

Social Issues and Community Conflicts

One of the trends over the last two or three decades has been the sale or transfer of irrigation water to municipal uses. Increasingly, these sales or recent offers to buy involve transfer of water out of the Arkansas Valley. Water transfers and the loss of irrigation water have become a significant social issue in the area (see Chapter 2). A recent survey (Fulton, et al. 1992) shows clearly that attitude differences exist between three identifiable interest groups in the area:

1. the "general public";
2. irrigators in the region; and
3. shareholders (owners) of irrigation water (Amity Mutual Irrigation Company).

Assuming that the methodology of the study ensured that membership in each of the three groups was mutually exclusive, although the section of the report on sampling is not clear about this, we find that all groups overwhelmingly agreed (95% of the general public, 95% of irrigators and 87% of owners) that the most important use of water is to sustain agricultural productivity. Still, owners differ substantially from the other groups on this critical issue. Also, high proportions of each group agreed that some water should be purchased from "willing sellers" for the preservation of fish and wildlife. On this issue, irrigators emerged as being slightly less likely to agree.

On most issues, however, it appears that those who own water hold attitudes about its use that are significantly and substantially different from the other groups. At the time of the 1992 survey, the Amity Mutual Irrigation Company was marketing its water. Not surprisingly, owners of Amity Company shares were significantly more likely to agree with water sale scenarios than were members of the general public or irrigators. Sixty-two percent of the owners, but only 47 percent of the public

and 42 percent of irrigators felt that water should be purchased to increase recreational opportunities. Moreover, while 42 percent of owners believed water should be sold to support the growth of cities, only 27 percent of the general public and only 29 percent of irrigators agreed with them.

A majority of the public (55%) felt that water should be available for fish and wildlife even if it requires the local citizenry to help pay for it. Irrigators, as we might expect, were considerably less inclined to agree (37%). Irrigators were also less likely (33%) to feel the local public should help pay for water for recreation than were the general public (42%) and the owners (40%).

In summary, water transfers have become enough of an issue in the area that the local population can be defined and divided by where they stand on the sale and appropriate use of irrigation water.

Summary of Present Sociological Profile

This agricultural area of the Great Plains is experiencing population changes including declining numbers, aging, and "an increasingly weakening income position" (Weber 1991, 36). Young adults are moving away from the area disproportionately, and fewer childbearing couples remain behind to start new families and contribute to the communities, compared with the nation as a whole.

With population decline and out migration, occupational replacement becomes increasingly difficult (Weber 1991, 37). As members of the business and professional occupations age, retire or die, and are not replaced, the community loses the critical mass that enables its continuity. Smaller communities are further undercut as services and supplies become increasingly centralized in sub-regional centers (Weber 1991, 37).

Educationally, the population of the study area does not appear to be at a great disadvantage. The proportion of adults who have graduated from high school varies among counties and tends to be lower than the state average. On the other hand, except for Bent County, there are fewer high school drop-outs in proportion to the population than the state average. The median school years completed in 1980 (the last year for which data are available) is roughly comparable to that for the state. All of this indicates a reasonably well-educated labor force capable of taking advantage of employment opportunities that might arrive.

The people of the area appear to be longtime residents; large majorities in most counties were born in the state and are likely to have been born and reared in the valley. While there has been a significant amount of migration out of the area for many decades, those who remain have strong roots and ties to the area. Thus, unlike many rural areas of Colorado, where recent arrivals from cities have moved in and "urbanized" the local culture, the roots and values of these people are still found in agriculture and ranching. This suggests a strong attachment to the agricultural way of life and a resistance to its loss.

Ethnically, the area has a significant Hispanic minority, approximately twice the proportion of the state average. There are very few other ethnic or racial minorities represented in the area. With the Arkansas River having once been the border between Mexico and U.S. territory, the history of experience between Hispanics and Anglos is as long as the history of European settlement. Added to this is the gradual, permanent settlement of previously migrant workers of Hispanic background. As elsewhere in southern Colorado, the local culture in the lower Arkansas valley is a rich mixture of Anglo and Hispanic roots. While ethnic relations between these groups have not always been

unproblematic, the long history of multicultural experience is an important feature in the present social order.

According to national standards and definitions of poverty, the area is among the poorest in the nation. Except in Kiowa County, Anglos are considerably better off financially than are Hispanics and Blacks. This is part of a pattern wherever labor-intensive row crops are grown and a significant number of permanent or migrant farm laborers are employed.

A major social issue in the valley is the additional transfer of water from the valley. Residents of the area recognize the inherent right of water owners to sell these water rights to the highest bidder. On the other hand, people expect that additional water transfers seriously threaten their agricultural way of life and the quality of life in the valley.

Sociological Forecast Based on Existing Trends

Demographic projections. Population projections were obtained from the Colorado State Demographer's Office. It is important to realize that potential water transfers were not built into these projections, nor was the population of the planned prison in Bent County. The projections for Crowley County include the prison population and, therefore, are misleading. Nevertheless, the figures for Crowley County are included in Table 4.18.

The projections predict that population decline will continue for the foreseeable future (see Table 4.18). Only Prowers County appears not to be losing much population. Prowers' size will remain relatively stable around 13,000 through the year 2010. Prowers has been that size since about 1960.

That aging will continue in the study area is implied in the projection model. The median age will continue to increase until at least the year 2010 (see Table 4.18). At that time, the median age will begin to level off or rise more slowly.

It is also assumed that the rate of natural increase (births minus deaths) will continue to drop. The result of fewer children entering the population is responsible for a drop in the dependency ratio between 1990 and 2010 in all counties. This means that the "dependents" in the area will disproportionately be the elderly.

Table 4.18 Projections of Population Characteristics for Study Area Counties

County	Population Size			Median Age			Dependency Ratio		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
Bent	5,033	4,791	4,686	39.18	43.73	43.77	68.8	65.4	65.9
Crowley*	3,955	4,076	4,137	33.99	36.24	36.62	48.5	43.2	39.1
Kiowa	1,714	1,618	1,508	37.16	40.75	42.68	77.7	58.5	64.4
Otero	20,154	19,212	18,606	34.92	38.54	39.42	70.0	62.7	60.5
Prowers	13,317	12,922	13,069	31.94	36.73	37.54	64.4	40.4	56.5

Source: State Demographer's Office; Department of Local Affairs.
* Includes prison population.

The Potential Social Impacts of Additional Water Transfers

Since the social systems in the Arkansas Valley historically have been dependent upon irrigation (Sherow 1990) and water transfers currently are an important social issue in the valley, the potential for additional water transfers cannot be ignored in a sociological forecast. A review of the literature revealed that very little work of a purely sociological nature has been done on the subject of water transfers. What little exists has been done by Helen Ingram, her associates, and others in Arizona (cf. Oggins and Ingram 1990; Charney and Woodard 1990; Shupe, et al. 1989), Greider and Little in Utah (1988; Little and Greider 1983), and Kenneth Weber in studies of Colorado's Arkansas Valley (1989a; 1989b; 1990a; 1990b; 1990c; 1990d; 1991). A number of other "socioeconomic" studies have been almost exclusively economic in their focus (cf. Charney and Woodard 1990; Howe 1992; Howe, Lazo and Weber 1990) and are limited in their ability to inform a sociological analysis. Our visit and interviews in the study area revealed that many of the social factors reported in the literature are present in the valley. The potential for transfer of the Ft. Lyon Canal water already has produced some tension and anxiety.

Recent studies have been concerned with the factors inherent in: a decision to sell water; undesired changes in the quality of life and in lifestyle; strains, tensions and conflicts between neighbors; and perceptions of the proper relationship between the social and physical environments. These are summarized below.

Weber reports (1990d, 26) that the depressed economic condition of Arkansas Valley farms makes the selling of water shares both necessary and desirable for many farmers. Many see sales of water rights preferable to either continuing to farm or the potential of a sheriff's sale in the near future. Prices offered for shares of water in this area are considerably greater than current land prices and water sales offer a means of paying existing debt and a more secure retirement. Farmers who do not sell their water shares are those who already are in a financial position not to be caught up in the economic dilemmas of their less fortunate neighbors. These farmers can base their decisions to remain in farming on both economic and lifestyle considerations. This general situation may be less true now for the remaining farmers who survived the economic conditions of the 1980s.

Other writers have touched upon the social conflicts that emerge from the economics of transfers. Shupe, et al. (1989, 428) found large transfers of water from rural to urban areas typically cause controversy in the area where the water rights originate. But Weber argues that "controversy" is too mild a term for describing local feelings and refers to times when farmers felt obliged to carry firearms with them as they went out to irrigate (Weber 1990b, 13). He points to the frustration, anxiety and tension which are present in those who chose not to sell. When such conflict between neighbors is present communities which took pride in their neighborliness, cooperation, and kinship ties become increasingly polarized (Weber 1990b, 14).

The overall quality and character of life can be undermined in areas where historic irrigation is suddenly terminated (Shupe, et al. 1989, 429). The people of the area lose their psychological and cultural "roots" (Weber 1990b, 15).

Even in highly homogeneous communities, such as the Mormon towns in southern Utah, proposed water transfers have created conflicting interpretations among residents regarding the proper relationship between the physical and social environments and the proper relationship among themselves (Greider and Little 1988, 47). Conflict over water transfers differs from historical interpersonal conflicts over water in that many of the past conflicts pitted one agricultural user against

another as one would try to expand his farming or ranching operations using the water owned by another. Greider and Little argue that underlying past water controversies in the rural west was a shared, subjective interpretation that water should be used to maintain the agricultural way of life (Greider and Little 1988, 49). Most, if not all, of the opponents to water transfer in their study were tied to agriculture, philosophically if not economically (Greider and Little 1988, 51). For those opposed to the transfer of water away from agriculture, a way of life was believed to be doomed (Greider and Little 1988, 51).

Grieder and Little also found that hostilities are not directed at the developers or purchasers of water but at the community residents who sell their water (Greider and Little 1988, 52). Hostilities expressed by proponents of the water transfer are directed at the opponents within the community and stem from the common belief that it is nobody's business what the water owners do with their water (Greider and Little 1988, 53). The emergence of competing interpretations of the proper relationship between the physical and social environments has long term consequences for the relationships between community residents (Greider and Little 1988, 53).

Results of limited interviews in the valley, a recent sample survey (Fulton, et al. 1992), and the knowledge of the study team members indicate that many of these same concerns exist in the study area. These concerns already influence social interactions in a significant way and are therefore an important part of the sociological profile and forecast for the study area.

CHAPTER 5 DEMAND FOR FT. LYON CANAL COMPANY WATER

In addition to its present use, Ft. Lyon Canal Company water could potentially be used by other municipal, agricultural, or recreational interests. The purpose of this chapter is to describe the uses which have been previously projected as well as to describe new uses for Fort Lyon water in the Lower Arkansas Valley.

The uses include municipal uses in areas within and outside the Lower Arkansas Valley; as a source of supplemental agricultural water or to agribusiness in the lower Arkansas Valley; or for recreational use at the Great Plains Reservoir system or John Martin Reservoir. Demand projections and estimates of willingness to pay are presented.

Municipal Demand Outside the Lower Arkansas Valley

Potential demand for Ft. Lyon Canal Company water exists in Colorado Springs, Pueblo, and other growing Front Range municipal interests within the Denver metropolitan area. Representatives from both the City of Colorado Springs and the City of Pueblo were contacted to determine interest in water to supply growth in either city. Both Colorado Springs and Pueblo have stated that they have no interest in acquiring this water. (Bostrom 1993; O'Hara 1993) There are no other known municipal water suppliers within the upper Arkansas Basin that have a requirement for the Fort Lyon water.

In regard to the acquisition of Ft. Lyon water to serve growth in the Denver metropolitan area, future water requirements have been well documented within the Metropolitan Denver Water Supply EIS (U.S. Army Corps of Engineers 1988). Table 5.1 which has been extracted from this source shows the existing water supply and projected water demand through the year 2035 for the Denver metropolitan area.

Table 5.1

Metropolitan Denver
Existing Water Supply and Projected Water Demand*

	1980	1990	2000	2010	2035
Total Available Safe Yield	418	418	424	424	424
Baseline Water Demand	314	381	464	522	587
Water Shortage	0	0	40	98	163

* Values are in thousand acre-feet per year

Source: U.S. Army Corps of Engineers 1988

The total available water supply in the Denver metropolitan area will increase to 424,000 acre-feet in the year 2000. This includes a small growth in the supply from present as some large suppliers in the Denver metropolitan area have not fully developed their available supplies.

