Water Partnerships

AN EVALUATION OF ALTERNATIVE AGRICULTURAL WATER TRANSFER METHODS IN THE SOUTH PLATTE BASIN

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Consultants, Inc.

March, 2012

Prepared for

the Farmers Reservoir
and Irrigation Company

and

Colorado Water
Conservation Board

In Association with:

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ACKNOWLEDGMENTS

This report and the associated research were made possible by a grant from the Colorado Water Conservation Board (CWCB) through the Alternative Agricultural Transfer Methods Program under the guidance of Todd Doherty, CWCB Planning staff.

The Farmers Reservoir and Irrigation Company (FRICO) provided cash funding and in-kind services for this project and participated in the survey of FRICO Barr Lake agricultural shareholders, analysis of the alternative transfer mechanisms and the shared water bank modeling. In addition to the Board of Directors, current and former staff that provided in-kind services include: Scott Edgar, Geneva Sandusky, James Lester, Diana Medina, Rose Murphy, Molly Lockhart, Mary Hansen, Manuel Montoya, John P. Akolt and John C. Akolt.

Todd Doherty, Dieter Erdmann, Marshall Frasier, Manuel Montoya, John C. Akolt, James Pritchett, Reagan Waskom and the FRICO Board and staff participated in the water market experiments and provided valuable insight. Seminar audiences at Colorado State University, University of Wyoming, and the South Platte Forum provided helpful comments and suggestions. Carolyn Davidson and Christopher Nicoletti helped conduct the market experiments.

Todd Doherty, members of the Intrastate Basin Compact Committee Alternative Agricultural Transfer subcommittee, Chuck Howe, Sean Cronin and Nancy Koch provided suggestions on the municipal and industrial provider survey. The 22 providers that graciously provided time to participate in the municipal and industrial survey provided feedback that will be used to guide future development of alternative agricultural transfer methods.

Mark Koleber and Emily Hunt, City of Thornton and Jim Jones and Curtis Bauers, South Adams Water and Sanitation District participated in workshops on shared water banking and provided data used in the example modeling of a shared water bank.

Graphic Design : Jeremy Carlson

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1. INTRODUCTION

The Colorado Water Conservation Board (CWCB), through the Statewide Water Supply Initiative (SWSI), identified that

- Colorado faces significant and immediate water supply challenges.
- The State's population is expected to nearly double within the next 40 years.
- A continuation of current trends will lead to a larger transfer of water out of agriculture.

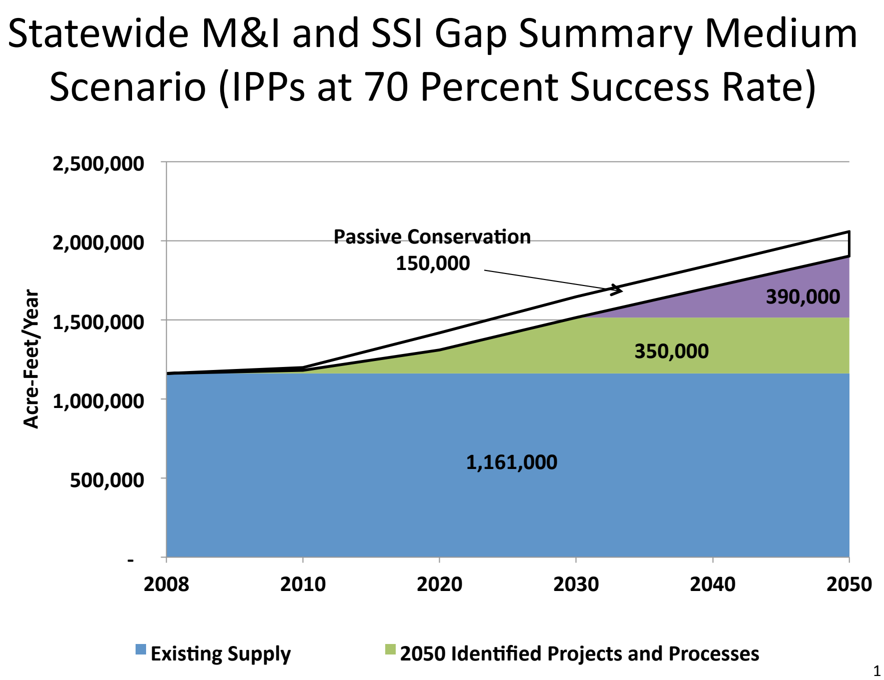
A key finding of the CWCB planning efforts is that Colorado faces a shortage of water for meeting the state's consumptive and nonconsumptive water needs. In order to meet Colorado's water management objectives, a mix of local water projects and processes, conservation, reuse, agricultural transfers and the development of new water supplies should be pursued concurrently (CDM 2011).