The projected demand is estimated to reach 587,000 acre-feet in 2035. The demand projection assumes continuation of the Denver metropolitan area existing conservation measures. Total shortages to the safe yield of water supplies in the Denver metropolitan area are projected to range from 40,000 acre-feet in the year 2000 up to 163,000 acre-feet in the year 2035. It is projected that a portion of the shortage to the Denver Metropolitan area could be supplied with either a transfer or temporary dry year lease of Ft. Lyon water.

Municipal Use of Water Within the Lower Arkansas Valley

In its studies relating to the operation of facilities of the Fryingpan-Arkansas Project, the Southeast Colorado Water Conservancy District in 1972 retained Black and Veatch Consulting Engineers to study existing municipal water supplies and projected uses within the lower Arkansas Valley. Appendix 5 lists the entities, supply source, and estimated yield for municipal water systems. The yield of the water supplies within the basin was 15,506 acre-feet in 1972 (Black and Veatch 1972). The projected year 1980 municipal water demands for a population of 46,874 was 11,041 acre-feet. This 1980 projection for growth served by municipal systems surpasses the present population projection for all areas within the five counties through the year 2010. Therefore, it appears that existing water supplies are able to serve projected municipal water demand within the Lower Arkansas Valley.

There are, however, two issues which are frequently raised regarding existing municipal water supplies in the lower Arkansas Valley. The first is the use of tributary ground-water supplies as a source of supply for these municipal uses and the second is water quality of existing supplies. The Colorado State Engineer's office also has recently reminded well owners in the Arkansas Valley that the well pumping rules and regulations will be actively enforced (Office of the State Engineer 1993). As shown in Appendix 5 there is a nearly complete reliance on groundwater for the municipal supply. The impact of this announcement has not been determined at this date. Local economic development offices also have expressed a desire to develop additional industrial base which may require new sources of high quality municipal water supplies. These issues suggest that a study of the municipal water supplies in the lower Arkansas Valley is warranted, but it is beyond the scope of this Phase I study. As a worst case augmentation of all existing municipal supply is proposed as a municipal demand ceiling in Chapter 6 and placed at 15,000 af or 5400 af C.U.

Agricultural Demands

Requests to the Southeastern Colorado Water Conservancy District for supplemental agricultural water demonstrate that there is a large demand for additional water supplies for agricultural users within the Lower Arkansas Valley. Table 5.2 is a summary for the years 1990 through 1992 of supplemental agricultural water requested from the Southeastern District at a cost of $8 per acre foot (Simpson 1993). For these three years, the unsatisfied requests varied from 53,261 acre-feet to 92,890 acre-feet. Also shown on Table 5.2 is the record of leases of water from the Pueblo Board of Water Works for these years. The average cost was $10.00 to $13.70 per acre foot.

During this same period, Pueblo leased in excess of 15,000 acre-feet annually to Aurora at an average cost of $24.33 per acre foot for municipal and revegetation uses (O'Hara 1993). It is assumed that the demand for supplemental irrigation water is price sensitive and that increases in the cost of supplemental irrigation water supplies above the $8 per acre foot lease rate will reduce the demand for additional agricultural water supplies. This $8 cost is for the federal project water and does not include interest cost. In addition to these documented agricultural demands, local economic

development offices have also expressed a desire to develop additional agribusinesses in the lower Arkansas Valley. A study of the water demands of new agribusiness is warranted.

Table 5.2

Demand for Agricultural Water

Year	SECWCD [1] Request	SECWCD Available	SECWCD [2] Cost	Unsatisfied Requests
1990	131,775	48,472	$8.00	83,303
1991	112,095	58,834	$8.00	53,261
1992	128,354	35,464	$8.00	92,890
Year	Pueblo Leases to Ag Users	Average Cost	Pueblo Leases to Aurora	Average Cost
1990	4,882	$10.00	15,214	$24.33
1991	4,000	$10.00	15,700	$24.32
1992	4,000	$13.76	15,171	$24.35

[1] No records are available from SECWCD for prior years.
[2] The present worth of this annual cost of $8.00/acre foot is $117/acre foot (PW, 6%, 30 years) this present worth of the SECWCD lease rate will be utilized in comparing the willingness to pay for alternative uses of water.

Recreational Demand for Water

The Colorado Division of Wildlife completed a study in January, 1993, of the water supply requirements for the proposed Great Plains Reservoir State Park in Kiowa County. Five alternatives for operations of the Great Plains Reservoirs were analyzed to estimate water supply requirements. Results indicate 17,900 acre-feet to 25,600 acre-feet of water is required at the Great Plains Reservoirs. In order to deliver this quantity through the Fort Lyon Canal, 28,000 acre feet to 40,100 acre feet is required to be diverted from the Arkansas River. Data from the study are summarized in Appendix 5 (Boyle Engineering Corporation 1993).

The water supply cost could range from $1.5 to $14 million, depending upon the estimates of consumptive use for each alternative. Water acquisition costs ranged from $50 to $420/acre foot and did not include additional costs due to changes of the Great Plains Reservoir decree to ensure removal of acreage to irrigation or to accomplish other terms and conditions which might be necessary to use Great Plains decree for a state park. Therefore, acquisition cost may have to be adjusted to reflect these costs.

Summary

Future additional water demand for the Denver Metropolitan area ranges from 40,000 to 163,000 acre-feet per year for the years 2000 through 2035. In addition, as identified in Chapter 2, it has been demonstrated that users in the Denver metropolitan area are willing to pay up to $3,150 per acre foot for the acquisition of valley water rights (there will be other transaction and transportation costs. Colorado Springs and Pueblo have not expressed any interest in the acquisition of additional water rights from the Lower Arkansas Basin. There are no other known municipal interests in the upper basin.

In regard to the use of Ft. Lyon water in the Lower Arkansas basin, demands have been projected for municipal, agricultural, and recreational uses. At this time, no additional municipal demands are anticipated based on projections made by the Colorado State Demographer's office but augmentation may be required. Local economic development officials, however, have expressed a desire to develop an additional industrial base which may require new sources of high quality municipal water supplies. For estimating purposes, 3,500 af C.U. may be set aside for expansion of existing industry and 5000 af C.U. may be set aside as an economic development pool.

As is shown in Table 5.3, additional water demands have been documented for both agricultural and recreational uses. The additional agricultural demand has varied from 53,261 to 92,890 acre-feet per year for the years 1990-92. Agricultural water is leased at an annual cost of $8 per acre foot has a present worth of $117.00/acre foot. This is considered supplemental water from a federal project. By way of comparison, as stated in Chapter 3, Ft. Lyon water may be about $720/1.27 or about $600 af C.U.

The demand for water required for the creation of the at Great Plains Reservoirs State Park has been projected to range from 28,000 to 40,100 acre-feet per year at the Ft. Lyon headgate. The purchase price has been projected from $1.5M to $14.6M at a cost of $50 to $420/acre foot.

Table 5.3

Lower Arkansas Basin Summary of Demands for Additional Water Supplies

Demand	Max Quantity acre-feet/year	Cost/acre foot
Municipal	5,400 (C.U.)	$1600
Industrial	3,500 (C.U.)	$1,600 or more
Agricultural	53,261 - 92,890	$117
Recreational	28,000 - 40,100	$50 to $420

In addition to these documented demands for Lower Arkansas Basin water, additional supplies may be required for new municipal or agribusiness uses.

CHAPTER 6

ALTERNATIVES TO WATER TRANSFER

Introduction

Preceding chapters have identified issues, described the Ft. Lyon System, characterized the study area which includes the surrounding communities and presented an overview of water demands for Ft. Lyon water within and outside the study area. Information from historical water transfers suggests that pressure has existed for many years to move agricultural water to other uses in the valley or outside the valley. This chapter develops alternatives to out-of-basin water transfers and has three objectives:

- Identify and describe a useful method of evaluation of alternative proposals
- Identify and describe alternatives to transfer of Ft. Lyon water
- Perform preliminary assessment of significant effects of alternatives

Formulation of alternatives and identification of effects which the alternatives may produce relates to the issues and concerns presented in Chapter 2. The primary challenges are, first to describe alternatives in concise and understandable language and, second to assure that the evaluation process addresses the most critical issues. Questions posed by one study team member properly state the challenges and reflect the concerns of the Lower Arkansas Valley residents:

- What does the study area, and specifically the Ft. Lyon system, now have in the way of water resource assets which can benefit the Ft. Lyon shareholders and the Lower Arkansas River Valley economy?

- How can the assets be used to improve the socio-economic situation in the Ft. Lyon system and in the surrounding communities?

As to assets, the study area of the five counties in Figure 1.1 contains about 6.7 percent of the state's land area. The area supports about 1.3 percent of the state's population and produces 8 percent of the state's total annual income from field crops. The citizens of the Lower Arkansas River Valley have a rich heritage of development and productivity for the past 150 years. The Ft. Lyon system controls 211,597/838,000 af or one-quarter of all diverted water between Pueblo and the Kansas state line. It irrigates more than one-third of all land along the mainstem of the Arkansas River below Pueblo. Land under the Ft. Lyon Canal produces $23 million annually, or 24 percent, of the total field crop income in the study area. Income from livestock is even more significant. The five county area and the Ft. Lyon shareholders therefore have assets which include considerable land resources and water resources. Because of economic factors, the water resources are presently undervalued and markets for these resources have been developing outside the lower valley.

Improvements in the use of these assets will be instrumental in stabilizing the socioeconomic conditions in the study area. The Ft. Lyon shareholders, through their mutual ditch company, can have considerable influence in the employment of their own land and water resources and, through multiplier effects, in the stability of the study area as a whole. Proactive efforts by the Ft. Lyon Canal Company, alone or in coordinated actions with other organizations, will play a significant role in future of the Lower Arkansas River Valley. The following sections of this chapter will describe some opportunities available to the Ft. Lyon Canal Company.

This chapter develops an evaluation process and identifies significant effects which should be considered. Alternatives to permanent loss of water from the basin are developed and described. Affects of these alternatives on elements of the study area are estimated. Mitigation measures such as economic development programs, revegetation of dryed-up land, return flow accounting and wetland replacement are discussed. Appendix 6 contains significant detail and background information.

Alternative Evaluation

To determine the merit of any alternative, the scheme may be evaluated. Evaluation will identify problems with an alternative as well as benefits which may result from implementation. An essential function of an evaluation is to represent critical concerns of those parties who bear the effects and costs of a proposal. The purpose of the evaluation process at the initial stage is to identify alternatives which should progress to the stage of more in-depth study and development.

The process of evaluating alternatives resembles an environmental impact study. An impact study includes:

- impact identification
- description of the affected environment
- impact prediction and assessment
- selection of an action from set of alternatives

To better understand the evaluation process developed in this study, definition of key terms used in discussion is required:

- An impact is an effect on the study area, and may or may not be measured and quantified. Taken in a broad sense, it can be beneficial or adverse to human welfare. It also has the characteristics of relative significance (importance) and magnitude (quantity of measure).

- Criteria are standards on which a judgment or decision will be based. Criteria may be applied to set limits and consider alternative proposals on a common basis. The establishment of criteria is mostly a matter of judgment, except where standards already exist, such as water quality standards, minimum soil characteristics for crops, necessary habitat requirements, etc.

- A sector is a distinctive aspect of the study area to which inquiry and interest are directed. Examples are commercial interests, Ft. Lyon shareholders, or the natural environment. Sectors were defined by reviewing issues in Chapter 2. The scientific or technical disciplines which should be applied to study the issues are also considered.

To distill the issues of Chapter 2 into essential elements that are most critical to all of the constituencies affected by a transfer for Ft. Lyon water, the task leaders of the project team developed criteria for the evaluation process. Feasibility and practicality of each alternative are most important, but potential problems are also important. Table 6.1 presents a summary of the process of developing "indicator impacts," i.e. impacts which seem most significant to the issues identified in Chapter 2 and the various interest groups concerned with those issues. The indicator impacts are used in the next

section to more fully describe the anticipated results of implementation of the alternative. More details of evaluation process development are contained in Appendix 6.8.

All of the alternatives presented in the next section are considered feasible from the technical, legal and administrative points of view. However, several aspects of evaluation should be clarified:

- Cost of implementation has not been estimated.
- Benefits of the implementation are difficult to quantify because specific users of the water, for the most part, have not been identified. Long range benefits are not estimated at this stage. In the preliminary assessments benefits are identified as "gains".
- Economic impacts of transactions are estimated in the next section by applying crop production data, income data, estimated demands, estimated water prices and other data from previous chapters. A multiplier of 2.6 (from Chapter 4) is used to estimate job changes and spending impacts.

Details of some of the estimates are presented in Appendix 6.8.

Legal Issues in Alternative Assessment

Legal issues with respect to the alternatives depend on the specific method of implementation of each alternative. In a broad sense, legal issues arise when it is important to impose enforceable restrictions and mitigations on the method of implementation, be it, for example, return flow maintenance, or payment in lieu of tax mitigation, or control of lateral water deliveries. As indicated in the issues in Chapter 2, legal protections are necessary for the non-selling shareholders of a ditch, for other water users, for wildlife interests, for downstream states, and for the nearby affected communities.

The FLCC is the largest user of water in Southeastern Colorado; it operates a complex system stretched for nearly a hundred miles along the river. Its return flows provide water for numerous other ditches as well as many wells and wetlands.

Delivery of water, whether upstream by exchange, or downstream raises injury questions for intervening water rights, and for non-intervening water rights which can be affected by the rebound effects of changed flow regimens and calls for water by users in priority. Major changes in uses of FLCC water will require changes in the company articles and bylaws which currently restrict the changes which may be made. This gives perhaps arbitrary discretion to the board to deny partial transfers both within and outside the ditch. No objective standards seem to be in use.

Because canal systems typically have been operated for optimum delivery of water in a fashion which has stabilized over the years, any change in delivery upsets that stability, and causes new costs, conflicts over delivery, and unresolved questions. Opposition to all change may ultimately trigger unforeseen impacts. The material expenses and losses resulting from incremental changes should be born by those benefitting from the changes.

Major changes will likely also trigger the need for federal permits and approvals. The Bureau of Reclamation and the Corps of Engineers and other federal agencies may consult with the Fish and Wildlife Service and EPA in issuing many permits, and may therefore consider endangered species, wetland, water quality and sometimes the other issues composing the Environmental Impact Statement process. New uses triggering discharge may require state discharge permits, and water quality

Table 6.1 Development of Criteria for Evaluation

Sectors	Criteria	Indicator Impacts
Ft. Lyon System Operations	Shareholders' costs and property values, timing of deliveries, property rights of potential sellers, water quality.	1. Number of irrigated acres 2. Water value 3. Operation cost
Regional Economy	Finances of local governments, economic opportunity, local business.	1. Property tax/sales tax revenue 2. Local income/spending 3. Employment
Regional Population and Communities	Effects on institutions, consideration of conflict, political acceptability, out-migration effects.	1. Loss of population segments 2. Internal conflict 3. Stress related behavior
The Natural Physical Environment	Endangered species, wetlands, value of resources, recreation resources.	1. T and E, wetlands, habitats* 2. Recreation opportunities 3. On-farm lands
Legal Considerations	Arkansas River Compact, no injury to water rights, water quality standards, costs of litigation.	1. Return flows 2. Water quality changes 3. Transaction costs
State and Local Administration	Practical implementation and management scheme, off-setting mitigations, local self-determination, local infrastructure	1. Government implementation costs 2. Local control 3. Impacts on infrastructure

*T and E: threatened and endangered species

management plans. Re-vegetation to mitigate land changes may be required by the water court. Local dust and weed ordinances or wildlife habitat and soil conservation practices may also apply.

Litigation over water rights and the administration of water rights is not new. In a delicately balanced, complex system, water administration is more of an art form than a science. Any change of water rights invites the need for an unbiased, but informed dispute resolver. The water court traditionally fills that need. Necessarily, information and advocacy requires expensive expertise, and multi-party dispute resolution requires substantial time. All parties affected by a water transfer hire engineers, attorneys, geologists, agronomists, and other experts to help form adequate protective conditions and to negotiate. Sometimes it is more expensive to negotiate a consensus than to prepare for trail.

If the proponents of water transfers, especially proponents of smaller transfers to only marginally higher values uses, were obligated to pay all the transaction costs of opponents, there would be little likelihood that any change in water use would be economical, and water use would be effectively frozen to the status quo.

Some suggest that because of those transaction costs, the water transfer system and its legal bindings should be changed. It is a question of political philosophy beyond the scope of this study as to whether the government should actively protect certain interests in a water transfer, should facilitate transfers or should reallocate water rights to "higher uses" in the "public interest".

Possible Social Impacts: Changes in Quality of Life

Traditionally, the quantification of socioeconomic impacts is limited to the variables on the economic side, where impacts can be translated into "dollars" or "number of jobs". In studies such as this, it is not sensible to try to quantify changes in the sociological variables. All of these social factors can be generalized in terms of issues about the "quality of life", indicators of which are shown in Table 6.1 as demographic change, internal conflict, and stress.

It is possible to describe the social changes that might occur under different alternatives and to speculate about their magnitude. This approach is possible through:

1. an understanding of the social impacts brought about by similar physical and economic changes in the past;

2. an understanding of the current social and economic conditions in the area; and

3. an understanding of the interactions between economic and social factors.

In Chapter 4 the few sociological studies that have dealt with the social impacts of water transfers were reviewed. These studies addressed:

1. the social factors inherent in the decision to sell water;

2. undesired changes in the quality of life and in lifestyle;

3. strains, tensions and conflicts between neighbors and within communities; and,

4. perceptions of the proper relationship between the social and the physical environments.

Examination in Chapter 4 of the current socioeconomic condition and trends in the study area showed that the area population is declining as well as aging with young adults moving away in disproportionate numbers. The area contains a labor force educated well enough to take advantage of new employment opportunities. There is a multi-cultural richness in the valley, but the area is among the poorest in the nation.

All cultural and economic groups have, in common, an agricultural "way of life". Recent surveys have shown that the population feels their agricultural way of life, indeed, their "quality of life", is presently threatened by the potential of additional water transfers out of the valley. Conflicts over water transfers are apparent and the Fulton study (1992) demonstrated that the population is divided by where people stand on this issue. Social impacts are estimated in each alternative description and summarized in Appendix 6.8.

Formulation of Alternative Proposals

An alternative is a combination of conceptual ideas relating to water use, land use and a practical administrative framework which includes organizations and institutions in the study area. The formulation and description of alternatives to out-of-basin transfer of Ft. Lyon water is not a simple process. From the Request for Proposals (RFP) issued by the CWCB, several concepts were presented for study:

1. Transfer water to new uses in the valley
    - moving Ft. Lyon water to other places and uses
2. Improve water supply management in the Ft. Lyon system
    - comprehensive evaluation of facility improvements and management methods
3. Water salvage under the Ft. Lyon system
    - reduction of seepage to increase beneficial use on crop land while maintaining return flows
4. Water banking
    - pledge Ft. Lyon shares, store the water and deliver the water to other users for temporary use
5. Retirement of marginal agricultural land
    - estimate amount of less productive land and how much water could be available for internal transfer
6. Land fallowing
    - leave some land out of production; determine water available and impacts of loss of production
7. Interruptible supply
    - move water temporarily; estimate demands and terms; determine effects
8. Agricultural production interference charge
    - multi-year contracts to transfer water temporarily; estimate compensation for loss of production; determine effects on third parties
9. Water supply recycling
    - first use by municipalities; second use by Ft. Lyon shareholders for agricultural production; exchanges now and in the future; water quality considerations
10. Combinations of the above concepts
    - other alternatives; detailed consideration of new statutes to modify the water transfer process and quasi-government management entities are specifically excluded.

This report identifies alternative programs which include the above concepts. Clearly, some of the above concepts overlap or are not directly comparable. In this report, alternatives represent objectives for the Ft. Lyon shareholders. The shareholders can adopt one or more "mechanisms," i.e., administrative methods, to accomplish their objectives. Using this logic of alternative development, the above listed concepts are integrated into workable alternative descriptions.

The development process is presented in Figure 6.1. The process begins with identifying probable alternative uses for Ft. Lyon water. Several of these uses were identified in Chapter 5. Next, variables such as type of use, place of use and duration of use are considered. The traditional strategy for changing any of these variables is the sale and permanent transfer of the water and dry-up of irrigated farms. This path is irrevocable. Another strategy is the temporary transfer, herein referred to as a "lease" of water by the water right owner for one season at a time. New methods of administration for change are:

- water banking, where Ft. Lyon water is leased to another user while the owner's lands are fallowed

- first-use agreements, where Ft. Lyon water is first diverted and used by others, then reused in the Ft. Lyon system

- water option leases (also called interruptible supply contracts), where Ft. Lyon water is used by others in dry years while Ft. Lyon land is fallowed

- internal system improvements, to salvage water and make it available to other users, possibly for alternative uses.

The possible alternatives for the Ft. Lyon Canal Company are:

1. Internal transfers within the Ft. Lyon Canal Company
2. Transfer to new uses in the valley, permanent or temporary
3. Temporary transfer to new uses outside the valley

Other possible alternatives are:

4. Acceptance of an offer, such as the CWS offer described in Chapter 2, to sell and transfer of as much as 51 percent of the water outside the valley

5. Adopting the "status quo;" that is, no alternative to out-of-basin transfer of Ft. Lyon water may be implemented.

Any of the above alternatives will have beneficial or adverse impacts on parts of the study area. Effects are difficult to identify and measure, as stated in Chapter 2; however, some significant effects are presented and discussed with each alternative. Mitigation measures are described which will offset possible adverse effects. The effects identified in Phase 1 are first-cut estimates of impacts of the alternatives and can be expanded in later Phases of the study. To better understand the alternative descriptions, the methods of administration are first described in the following sections.