Many municipal and industrial (M&I) water providers identified the transfer of agricultural water rights to M&I use as a means of meeting future water demands. These transfers will result in the loss of irrigated acres. The projected losses in irrigated acres vary widely based on the assumed population growth, future water demands, water conservation, the success of identified projects and processes (IPPs) and new water supply development.

IPPs include agricultural water transfers, reuse of existing fully consumable supplies, growth into existing supplies, regional in-basin projects, new transbasin projects, firming in-basin water rights and firming transbasin water rights. Additional water supply development projects in the future will also help meet these future demands.

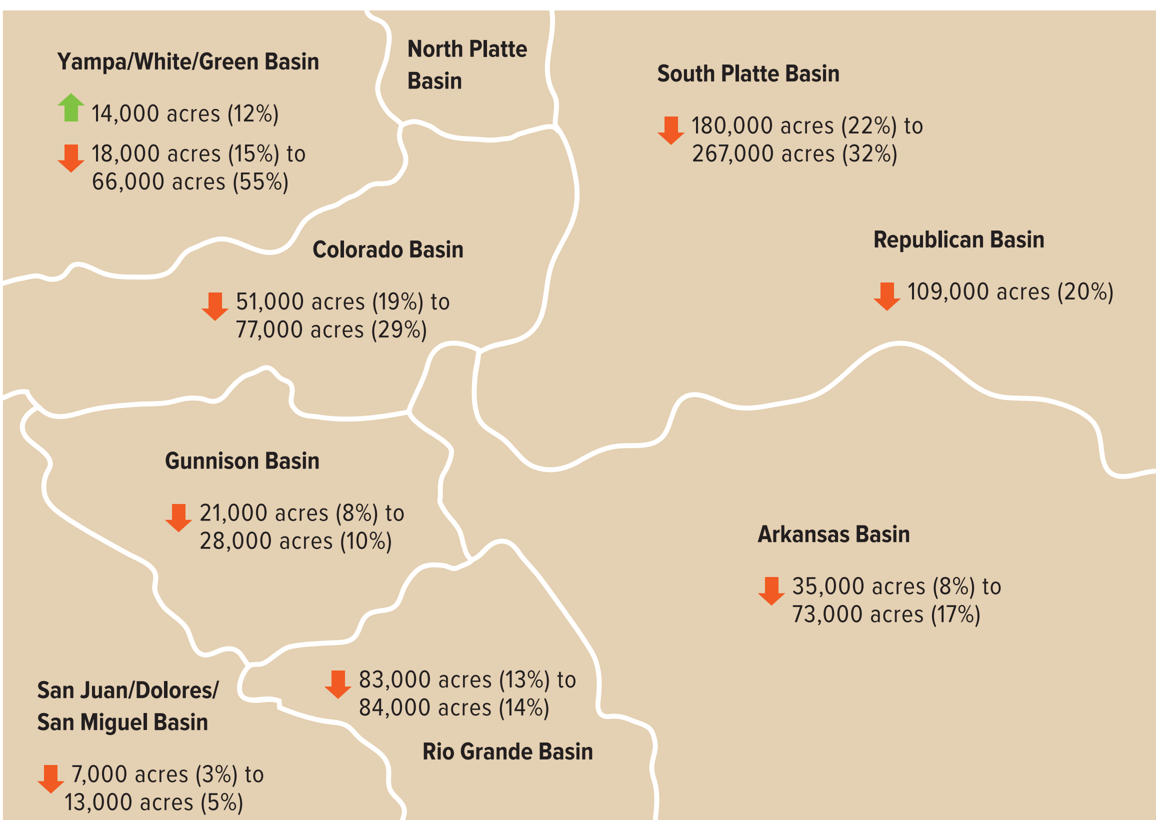
Figure 1-1 shows the estimated projected water demands under a medium-growth scenario. It also shows estimated existing supplies, yield of IPPS at a 70 percent success rate, savings from passive conservation, and the remaining water supply gap. Water demand is projected at approximately 1.8 million acre-feet after passive conservation savings, with a remaining gap of 390,000 acre-feet per year (AFY.) The CWCB, as part of the SWSI planning efforts, identified the range of potential losses in irrigated acres in

Figure 1-1. Estimated Projected Water Demands Under Medium-Growth Scenario



Source: CDM (2011)

Figure 1-2. Potential Changes in Irrigated Acres, 2000–2050



Source: CDM (2011)

each basin. Updated estimates of potential losses in irrigated acres by 2050 are shown in Figure 1-2.