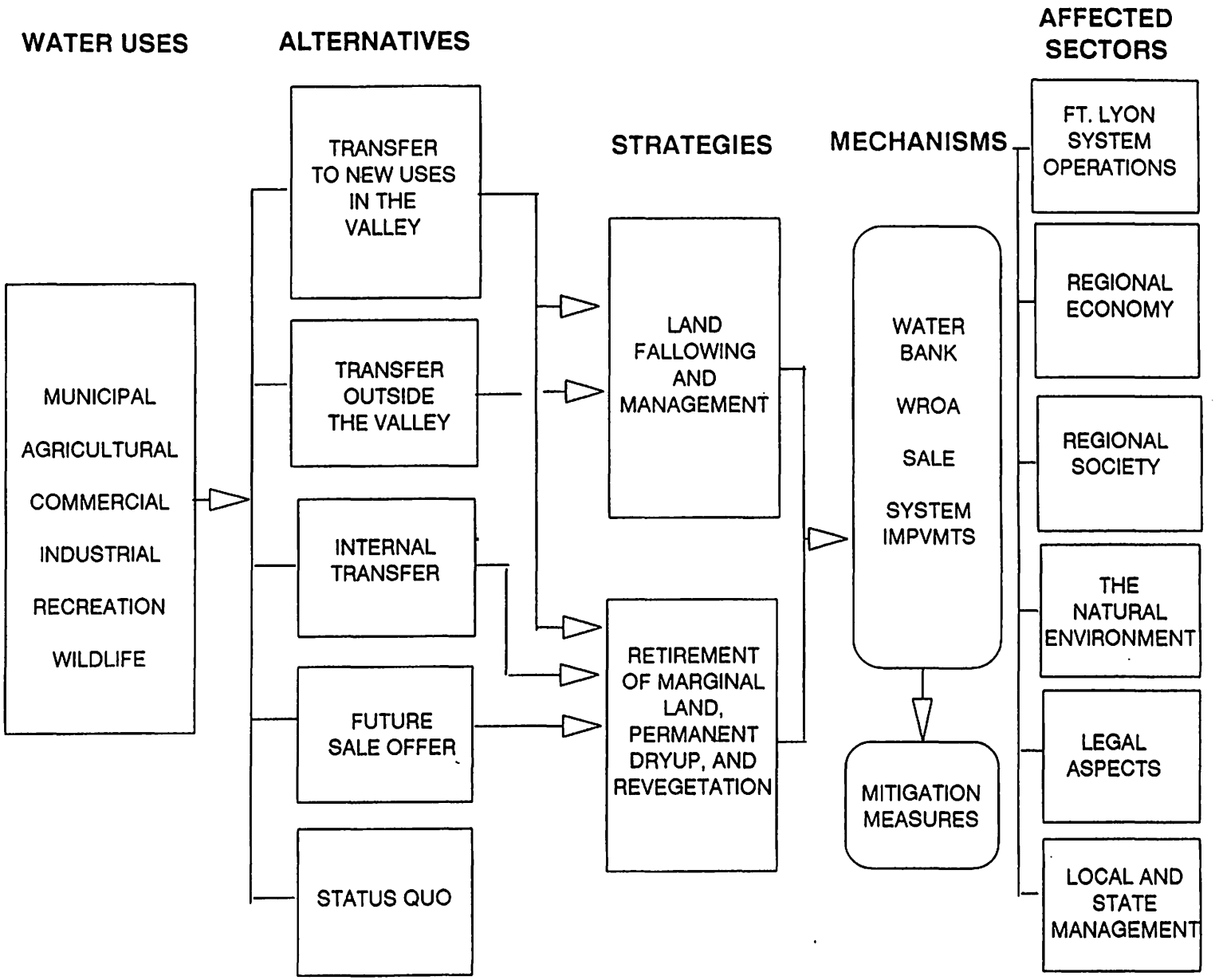


FIGURE 6.1 DEVELOPMENT OF WATER TRANSFER ALTERNATIVES

Water Bank: Mechanism for Temporary Transfers

A water bank is herein defined as an accumulation of Ft. Lyon water shares acquired from shareholders through lease for distribution to users on a seasonal, temporary transfer basis. The temporary users would be inside or outside the Ft. Lyon system. A Ft. Lyon water bank would have five components:

1. willing shareholders who place their shares up for lease.
2. an agency to pay for the leased shares and administer sale to the users.
3. a storage facility to hold the shares in an account.
4. standards for and inspection of fallowed land.
5. a set of rules defining which users can purchase the banked shares; computation methods for credits and debits to shares to determine delivered quantity (yield); rate structure to determine net revenue to the shareholder based upon conveyance, storage and administration costs and price to the purchaser based upon location of delivery.

All shareholders under the Ft. Lyon system could be eligible to participate in the water bank. Shares voluntarily leased to the bank would be limited under the water bank rules. Land can be placed in fallow under prescribed requirements to match the shareholder's consumptive use plus lateral losses downstream of the main canal.

The agency formed for administering the rules for the bank and making the purchases could be designated the Ft. Lyon Water Bank (FLWB) and can be formed as a non-profit enterprise by the Board of Directors of the Fort Lyon Canal Company for the sole benefit of the shareholders of the company. It should have its own budget, a manager and a management committee to set operating policy. Other choices for the operator of the bank include the state, Southeastern Colorado Water Conservancy District, FLCC, a new Arkansas valley entity, a private entrepreneur, or group of shareholders.

For deliveries inside the system, storage and conveyance can be in existing Ft. Lyon facilities. For deliveries outside the system, delivery may be made by exchange from the Ft. Lyon Canal headgate to the user's point of diversion. If required, cooperative storage agreements can be created with Lake Meredith Irrigation Company, Lake Henry Irrigation Company or other offstream storage facility for delivery by direct release, substitution or exchange. Cost for all required storage, conveyance and cooperative agreements may be set out in a rate schedule and assessed to the user in adjustments to the base purchase price.

As an example of determining rates, the basis of delivered quantity can be gross yield of each share at the Ft. Lyon headgate. The gross yield would be computed as the consumptive use at the shareholder's point of beneficial use plus credits for delivery losses. The net yield to the user would be computed as gross yield less storage, conveyance and other losses to the user's point of diversion on the mainstem of the Arkansas River or on the main Ft. Lyon Canal. Purchase and sale by the FLWB would be based upon gross yield at the Ft. Lyon Canal headgate. Since ultimate deliveries in any season are uncertain, adjustments to final deliveries and final payments may be made. Winter storage of carryover water from preceding the water banking season should be considered to optimize the operation of the water bank, consistent with the interests of the non-participating shareholders.

Return flow obligations could be managed in a Return Flow Account such that 1) return flows are credited to the shareholder's account from the use of his water by users not in priority at the time of diversion, with adjustments for losses or gains, or 2) held in storage and released as required by a return flow schedule, with adjustments for losses or gains.

Lands should be fallowed as determined by the water shares offered for lease to the FLWB and the anticipated temporary water transfer. The FLWB, through the management committee, should adopt and maintain standard practices for the fallowing and maintenance of land by the shareholder. Costs of the administration of the standards may be carried by the FLWB. Cost of land preparation, maintenance and management may be carried by the shareholder.

The water bank could be used to create greater flexibility of use of water outside the Ft. Lyon system without removing the water from agricultural ownership. Therefore, the water bank could be viewed as a means to maximize the enterprise of the Ft. Lyon Canal Company in developing its water resources, because part of the income derived from leases could be used to improve the system.

The two key elements to water banking are the place of physical storage and the financing plan. A water bank differs from an interruptible supply contract (described in the next section) in that water is committed to the bank at the beginning of the season without the bank knowing whether or where it will sell the water; a water bank essentially speculates that it will be able to sell the water to users. Unused water in a water bank suffers evaporation losses. At season end, the bank either carries over the water in storage or releases the water.

Because of the transaction costs, water banking is not feasible for transferring water from one low value crop production to another low value crop production. Water banking is feasible when higher value uses of the water such as economic development or higher value crop production. As stated in alternative 2E, such economic development would ultimately need a firm water supply. For economic development, the water needs to be available anywhere between Pueblo and the Colorado state line. Use may be obtained by physical release, exchange, or use for well augmentation. Well augmentation is most likely for industrial and commercial uses because those uses need a year-round supply which direct flow diversions cannot provide.

Use for high value crops is most likely in the river reach between Pueblo and Rocky Ford. Poor water quality adversely affects high value crops below the Rocky Ford ditch, although limited use may be possible.

Use in the Denver area requires a delivery mechanism. It should be noted that exchange opportunity below Pueblo Reservoir is largely already decreed, and that a pipeline from Pueblo Reservoir, John Martin Reservoir, or FLCC reservoirs would be very expensive if used solely for drought service. Technical or financial feasibility is therefore in doubt unless water could be moved both ways using such delivery systems in alternating years.

Storage at Pueblo Reservoir is available at a very low cost for uses within the boundaries of the Southeastern Colorado Water Conservancy District, and at a significant price when stored water is used outside district boundaries. Storage is subject to physical availability of space and is subordinate to existing uses such as storage of Fryingpan-Arkansas project water, winter stored water and a small permanent pool. Contracts are made with the U.S. Bureau of Reclamation. There appears to be no significant hydrologic limitations on capacity for storage in Pueblo Reservoir in dry years. More significant are the limitations on ability to physically move those amounts to Pueblo Reservoir in dry years. Storage would be by exchange, and exchange opportunity is limited at low flows. In wet years space is limited, but water is available from other sources for economic development pool, and agricultural demand is typically satisfied.

A water bank pool at Pueblo Reservoir for economic development or agricultural drought use would have some additional recreational benefits at the reservoir until it is used.

Water banking constitutes a change from direct flow to storage, a change in place of use, and an exchange program. Thus, a substitute supply plan or water court decree would be required. Traditional conditions would be required to protect other water users from injury. While Colorado has a "water loan" statutes C.R.S. 37-83-105, the loan may be made without injury to other vested water rights and seems to add little to the substitute supply plan or water court change statutes Fort Lyon Canal Co. v. Chew, 33 Colo. 392, 81 p. 37 (1905).

The injury issues can be simplified if the water stored is "consumptive use" water, and return flows from anticipated future use need not be estimated or considered. If the bank sells only consumptive use water, it may sell the right to total consumption including reuse to extinction. This arrangement is subject to the purchaser demonstrating no loss of dominion and control, adequate accounting, and other terms to prevent injury by reason of the reuse.

Water banking contemplates that water rights owners will lease water to the bank prior to the irrigation season. That arrangement will need to be documented, as will the sale of the water to purchasers. In the California Water Bank, the state appropriated money for the purchase of the water from farmers. Water was then sold by the bank at a premium. Because there was ultimately less demand than anticipated, there was water left in the bank unsold, and the bank operated at a substantial loss. If a Pueblo Reservoir based water bank could carryover water in storage, it would keep its unsold inventory subject to evaporation loss and additional storage charges for an additional year. However, a wet spring forcing spill of the water could leave the bank without water to sell. Refer to Appendix 6.2 for background information on other water banks.

Denver metropolitan water users may be willing to contract with the bank on a "take or pay" basis. If the price is high, it is unlikely that agricultural users in the Arkansas valley would buy from the water bank. Hydrologic and economic modeling could prescribe operations that would lead to a long-term profitability for the bank, but there would still be risks in the water bank operation.

First-Use Agreements

An agreement between a water right owner and another user to first divert water to the new use, augment the resulting consumptive use, and recapture the water by diversion to the original owner is called a "first-use agreement." The possibilities for the application of such an agreement to the first use of Ft. Lyon water is limited because many diversions already take place upstream of the Ft. Lyon headgate. The location of the Ft. Lyon system on the river makes such an arrangement unlikely due to many exchanges of water that take place in the upstream part of the basin.

Water Rights Option Agreements

A water right option agreement (WROA) is a long-term contract to temporarily transfer water during a dry year and compensate the water-right owner. The contract may run for any length of time, say ten to forty years. The scope of the agreement is determined by the needs of the lessee (water user), lessor (water-right owner), and water administration agencies such as a ditch company and the State Engineer's Office (SEO). Thus, the lessee has the "option" of using the water under certain stated conditions. The water transfer in the WROA should be approved for execution within the administrative system, either by court decree or through a substitute supply plan accepted by the State

Engineer's Office. Conceptually there is no constraint on the type of use to which the water is applied in a dry year. Thus, the water may be used for recreation, augmentation, instream flow, or other uses.

The model WROA is composed of three components; a water transfer plan, a financial analysis and a contract document. The first component, the water transfer operations plan, requires rigorous engineering analysis. Location of the existing use relative to the proposed temporary use determines the return flow requirements and impacts of the transfer on other parties. The deep percolation returning to the stream system is accounted for in a delayed return flow schedule in the agreement to avoid stream depletions. Land fallowing, if allowed, would be controlled by the Ft. Lyon Canal Company to protect adjacent land owners.

In the financial analysis, the cost to purchase the water right is estimated first. Then the cost of the WROA is estimated. Cost of outright purchase of the water right (WRPC) is the primary variable in estimating the WROA cost. The transaction cost (TC) is necessary to determine cost of ownership to the potential buyer. TC must be estimated by the analyst, but is quite variable and depends upon many factors.

To estimate dry-year yield, direct diversions from Table 3.6 are analyzed in intervals of 5000 af/yr to assess frequency of occurrence. The result is presented in Figure 3.2. A yield of 110,000 af/yr has a probability of one in ten (1:10) for the 36-year period of record. The yield in a dry year is 110,000/211,597 = 0.52 of average. Consumptive use actually available in a hypothetical 1:10 year is estimated at 1.27 x 0.52 = 0.66 af C.U. per acre.

From Chapter 3, Table 3.9, the market price of Ft. Lyon land and water is estimated to be $817/acre. From Table 3.7, Average yield is about 1.27 af/share. Price of water is about $723/share or $723/1.27 is about $600/af C.U. Assume a transaction cost to the buyer of about $280/af as a rough estimate. Annual assessment by the Ft. Lyon system is about $10/share or $10/1.2 = $8.30/af C.U. Using a discount rate of 4 percent above inflation, the WRPC to the buyer is (600 + 280) + 8.3 x 13.59 PVF = $993/af. Thus, the approximate cost WRPC of a $600/af water right to the buyers would be $993/af. Allowing for a dry year yield, however, the actual water delivered in the example purchase would cost him/her $993/0.52 = $1910/af for a 1:10 yield.

The estimated cost of a water right option contract (OC) to the buyer is a total present value cost made up of an amortized change in value over the length of the lease contract, costs for analysis and negotiation (TC) of the WROA, an initial payment to the lessor (CP) at inception of the contract, and an option payment (Ex) at the time of use. Thus, the model WROA includes two types of payments, an inducement payment (CP) and an exercise payment (Ex).

Assume the period of the contract to be 20 years with a renewal negotiation (TC) cost allowed at the end of the 20 years. Probability of actual exercise can be estimated by stochastic analysis; based upon the dry yield assumption above, it is assumed to be 1 year in ten. This assumption is conservative; choice of smaller values of probability (p) will have very little influence on the final cost. A discount rate of 4 percent over inflation is assumed. Calculations show the present cost of the example WROA to be $1,510/af of delivered water, based upon a CP of $59/af for each and every year of the WROA and Ex of $128/af additional payment in the year of the option. The example resulting present value advantage to the lessee is $1,910 - $1,510 = $400/af, due primarily to savings in transaction costs and not having to purchase an equity position in the water right. The foregoing computations, however, are only by example, using estimated or assumed variable values. Ranges of values are presented in Table A6.2. In Table A6.2, Ex ranges from about $17.25/ac/1.27 = $13.58/af to $208.41/ac/1.27 =

$164.10/af, paid in the year of the option. Keeping in mind that the shareholder continues to pay his/her assessments as the owner and that the formulation deals with nine independent variables to obtain the present value cost of the option, OC ranges between about $1,200 and $2,700/af for $600 - 1,600/af water. This price range accounts for the actual cost of the water to the lessee in the (1:10) dry year.

The third component of the WROA is the legal contract which defines the responsibilities of the water utility and the water-right holder. The contract will combine policy, definitions, technical data, compensation arrangements, and administrative elements into a workable operating plan. Key provisions of the option contract were developed by research in Clark (1992) and are listed in Table A6.3. The influences of potential objectors to the water transfer, the water administration officials, and others impacted by the water transfer should not be underestimated. Supporting documents relative to quality, quantity, and administration should be included in the WROA as attachments.

Research into existing and proposed WROA suggest that the "description of property" clause and the "first right of refusal" clause are of particular interest. Water rights are considered real property in Colorado subject to line of title and encumbrances on equity through debt. Sorting through the equity positions on farm properties can be complex. In recent cases of WROA proposals, numerous constraints on the seller (owner) have been added to the contract to protect the interests of the buyer. An example of this potential problem is the CWS proposal to Ft. Lyon shareholders which is described in Chapter 2. If the Ft. Lyon shareholders were active parties in the negotiations of such an agreement, they could work out protections satisfactory to both the lessees and lessors.

Triggering mechanisms and notice to exercise the option will have both operational and administrative considerations. Clearly, intent of the lessee to initiate the temporary transfer is not the same as providing notice of the intention to the lessor due to the degree of commitment involved for each party. Research indicates that irrigators desire early notice while a city's water utility wishes to delay the decision to exercise the option until the annual yield of the traditional water supply is more certain.

Impacts on other parties of entering into and exercising water option contracts are not precisely known. Effects are thought to be similar to but less pronounced than the effects of permanent transfers due to the temporary nature of the arrangement. The primary advantages of the WROA are maintaining water ownership in the agricultural sector and providing a uniform income source for the lessor (irrigator). However, the temporary transfer and the WROA are not applicable to every situation. More details on WROA are presented in Appendix 6.3.

Ft. Lyon System Water Management Improvements

Water management improvements strategy can be characterized as structural or operational improvements. Structural changes may be required for the rehabilitation of the system due to deferred maintenance, or which improve the per share delivery of water and lower cost to stockholders.

As described in Chapter 3, the Ft. Lyon Canal Company performed a study of rehabilitation requirements to the system in 1983. Of the $2.7M of improvements identified in this program, limited progress has been made in the completion of these maintenance items. These include the Thurston Reservoir pumping plant and improvements to some Ft. Lyon Canal structures. It is estimated that approximately $2.5M of the 1993 deferred maintenance items remain to be completed. However, this estimate is not yet confirmed by the Ft. Lyon Canal Company.

Improvements are needed to increase the per share delivery of water to stockholders at reasonable cost. In Chapter 3, the irrigation efficiency under the Ft. Lyon Canal is estimated to be approximately 47%. Prior engineering studies have estimated that canal losses average 30%, lateral losses average 10%, and farm losses average 25%. To improve the delivery per share to each irrigated farm, a series of construction projects and operational changes would be required. These include lining of canal segments, construction of pipelines to deliver water to parts the system, improvements in storage of Ft. Lyon canal water (including storage of water in other reservoirs) and creating additional storage within the canal prism in upstream reaches.

Irrigation wells and municipal wells may be effected by this alternative because tributary aquifers underlie parts of the Ft. Lyon system. These aquifers are recharged in some areas by percolation of irrigation water and canal seepage. This process occurs in the La Junta Division. At the request of the North La Junta Water Conservancy District, the USGS conducted a study of wells and 2100 irrigated acres comprising most of the La Junta Division (Evaluation of Proposed Water Management Alternatives...1992). Refer to the map in Figure 3.1. The study was conducted because in the 1980's the high water table caused flooding of basements, loss of some productive farm lands and closing of a public school. Water management improvements which included the lining of five (5) miles of the Ft. Lyon Canal were input to a transient simulation model of the study area. The simulated lining caused a 5-foot decrease in simulated well levels near the canal, and almost no change in well levels near the Arkansas River. Estimated seepage from this portion of the canal was 3910 af annually, for the period 1960-1979. Actual seepage was 5888 af for the water year 1985-1986. Total pumpage remained unchanged with the simulated lining. This example illustrates that the phenomena of canal seepage and the behavior of alluvial wells can be estimated and that effects of change can be anticipated.

One environmental resource impacted by irrigation efficiency changes is wetlands. Losses from irrigation systems can augment the water supply for natural wetlands and often result in creation of new wetlands entirely dependent on irrigation for their water supply. Water that would otherwise return to the surface stream is consumed by wetland vegetation, creating a stream depletion. Incidental consumptive use within an irrigation system is often reduced with a corresponding loss of wetland acreage. Proposed improvements to the Ft. Lyon facilities may allow for impacts on major wetlands in the Ft. Lyon system and the river system.

There are also socio-economic impacts associated with improved irrigation efficiencies. The vegetation along ditches, which relies on conveyance losses for a water supply, has in some areas become a major community amenity. Ditch lining eliminates this vegetation unless special water supply is considered for significant wetlands and vegetation. Replacing ditches with pipe eliminates both the vegetation and the artificial waterway. Additionally, final design of the program may ensure that no injury would occur to other users within the Arkansas Basin.

Alternative
Internal Transfers Within the Ft. Lyon System

Introduction

This alternative deals with transfers of water shares inside the present Ft. Lyon system. Limited short-term transfers, i.e. leases, currently exist and are not addressed further in this report. Permanent transfers offer opportunity for more efficient use of water in the system.

Purpose

The purpose of this alternative is to develop alternative uses for Fort Lyon Canal Company water within the Canal Company system, maintaining control of permanent transfers of water solely by the shareholders and the Articles and Bylaws. Clearly, the major constraint in this alternative is the apparently limited market which exists for the water inside the system.

Description

A demand for additional water by shareholders irrigating from the lower reaches of the canal, in the Limestone and Lamar diversions apparently exists.

Stock ownership by division is estimated as follows:

Ft. Lyon Canal Division	Irrigated Acres	Estimated Shares	Share Ownership* (Percent)
La Junta Division	2,140	2,191	2
Horse Creek Division	9,280	13,360	14
Las Animas Division	13,960	21,624	23
Limestone Division	29,900	25,818	28
Lamar Division	36,380	31,096	33
*Source: (Smith 1993)	91,670**	93,989	100

*(USGS 1990) Irrigated acres varies from year to year. Annual average for the Ft. Lyon system is identified in the Kansas vs Colorado materials as 92,600 ac. but not broken down by division

Individual farmers may not have sufficient water. As an additional incentive for internal transfer approximately 7,400 acres of class III and class IV soils within the system are being cultivated and irrigated (Table 3.6, p.3-12). Transfer of shares from these soils to use on class II soils, particularly on farms needing additional water, would appear beneficial in terms of increased agricultural production and income. In terms of water, these acres of so called "marginal lands" represent an average annual water supply of about 10,000 af. Transfer of these shares to the FLCC would place the company in control of a considerable block of water having a high potential value for any alternative use.

The present capacity of the Fort Lyon Canal itself restricts downstream transfer of shares. The capacity ranges from approximately 1800 cfs above the Kickingbird bifurcation to 1500 cfs below the

bifurcation, and to approximately 600 cfs near the end of the 100 mile long canal. Enlarging the canal to carry significantly more shares to the lower two divisions would be costly. Hydraulic analysis may identify localized problems which may have cost-effective solutions. In addition to cost, problems include increased water loss due to seepage, environmental concerns and legal concerns on return flow. This alternative therefore would require a feasibility study prior to consideration by shareholders of a change in the by-laws to allow downstream transfers. Given a favorable feasibility report, however, there is reason to believe that the existing supply-demand situation relative to the upper and lower divisions could lead to ready acceptance changes in the by-laws. Analysis of recent irrigated land sales in Bent County and recent sales in Prowers County indicate that a financial differential favoring transfer of water from the upper to lower end of the system does exist.

In addition to internal transfers for irrigation use, there is potential for internal transfers to recreation and wildlife use utilizing Horse Creek and Adobe Creek reservoirs. This alternative assumes willingness of the public, through the Division of Wildlife, to purchase or lease FLCC water to establish and maintain adequate pools of water at these reservoirs for fishing, boating, and waterfowl. It is assumed that a change of use decree would be required for this alternative. No capital outlay for storage and delivery facilities by FLCC would be required as reservoirs and the delivery canal are in place and currently operable.

Transfer of water from the Fort Lyon Canal Company to the Great Plains Reservoirs for recreational uses has been considered. The Great Plains Reservoirs are owned and operated by the Amity Canal Company. While it is true that the Fort Lyon Canal Company provides the transportation for water destined for the Reservoirs, the ownership is vested with the Amity Canal Company. In addition, many of the Amity Canal Company stockholders are extremely interested in selling their water for recreational use in the Great Plains Reservoirs. Cooperation between the two canal companies would appear to be extremely beneficial to all shareholders.

Based upon observations and conversations with various Fort Lyon Canal Company stockholders, it appears that the Colorado Water Supply offer to purchase 51 percent of the Canal Company has provided stockholders with a potential value of water that agriculture can not afford. Refer to Chapter 2. The figure of $2,228 per share less revegetation cost is considered by many to be the value of a share of Fort Lyon Canal Company water stock. Irrigated agriculture does not have the financial capability to buy water at this price. Reportedly, there are shares available at $800 per share, but even at that price they are more than agriculture can pay and still make a profit (Scranton 1993). There does not appear to be any other alternatives uses such as municipal or industrial uses at this time. Potential permanent internal transfers of 10,000 af CU have been identified at the price of $720 to $800 per share or about $600/af. Dryup of 7400 acre of marginal land may result.

Implementation

In the implementation of the internal transfer alternatives, the Fort Lyon Canal Company through its board of directors would be the leading player. For example, assuming a course of action transferring water from marginal lands to recreation use in FLCC reservoirs, the FLCC would be the logical agent for accumulation of shares and for negotiation of required agreements and contracts with participating outside agencies such as the Division of Wildlife.

Presently, by-laws prohibit transfer of water from the upper part of the canal to the lower part, the demarcation point being the approximate location of the Kickingbird bifurcation. Any transfer of water

even within a division requires approval by the FLCC board of directors. Any change in by-laws requires an approval by a majority of shares voted by the shareholders.

However, water may be transferred up stream or within the same division of the canal with Board approval. Internal transfers in the past have been of two types: 1) transfers of shares between shareholders, and 2) transfer of shares from shareholders to the Ft. Lyon Canal Company. Thus, it appears plausible that if the Board of Directors chose to do so and if the shareholders were agreeable, shares could in the future be accumulated by the FLCC and used for the betterment of the company within the current by-laws. These changes are recommended.