One of the outcomes of the SWSI planning efforts was the recognition that the State of Colorado might be able to provide incentives for M&I providers to consider alternative methods for their water supply options. In response, the legislature authorized the CWCB, in Senate Bill 07-122, to develop a grant program to facilitate the development and implementation of alternative agricultural water transfer methods. Since its inception in 2007, the CWCB's Alternative Agricultural Water Transfer Methods Grant Program has awarded grants to various water providers, ditch companies and university groups for the funding of projects.

The purpose of the program is to study alternatives to the typical "buy-and-dry" approach to agricultural water transfers. Initial emphasis of the program was on the South Platte and Arkansas river basins, but it has now been expanded to all basins in the state. Projects include field research and deficit irrigation and quantification of consumptive use savings; research regarding establishment of water banks; research on new institutional and legal mechanisms to facilitate alternative water transfers; and creation of tools to help agricultural producers and others evaluate the economic feasibility of alternative water transfers. Rotational fallowing, interruptible supply agreements, water banks, purchase and lease backs, deficit irrigation and changing crop types are the kinds of options that are available as alternatives to permanent agricultural transfers. With the exception of purchase and lease backs and some limited occurrences of short-term leasing, these alternative agricultural transfer methods (ATMs) are just beginning to be explored as viable options for meeting M&I water demands. While promising, there are technical, legal, institutional and financial issues associated with ATMs. The CWCB and others through this grant program are currently exploring ways to address these issues utilizing incentives to gain greater awareness, interest and participation from agricultural water users and municipalities with alternative agricultural water transfers (Colorado Water Conservation Board/CDM, 2011).

Through the CWCB's ATM Grants Program, numerous hurdles have been identified that must be overcome for these alternative water transfer methods to be successful in Colorado. The major hurdles facing the implementation of ATM programs in Colorado include:

1. High transaction costs.

2. Water rights administration.

3. Certainty of long-term supply.

South Platte Diverted into Burlington Ditch, 1910.
Photo courtesy of Denver Public Library
Western History/Genealogy.

2. PROJECT DESCRIPTION

The Farmers Reservoir and Irrigation Company (FRICO) is a recipient of a grant from the Colorado Water Conservation Board under the Alternative Agricultural Water Transfer Methods (ATM) Grant Program. Through the ATM program, the Farmers Reservoir and Irrigation Company (FRICO) was provided funding to investigate a number of alternative ATMs, including rotational fallowing, interruptible supply agreements, lease back agreements and changes in cropping patterns. The project consists of several components conducted to increase the understanding of perceptions of alternative agriculture methods by both irrigators and municipal and industrial (M&I) water providers. These components included a survey of the FRICO Barr Lake division agricultural water rights' holders and irrigators regarding agriculture water leasing, a water market experiment and a survey of M&I water providers regarding their attitudes and willingness to enter into various alternative ATMs. A screening and analysis was conducted of the potential alternative ATMs that could be applicable to the FRICO system given the specific nature of FRICO's water rights and results from the FRICO Barr shareholder and M&I provider surveys. Additionally, the project also included the evaluation of a shared water bank concept that would utilize existing FRICO infrastructure to divert, manage and store excess M&I supplies for later use by both the M&I provider and FRICO shareholders.

2.1. FRICO Organizational Structure

FRICO is a Colorado corporation, incorporated in 1902. It is operated as a mutual ditch company, diverting and providing water for the benefit of its shareholders, pursuant to C.R.S. Section 7-42-101 et seq.

FRICO operates a ditch and reservoir system that extends across approximately 3,500 square miles along the Front Range corridor extending from Denver to Kersey, Colorado. The FRICO system presently consists of four major reservoirs, numerous smaller reservoirs and approximately 400 miles of diversion and delivery canals. FRICO, as a corporate entity, is also the owner of 1,257 of the 2,111 Burlington Ditch, Reservoir and Land Company shares allocated for water delivery purposes at or below Barr Lake (personal communication, Manuel Montoya).

There are 10,000 FRICO shares authorized, 8,054 of which are issued and outstanding (Table 2-1). The FRICO system is organized into the four reservoir divisions — Standley Lake and Marshall Lake, which are west of the South Platte River; and Barr Lake and Milton Lake, which are east of the South Platte River. In addition, FRICO operates a municipal division, which is exclusively for providing water to the South Adams County Water and Sanitation District. Map 2-1 shows the service areas of the four FRICO reservoir divisions.

FRICO shares on the west side of the S. Platte have already been largely changed to M&I use. At this point, about half of FRICO shares are still in agricultural ownership, primarily on the east side of the system in the Barr and Milton divisions. Many shareholders under the system wish to remain in agriculture; however, economically feasible alternatives to agricultural dry-up as well as opportunities to increase overall water supplies for agricultural shareholders are needed to maintain the productive value of this agricultural land. Map 2-2, derived from South Platte Decision Support System (SPDSS) data, shows the irrigated acres under each division from all sources for 1976 and 2005. The red highlighted acreage represents the loss of irrigated acres since 1976. The red colored irrigated acres represent lands that were irrigated in 1976, but were not irrigated in 2005. The significant reductions in irrigated acres in the Marshall and Standley divisions can be seen as well as the impacts in the Barr Division.