Anticipated Results

Limited adverse impacts are anticipated from removal of marginal land from irrigation. The increased flexibility engendered by changes to the operations which support internal transfers will raise the value of Ft. Lyon shares. Also, internal transfers should provide incentives for improvement programs such as canal lining and widening. A preliminary assessment of effect of this alternative is presented in Table 6.2.

Mitigation of Effects

The only economic effects anticipated are the cost of improvements in facilities to be borne by the shareholders. Internal transfers are considered technically feasible; additional investigation is required to determine the extent of changes required and to develop a financing program to pay for facility improvements.

Table 6.2 Internal Transfers Assessment

ALTERNATIVE: INTERNAL TRANSFERS		1: SALE
Indicator Impacts		Preliminary Assessment
I Ft. Lyon System operations	AF	Move about 9400 af C.U.
1 Number of irrigated acres	ACRES	Dry up 7400 ac; "marginal land"
2 Water value	$/AF	Potential increase value above $600
3 Operation cost		Potential increase due to cost of improvements
II Regional Economy		
1 Property tax/tax revenue	$/YR	Gains offset $48,200 loss in taxes due to dry-up
2 Income/spending	$/YR	Gains offset $1.9 million in production
3 Employment	# JOBS	Gains offset $226,000 in spending Gains offset 188 farm and related jobs
III Regional Population & Communities		
1 Loss of population segments		No significant impact
2 Internal conflict		No significant impact
3 Stress related behavior		No significant impact
IV The Natural Environment		
1 T and E, wetlands, habitats		Minimal impacts, system wide
2 Recreation opportunities		Possible gains, if used in rec. at Ft. Lyon Res.
3 On-farm lands		Minimal impacts, with reveg.
V Legal Considerations		
1 Return flows		Minimal
2 Water quality changes		Minimal
3 Transaction costs		Minimal
VI State & Local Administration		
1 Government implementation costs		Possible cost sharing
2 Local influence		Improved
3 Impacts on infrastructure		Minimal

Alternative
Transfer to New Uses in the Valley

Introduction

Transfers to new uses introduces the regional aspects of transfer benefits and effects. Both permanent and temporary transfer strategies are included, as appropriate.

Purpose

In Chapter 5 demands for Ft. Lyon water by municipal, agricultural, and recreational used have been identified. The principal reason the shareholder sells his/her shares is to realize the value of the asset. Past attempts to sell shares and offers to buy shares are noted in Chapter 2.

Description

In this alternative, the Ft. Lyon Canal Company may adopt a set of policies which support the transfer of water shares to the identified uses. In doing so, the company removes barriers to sales while increasing the values of the shares, protecting non-sellers, and assisting in economic development throughout the Lower Arkansas Valley. The following uses and strategies have been identified.

A. Municipal Uses. Two issues are frequently raised regarding existing municipal supplies in the lower Arkansas Valley. First is the use of tributary groundwater supplies as a source supply for municipal uses and the second is quality of these existing supplies. Economic development offices have also expressed a desire to develop commercial and industrial enterprises which may require new sources of high quality municipal water. One method of accomplishing this is through augmentation of new or existing groundwater diversions using Ft. Lyon water. Potential for this use is estimated at about 15,000 af in Ft. Lyon diversions (5400 af CU) and 4250 acres of dryup. Sale of water for these uses may bring shareholders $1600/af.

B. Industrial (feed lot) supply. Although this demand may ultimately be included in the above classification of use, depending upon the approach of the local communities, economic development people have identified expansion of existing livestock feeding operations as a demand. Potential for this demand is set at about 3500 af CU and dryup of 2760 acres, at a sale price of about $1600/af.

C. Recreation and/or wildlife. The use of water for recreation in Colorado is growing rapidly. Several uses of water for recreation/wildlife uses in the Lower Arkansas River Valley have been identified. The uses include the Great Plains Reservoirs which are served by the Ft. Lyon Canal Company through an agreement with the Amity Irrigation Company. As a possible additional recreational/wildlife use, the use of Ft. Lyon water for stabilizing water level at existing Lower Valley reservoirs should be considered. The reservoirs for consideration would be Adobe Creek Reservoir, Lake Meredith, Horse Creek Reservoir, and several smaller reservoirs already under consideration by the Colorado Division of Wildlife. Recreation water use is very controversial in the Lower Valley. The economics of these opportunities may be carefully considered because any movement of water out of agriculture will probably involve dryup of agricultural land and loss of those acres to irrigated crop production. Demand at the Great Plains Reservoirs has been estimated at about 47,600 af in diversions, including water placed in John Martin Reservoir for the Transit Loss Account. If used on a seasonal, dry-year basis through a water option contract the transaction would fallow 40,300 acres. Over a 20-year contract period, with an estimated market value of $60 af C.U., payments to shareholders can be estimated. Income to shareholders under a WROA would be roughly $60/af for each and every year of the contract and an additional $128/af during fallowing of land. For the purpose of illustration and preliminary impact estimates, the long-term lease under a WROA is presented in Table 6.5.

D. Agricultural for irrigation. Demand for additional agricultural water has been identified. However, two factors are significant in shifting Ft. Lyon water to other agricultural locations for use. The first is price. Price elasticity for agricultural water is unknown but apparent demand exists between $8 and $14/acre foot on a lease basis in the basin below Pueblo. Existing facilities are in place to deliver this water. However, costs will accrue to Ft. Lyon's non-participating shareholders if shares are sold or leased and removed from the system. The second factor is timing of delivery to suit the needs of the new user. Storage arrangements are critical to meet this requirement. Potential demand of up to 93,000 af in diversions or 51,800 af CU has been identified in the price range stated above. The Ft. Lyon Canal Company (FLCC) can use two mechanisms to meet this seasonal demand: 1) a FLCC water bank and 2) improvements to facilities inside the system, releasing salvaged water. Both of these are described in preceding sections. Lease of up to 51,400 af CU would potentially fallow 40,800 acres, or up to 44 percent of Ft. Lyon land. It is highly unlikely that the anticipated demand will be met by Ft. Lyon water because farmers outside the Ft. Lyon cannot afford to pay what the Ft. Lyon shareholders will require to forego use of their water. Therefore, no further analysis of this alternative use is provided at this time.

E. Economic development pool. Attracting commercial and industrial enterprises to the lower valley by economic development interests is an ongoing process. Economic development is described in more detail in a later section. A pool of 5000 af CU is considered reasonable. A small water bank would be used as a mechanism to meet these demands on a temporary-transfer basis. Once the developing user is established, permanent transfer to the new use could probably be accomplished. If all of this water was used, 3940 acres would be fallowed. The shareholders participating in the water bank could anticipate up to twice the value of lost production for the leased water, say up to $300/af per season. This cost is anticipated by some municipal water resource managers as a possible cost of temporary dry-year water made available on short notice to shareholders.

Implementation

Should the Ft. Lyon shareholders decide to pursue this alternative, they would need to adopt by-laws to accomplish implementation. One action could be to jointly pursue a water court decree to allow the new uses and administer transfers. Land management regulations and revegetation standards would be developed. Although the alternative is feasible, details of such a plan and the resulting water court trial proceedings would require careful study and development of a financing plan.

Anticipated Results and Mitigation of Effects

Depending upon the development targets, proceeds to the shareholders could reach $33.4 million for sale in the recreation use to $6.8 million for sale in the municipal use. Losses in farm jobs and farm sector income would result. In the instances of sale of shares, wetlands impacts and effects on wildlife habitat would be considered, all across the Ft. Lyon system on a company-wide basis. Opportunities for mitigation of these impacts on the natural environment could be handled by the Ft. Lyon Canal Company or a subgroup of shareholders as a party to the mitigation plan. Refer to Tables 6.3 to 6.7.

Economic impacts on agribusiness would be significant. However, it is anticipated that, due to the local nature of the water transfers and the general increase in the value of shareholder equities, placement of water in the new uses would create offsetting positive economic impacts in other sectors of the economy. While such a result has been predicted for water transfers into recreation in the case of the Great Plains Reservoirs and a future State Park (Eubanks 1989)., many assumptions involved result in the widely varying projections of economic benefits.

Table 6.3 Municipal Transfers Assessment

ALTERNATIVE: TRANSFER TO LOCAL MUNI USES		2A: SALE
Indicator Impacts		Preliminary Assessment
I Ft. Lyon System operations	AF	Move about 5400 af C.U.
1 Number of irrigated acres	ACRES	Dry up max of 4252 ac
2 Water value	$/AF	Potential increase above $1600
3 Operation cost		Some increase in maint. cost due to change in operations
II Regional Economy		
1 Property tax/sales tax revenue	$/YR	Gains offset $27,706 loss in taxes due to dry-up
2 Income	$/YR	Gains offset $1.1 mil loss in production
3 Employment	# JOBS	Gains offset $884300 loss in spending Gains offset 132 farm and related jobs
III Regional Population & Communities		
1 Loss of population segments		Initial increase
2 Internal conflict		Initial increase
3 Stress related behavior		Offsetting effects
IV The Natural Environment		
1 T and E, wetlands, habitats		Minimal impacts, system wide
2 Recreation opportunities		No significant impact
3 On-farm lands		Minimal impacts, with reveg.
V Legal Considerations		
1 Return flows		Must consider in transfer
2 Water quality changes		Offsetting adverse effects
3 Transaction costs		Some adverse effects
VI State & Local Administration		
1 Government implementation costs		Moderate costs
2 Local control		Minimal impact
3 Impacts on infrastructure		Revenue gains offset more use

Table 6.4 Industrial Transfer Assessment

ALTERNATIVE: TRANSFER TO LOCAL INDUSTRIAL/COMMERCIAL USE		2B: SALE
Indicator Impacts		Preliminary Assessment
I Ft. Lyon System operations	AF	Move about 3500 ac C.U.
1 Number of irrigated acres	ACRES	Dry up max of 2756 ac
2 Water value	$/AF	Potential increase above $1600
3 Operation cost/share		Some increase/share for maint.
II Regional Economy		
1 Property tax/sales tax revenue	$/YR	Gains offset $17,957 loss in taxes due to dry-up
2 Income	$/YR	Gains offset $715,000 loss in production
3 Employment	# JOBS	Gains offset $220,400 loss in spending Gains offset 86 farm and related jobs
III Regional Population & Communities		
1 Loss of population segments		No significant change, if water goes to feed lots
2 Internal conflict		No significant effects
3 Stress related behavior		No significant effects
IV The Natural Environment		
1 T and E, wetlands, habitats		Minimal impacts, system wide
2 Recreation opportunities		No significant effects
3 On-farm lands		Minimal impacts, with reveg.
V Legal Considerations		
1 Return flows		Must consider in transfer
2 Water quality changes		Possible offsetting adverse effects
3 Transaction costs		Some adverse effects
VI State & Local Administration		
1 Government implementation costs		Moderate costs, offset by gains
2 Local control		Minimal impact
3 Impacts on infrastructure		Revenue gains offset more use

Table 6.5 Recreation/Wildlife Assessment (Lease)

ALTERNATIVE: TRANSFER TO LOCAL REC/WILDLIFE		2C: LEASE
Indicator Impacts		Preliminary Assessment
I Ft. Lyon System operations	AF	Lease up to 26,500 af C.U.
1 Number of irrigated acres	ACRES	Fallow up to 40,300 ac
2 Water value	AF	Potential increase above current
3 Operation cost		Significant increase
II Regional Economy		
1 Property tax/sales tax revenue	$/YR	No significant change
2 Income/spending	$/YR	Gain $1.6 mil (9:10) yr in income; Loss $0.4 mil (1:10 yr) in spending
3 Employment	# JOBS	Gains offset 183 net loss in (1:10) yr
III Regional Population & Communities		
1 Loss of population segments		Temporary loss in dry year; mitigate
2 Internal conflict		Unknown
3 Stress related behavior		Possible net decrease (1:10 yr increase)
IV The Natural Environment		
1 T and E, wetlands, habitats		Some effects, mitigate
2 Recreation opportunities		Significant gains
3 On-farm lands		Minimal long term effects
V Legal Considerations		
1 Return flows		Temporary effects must consider
2 Water quality changes		Unknown
3 Transaction costs		Unknown
VI State & Local Administration		
1 Government implementation costs		Significant state cost
2 Local control		Some state, some local
3 Impacts on infrastructure		Increased local cost for growth Potential adverse effects

Table 6.7 Economic Development Assessment (Lease)

ALTERNATIVE: TRANSFER TO ECONOMIC DEVELOPMENT POOL		2E: LEASE
Indicator Impacts		Preliminary Assessment
I Ft. Lyon System operations	AF	Temporary move of 5000 af C.U.
1 Number of irrigated acres	ACRES	Fallow of 3940 ac
2 Water value	$/AF	Potential increase above market
3 Operation cost		Minimal change/share
II Regional Economy		
1 Property tax/sales tax revenue	$/YR	Potential increase
2 Income/spending	$/YR	Gain of up to $500,000 in income Gain of up to $300,000 in spending
3 Employment	# JOBS	Net gain of 18 in lease year
III Regional Population & Communities		
1 Loss of population segments		New opportunities; net gain
2 Internal conflict		Possible conflict between residents
3 Stress related behavior		Possible decrease
IV The Natural Environment		
1 T and E, wetlands, habitats		Minimal impacts, system wide
2 Recreation opportunities		Possible gains as spin-off
3 On-farm lands		Minimal impacts; with fallow
V Legal Considerations		
1 Return flows		Must consider and mitigate
2 Water quality changes		Potential adverse effects
3 Transaction costs		Minimal impacts; with fallow
VI State & Local Administration		
1 Government implementation costs		Possible cost sharing; SEO costs
2 Local control		Possible gain in local control
3 Impacts on infrastructure		Revenue gains offset greater use

Transfer to New Uses Out of the Lower Valley: Leases to the Metropolitan Area Users or Others

Introduction

This alternative focuses on options for shareholders outside the valley. Permanent transfer, should it occur, is Alternative 4 which follows. This alternative presents temporary transfers.

Purpose

The purpose of this alternative is to facilitate the temporary use of Ft. Lyon water in dry years in the Denver Metropolitan area through the use of long-term contracts. The reason for development of this alternative is to exploit a municipal market for dry-year water supply with a significant future demand and demonstrated ability to pay. The ultimate goal is to provide sustained income for the Ft. Lyon shareholders, while retaining ownership of the water rights with the Ft. Lyon shareholders.

Description

The purpose of creating an interruptible supply contract, sometimes called a water right option contract (WROA) or a drought insurance agreement, is to temporarily transfer water to a water user for a special purpose. The WROA is a long-term agreement to lease water on an occasional basis triggered by special circumstances, such as a dry year requirement in the Denver basin. Thus, a temporary supply can improve the user's long-term reliability without outright purchase.

The WROA is defined in this alternative as an agreement between a water owner, such as a shareholder or the FLCC itself, and a water user outside the FLCC system. A WROA is developed in three parts: 1) an engineering analysis of the temporary transfer to the new location of use, 2) a financial analysis to determine amount and schedule of compensation, and 3) a contract document. These elements are described in some detail in Appendix 6.3. The potential shortfall in available yield in the Denver basin may be as high as 98,000 af in the year 2010, as cited in Table 5.1. A preliminary estimate of dry year yield of Ft. Lyon water, say one year in ten (1:10), is 0.52 af CU/ac. Assuming the entire Ft. Lyon system would be fallowed, allowing a 20 percent loss due to exchanges and transit losses in the Upper Arkansas and the South Platte Basins, and maintaining return flows to the Lower Arkansas River, the yield of the Ft. Lyon to the metro area is approximately 92,600*0.52/1.2 = 40,000 af CU. in the dry year. Thus, there appears to be potential for movement of Ft. Lyon water to the metropolitan area in dry-years.

From Chapter 3, Ft. Lyon water purchased for agricultural use may bring $720/share/1.27 or about $600/af. The same purchase for municipal use may bring $2000/share/1.27 or about $1600/af. Therefore, from the analysis in Appendix 6.3, the net present value cost (NPV cost) to the user for Ft. Lyon water through an WROA may be $1200/af to $2700/af. In this range, the NPV cost of about $1300/af is the most probable. This estimate does not include possible water quality concerns and treatment costs, which may pay a significant role in the viability of this alternative.

This cost carries the assumptions that:

- discount rate is 4 to 6 percent over inflation for a 20-year contract
- company annual assessments paid by the shareholder
- option is exercised at about 1 in 10 years, but is a random variable and can occur in any year

Compensation to the shareholder, assuming alfalfa at 3.5 ton/acre, is approximately: $59/af C.U. for each and every year of the contract plus $128/af C.U. in the year of option. These data translate to $75/share and $162/share, respectively. The figure of $75/share, at 4 percent discount for 20 years, is equivalent to an "inducement payment" at the inception of the contract of $1019/share.

Implementation

An approved substitute supply plan or permanent change decree would be required for the temporary transfer. An application could be made to the State Engineers Office or water court which would stipulate conditions for temporary transfer of Ft. Lyon water and most likely include requirements for land fallowing. As a minimum, the conditions would include assessment of transit losses, allowance for return flow management, and water accounting requirements. Review of the plans by the State Engineer's Office for adequate protective terms prior to operation would help assure that other water users would not bear the substantial costs of policing the plan. Those benefitting from the plan may need to bear the costs of the state engineer's review, as that office may not have adequate funds and staff to review the plan. The adopted plan would assist the SEO and the FLCC in managing the water so as to prevent injury to other water rights.

Interruptible supply raises legal questions in terms of article/bylaw changes of FLCC, state water law non-injury) and Arkansas River Compact material depletion. Articles and bylaws changes allowing temporary transfers would be required, and would rest on the ability to deliver water satisfactorily to the non-participating shareholders. An engineering solution is probably most important, so as to minimize delivery problems to the remaining shareholders in the laterals. Laterals wholly transferred would not require the same protections. Further, leaving a portion of the water in the ditch to pay for any increased transit losses in the main ditch and laterals would probably be required. These situations could be modeled and calculated.

Injury to other ditches and to Kansas may be avoided by assuring continued return flows in the place and time historically available. Legal requirements would be imposed to assure continuation of those return flows. Some return flows would be lagged over time; releases from storage in future years may be necessary to replace the return flow losses. Dedication of some storage releases from the FLCC storage reservoirs, and possibly FLCC waters in Pueblo Reservoir or John Martin Reservoir would be required for this purpose.

Interruptible supply contract with an individual farmer would be necessary. Enforcement of fallowing, and assurances of no additional well pumping would be important. Aerial photography and on-the-ground monitoring could be used to monitor these requirements.

Costs of modeling, enforcement, administration within the ditch, and other transaction expenses would need to be borne by those benefitting from the transfer. The FLCC should be indemnified from those costs. Such indemnity could be part of the articles and bylaws allowing such temporary transfers and providing for review and approval of such transfers by the FLCC board of directors. On the other hand, the FLCC could assume these costs as part of a system-wide management plan and collect part of the transaction proceeds as reimbursement.

Means for delivery of water to the user in dry years is crucial. Exchange of water upstream is one possibility. Implementation of the plan by exchange is highly unlikely due to senior exchanges near Pueblo Reservoir. The other possibility is a pipeline system; this system would be costly. However, potential may exist for reciprocal use of the pipeline to bring water to Lower Valley uses in average

and wet years. This possibility needs further analysis, but if feasible, may make the project cost effective.

Anticipated Results and Mitigation of Effects

It is anticipated that by adopting supporting bylaws and operating policies within the Ft. Lyon System to facilitate WROA, there will be an overall benefit to shareholders. The benefits result from the increased flexibility to Ft. Lyon water users in a dry year and produce an additional income stream for shareholders wishing to participate. Since the WROA involves a long-term contract and includes a triggering condition, provisions of such a contract would be known and understood in advance by all shareholders potentially affected by the temporary transfer. Refer to Table 6.8. The preliminary assessment does not include possible benefits of reciprocal use.

Benefits to the local communities and to non-participants may be limited because the transferred water may not be put to uses which sustain an income stream to these non-participants in a dry-year. This is especially true if WROA are developed with Front Range cities. Land will be temporarily removed from production in the option year, decreasing the need for seed, fertilizers, fuel and other agribusiness products and services. Farm labor will be similarly affected. It may be possible to offset these temporary effects by directing a portion of the compensation derived from WROA contracts to fund special projects in the study area.

Table 6.8 Municipal Use in Metro (Lease)

ALTERNATIVE: TRANSFER TO OUT OF VALLEY USE		3: LEASE
Indicator Impacts		Preliminary Assessment
I Ft. Lyon System operations	AF	Transfer up to 110,000 af (dry year)
1 Number of irrigated acres	ACRES	Fallow up to entire system; < 92,600 ac.
2 Water value	$/AF	Potential increase in value
3 Operation cost		Unknown; varies with participation
II Regional Economy		
1 Property tax/sales tax revenue	$/YR	No change; potential increase
2 Income/spending	$/YR	Gain of $7.2 mil (9:10 yr) Loss to $9.6 mil (1:10) in spending
3 Employment	# JOBS	Gain in most yrs; up to 2100; Offsets 780 farm jobs (1:10)
III Regional Population & Communities		
1 Loss of population segments		Potential increase; dry yr; mitigate
2 Internal conflict		Potential increase; dry yr;
3 Stress related behavior		Potential increase, dry year; offset by increased stability
IV The Natural Environment		
1 T and E, wetlands, habitats		Widespread but temporary; mitigate
2 Recreation opportunities		Unknown but unlikely
3 On-farm lands		Minimal impacts; mitigate
V Legal Considerations		
1 Return flows		Significant but temporary
2 Water quality changes		Unknown
3 Transaction costs		Unknown
VI State & Local Administration		
1 Government implementation costs		Possibly significant for dry year
2 Local control		Possibly increase
3 Impacts on infrastructure		Minimal

Other Alternatives
Accept an Offer to Sell 51 Percent of the System
Adopt No Alternative Action (Status Quo)

Introduction

Alternatives other than the preceding actions can be considered. Two other alternatives remain for the shareholders. The first is to accept the next offer to sell. The second is to adopt no cooperative action as an alternative to any offer to sell. Ft. Lyon water may move out of the basin or become devalued.

Description

Acceptance of offers is speculative because no current offer is at hand. However, discussion of two efforts to buy/sell Ft. Lyon water are presented in Chapter 2. For purposes of quantification, potential exists for sale of 51 percent of the Ft. Lyon shares, representing about 60,900 cu. See Table 3.7. Approximately 48,000 acres would be dried up. Sale at the estimated price of $1600/af would be $97.4 million plus revegetation costs.

If no action is taken, the future is equally uncertain. However, risk of devaluation should be considered. If the potential uses identified in alternatives A1, A2 and A3 are satisfied by other water. Ft. Lyon water may no longer be competitive for these other uses. No economic motivation will exist for temporary or permanent transfer under conditions which may be favorable to the shareholders of the Ft. Lyon Canal Company.

Anticipated Results and Mitigation of Effects

Results of either of these alternatives are unknown except in speculation. Losses to income and jobs can be estimated but are highly suspect due to the unknown economic conditions in the study are at the time of transfers, if any. However, some economic effects are estimated for the purpose of discussion in Table 6.9. Economic mitigation through economic development is also presented in some detail in the following sections.

Table 6.9 Offer to Purchase Assessment (Sale)

ALTERNATIVE: ACCEPTANCE OF OFFER OUT OF VALLEY		4: SALE
Indicator Impacts		Preliminary Assessment
I Ft. Lyon System operations	AF	Move about 60,900 af C.U.
1 Number of irrigated acres @ 51%	ACRES	Dry up about 48,000 ac
2 Water value	$/AF	Possible gain or loss in value
3 Operation cost		Possible increase
II Regional Economy	$	Loss in assessed valuation of $3.9 mil
1 Property tax/sales tax revenue	$/YR	Loss of $313,000 (property tax only)
2 Income/spending	$/YR	$21.9 to 47.5 mil income offset by $12 mil/yr loss in production; $6.8 net loss in spending
3 Employment	# JOBS	Net loss of 1130 to 1328 jobs
III Regional Population & Communities		
1 Loss of population segments		Significant losses
2 Internal conflict		Significant increase
3 Stress related behavior		Significant increase
IV The Natural Environment		
1 T and E, wetlands, habitats		Significant impacts; not quantified
2 Recreation opportunities		Some loss: not quantified
3 On-farm lands		Significant impacts; mitigate
V Legal Considerations		
1 Return flows		Significant consideration
2 Water quality changes		Unknown; depends upon diversion point
3 Transaction costs		Significant impacts; especially third parties
VI State & Local Administration		
1 Government implementation costs		Increase in social services cost
2 Local control		Probable decrease in control
3 Impacts on infrastructure		Deterioration

Mitigation of Economic Impacts: Economic Development Packages

The Arkansas River is the source of water for the majority of activities throughout the study area. Some smaller towns and individual farms and ranches rely on deep ground water, but the majority is supplied by the Arkansas River and its aquifer.

The five counties that comprise the study area are all rural with an agricultural background and agricultural based economies. The life styles and attitudes of the area's residents tend to reflect this rural heritage. Although the study area may not have all of the amenities found in the Front Range's larger cities, the majority of the area is within a four hour drive or less of Pueblo, Colorado Springs and Denver, as well as the mountains for summer and winter recreation. The majority of the people living within the study area seem to prefer their style of living.

These five counties all have resources to provide for economic development. These resources include land, clean air, water, agricultural raw products and labor. The majority of the municipal and irrigated agricultural development in this region has taken place in narrow bands along the Arkansas River Valley or its tributaries. Lands further away from the river are native grass livestock ranches or dry land farms. There is ample land available that is well suited for most types of industrial or manufacturing development.

One method to help stabilize the economic, social and environmental impacts of alternative water transfer schemes is through a well conceived, planned and executed economic development program developed jointly with the federal, state and local agencies. The local citizens, existing industries and potential new industries, would participate in the planning process.

One approach to economic development involves the use of existing or new agricultural products grown in the study area. The concept is to grow new crops or more livestock and manufacture products using those crops or livestock in local processing plants. Another concept is to combine the agricultural economy with technological development. It need not be manufacturing on a large scale but it can foster rural enterprises that bring 50, 100 or 200 jobs to a rural community to offset forming sector jobs lost due to transfers of water. These concepts are currently under development by USDA scientists. (New Crops, New Uses, New Markets 1992)

The study area currently has the potential to provide a wide variety of fruit and vegetables, feed crops and livestock for raw products in manufacturing. New agricultural commodities are being examined at this time for introduction into the area. An example is the edible soybean which is an excellent source of protein and is widely used in Japan. There are other potential new crops and livestock that could be produced in this region for domestic and foreign markets.

Another approach includes relocation of industries from the Front Range of Colorado into the study area. To be attractive and vital, the infrastructure of the study area needs improvement. Key items include the completion of a four lane highway from Pueblo to the Kansas state line, development of air passenger and freight service and enhanced rail service. Municipal and industrial water quality and sewage disposal for some of the study area's towns and cities needs evaluation. Water for these industries is available from most municipal water systems within the study area; however, water quality may have to be improved for some industries. These actions within the study area will improve the potential for economic development that could reverse the declining population and economy. Economic mitigation programs would consist of public and private investment with the objective of creating economic diversity and opportunity within the economic development activities that are

already in place. The region also has an abundant supply of labor available. The labor force has a variety of job related skills to offer. Refer to Chapter 4.

The six counties in Southeast Colorado, i.e., Baca, Bent, Crowley, Kiowa, Otero and Prowers, have joined together in forming Southeast Colorado Enterprise Development, Inc., an enterprise zone. The only county involved in the enterprise zone that is not a part of the Study Area is Baca County. This enterprise zone is the result of Colorado's Urban and Rural Enterprise Zone Act of 1986 which established a program for the designation of state enterprise zones. The enterprise zone program provides the following incentives for private enterprise to expand and for new businesses to locate in economically distressed areas of the state (Colorado EZ Facts 1992).

1) Three percent investment tax credit.
2) $500 job tax credit.
3) Double job tax credit for agricultural processing.
4) $200 job tax credit for employer health insurance.
5) Research and Development tax credit.
6) Credit to rehabilitate vacant buildings.
7) Credit for contributions to zones.
8) Exemption from state sales and use tax for manufacturing, mining and aircraft equipment.
9) Local government tax incentives.

According to Jan Goedert, Executive Director and Enterprise Zone Administrator, for the Southeast Colorado Enterprise Development, Inc., southeast Colorado businesses have received over $2,000,000 in credits. Linkages could be established between mitigation payments from water transfers and ongoing economic programs.

Bent County has seen five separate developments occur within the past five years. The Bent County Development Foundation, Inc., was formed due to the recognition by local leaders that an organized effort to support economic development was needed. This organization is a public-private partnership, with funding coming in equal parts from the City of Las Animas, Bent County and the private sector. The initial organizational period has been completed and marketing materials have been developed. The Foundation is now embarking on marketing Bent County to business prospects and undertaking studies necessary to implement downtown renovations.

With the purchase of land and formal designation of an industrial park, the City of Las Animas is ready to evaluate any prospects for development. The industrial park was the site being considered when the feasibility study regarding soybean processing was undertaken. The facility is reasonably close to rail and highway transportation and has room for expansion to handle any size of development project.

A private prison was financed and constructed by Diversified Municipal Services of Lebanon, Indiana. Bent County is buying and operating the prison as a long-term economic project. It is the first of it's type in Colorado. The prison will house 309 prisoners and is a restricted minimum-security facility that will help reduce the over crowding within the state prison system. This facility has provided 78 new jobs for the area with a total payroll of $150,000 per month. The prison was built at a cost of $9 million.

Kiowa County has two recent examples of economic development. It has taken the lead in development of the Great Plains Reservoirs into a recreational area. These lakes are located in Kiowa County, South of Eads and Kiowa County officials and residents feel that an assured water supply for the lakes could enhance recreational opportunities and create economic development in the area. The Great Plains Reservoir State Park has been approved by The Governor and is the initial stages of development. The second example is a major hog breeding operation which is now in place. Efforts are underway to develop the necessary support businesses and water supply. Otero County has recently brought into the area two manufacturing companies from Minnesota. These are the Debourgh Manufacturing Company and Lewis Nut and Bolt Company. Prowers County has seen economic development take place through the Neoplan Bus Company and a number of satellite industries, and is working to continue growth.

One key element for local support of economic development is the two community colleges, Lamar Community College in Lamar and Otero Junior College in La Junta have the ability to offer specialized short term classes to meet the needs on new or relocated industries within the Study Area. Both junior colleges have developed and taught a number of courses for new industries. Both colleges are aggressive and willing to take the lead in developing the necessary criteria for these specialized courses and an industrial management team to meet their requirements.

In summary, counties and communities within the study area are very active in economic development activities. If mitigation of economic effects of transfers is appropriate, some opportunities for application of mitigation funds exist. These include: infrastructure projects, water purchasers for water supply pools to attract new industry, research/development funds to support new promotions, relocation of Front Range industries, etc. Mitigation funds can also be used to retrain farm workers in new occupations. The existing economic development organization can provide experienced personnel and ideas for economic mitigation packages, which will be most suitable for specific circumstances of a water transfer alternative.

Mitigation of Land Dryup: Revegetation

Most alternatives described above include some changes to land management. The basic elements of dryup, revegetation and land fallowing may be considered in any alternative scheme.

Historical transfers in the Arkansas River Valley have dried up significant portions of formerly irrigated lands. Until recently, little success in revegetation had been obtained. (Refer to Review of Revegetation Activities in Appendix 6.4). The Arkansas Valley Revegetation Project began in 1985 on farms in Crowley and Otero counties (Miller and Conrad 1990).

The largest revegetation project in the Arkansas Valley is the ongoing Rocky Ford Ditch Revegetation project conducted by the city of Aurora. This project involves approximately 4,100 acres and 52 percent of the land under the Rocky Ford Ditch. Revegetation activities were started in 1988. As of December 1992, approximately one third of the land has been successfully revegetated. An intensive weed control program, using mowing and herbicides, has been necessary on all of the fields. Six grass species make up the basic seed mixture used on the Rocky Ford Ditch project. These include: western wheatgrass, blue grama, sideoats grama, alkali sacaton, yellow bluestem, and galleta.

Reliable cost data for revegetation has not been available until recently. Revegetation of land under the Colorado Canal was originally estimated to cost $40-$60 per acre. (Sutherland & Knapp 1988) These efforts have been only 35 percent successful to the present. Cost of the revegetation on the

Rocky Ford Ditch project, including all field operations plus local office and management costs is running between $280 and $300 per acre. Weed control has been the biggest problem and also the most costly, accounting for about two thirds of the field costs (Knapp 1993). The court appointed team evaluating the Rocky Fort project suggested that land preparation and irrigation methods were areas of Aurora's program which needed improvement (Dennis, Moss and Nielsen 1992). Future studies and field-evaluation of revegetation techniques should probably focus on those two aspects.

Interest has been shown in including new trees in revegetation, for commercial and aesthetic uses. Viability of trees in the Arkansas Valley is discussed by Nielsen in Appendix 6.4. Without water from a canal or direct irrigation, few trees would exist naturally in the study area except along the river.

Land Fallowing: Guidelines

A farmer in a fallow program would have the rate of flow at his headgate reduced when some of his land is not irrigated. This decreased head of water would appreciably decrease his irrigation efficiency on non-fallowed fields. Loss in efficiency would be greatest on alfalfa and grain crops where flooding, corrugations, or borders are the irrigation methods used. These methods require a relatively high inflow of water at the head of the field. Irrigation methods would therefore need to be examined prior to starting a large-scale fallowing program. Problems in canal operation would occur as in any alternative which reduces canal flows. Problems would be more severe if fallowed lands were concentrated in any one division of the Ft. Lyon system, unless improvements were made to existing flow control structures.

Under climatic conditions existing in the Arkansas Valley, two consecutive years of fallow would leave the land highly vulnerable to wind erosion, a risk not acceptable to the average farmer or to the community. However, from the standpoint of conservation and crop management, a one year fallow program appears to be feasible. Technology is available to control weeds and protect the land during a one year period. Farmers could adjust their cropping systems to bring the fields back into full production the following year. Refer to Appendix 6.5 for a case study of a test land fallowing program (Metropolitan Water district 1992).

In summary, the land fallow alternative is feasible provided that the period of fallow on any field is limited to one year. Unless corrective measures are taken, a marked decrease in irrigation efficiency would occur on non-fallowed fields due to reduction in head of water available. Some method of enforcement is required to assure water is not applied to fallowed land. Junior appropriators could be injured if safeguards are not put in place. Problems in canal operation would occur as in any alternative reducing canal flows. Dryup, revegetation or land fallowing will be included in almost any alternative water use considered. The Ft. Lyon Canal Company should play an active role in land management programs to assure coordination of management activities and protect non-participating shareholders.

Augmentation Planning and Return Flow Accounting

As developed earlier, no new depletions can occur in the valley. Prior to the implementation of any alternative discussed within this report detailed studies of the depletions and return flows must be performed to ensure that no material injury will occur to senior water rights holders. These detailed studies generally result in applications in the water court for water rights Changes of Use, Plans for Augmentation, or Exchange Plans. As a result of these established water court procedures senior water right holders will be protected from injury in the implementation of alternatives.

Wetland and Habitat Replacement

Means must be identified to compensate for significant losses to wetlands and habitat affected by implementation of alternatives. Mitigation of losses through planning for consolidation or improvements to other wetlands of particular merit should be considered. The assistance and participation of appropriate agencies and experts would be required.

Preliminary Conclusions and Recommendations

Economic, social and legal impacts of the selected alternative water transfer schemes are extremely variable. Variability is due to two factors. First, the magnitude of the transfer potential is dictated by the identified potential use for the water in the new location. The second factor is the strategy utilized. Permanent transfers appear to produce larger economic and social impacts; temporary transfers appear to produce more offsetting and transitory impacts. Sales to municipal and industrial users appears to be least disruptive with possibilities for offsetting benefits if these uses materialize. Temporary transfers for recreational uses and/or economic development seem to offer potential for income streams to shareholders, and to the communities through multiplier effects. Legal aspects of all of the above mentioned possibilities would be addressed through careful analysis of mechanisms and engineering hydrologic studies, coupled with the possibility of obtaining a water court decree for changes in location and type of use.

Decision as to merit of any alternative for further study rests with the Colorado Water Conservation Board, after consultation with and comment from all interested parties.