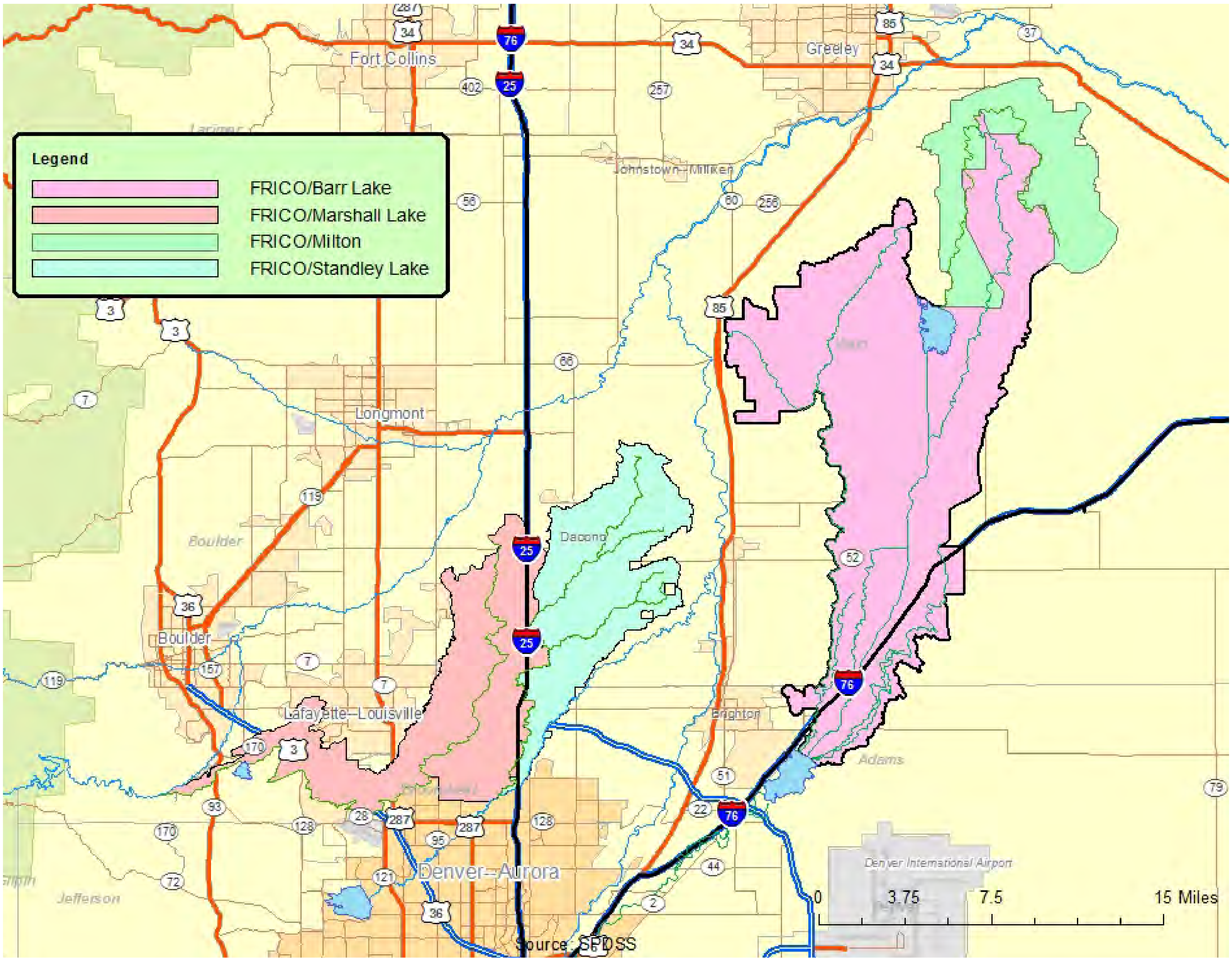
FRICO has 33 full-time employees with an annual operating budget of $3.5 million. The annual budget is funded through income received from several sources including interest on investments, oil and gas revenues, and charges for water and various water development activities.

Table 2-1. FRICO Shares Issued and Outstanding

Lake Division	FRICO Shares Issued and Outstanding
Standley Lake Division	2,373
Marshall Lake Division	1,273
Barr Lake Division	2,759
Milton Lake Division	1,647

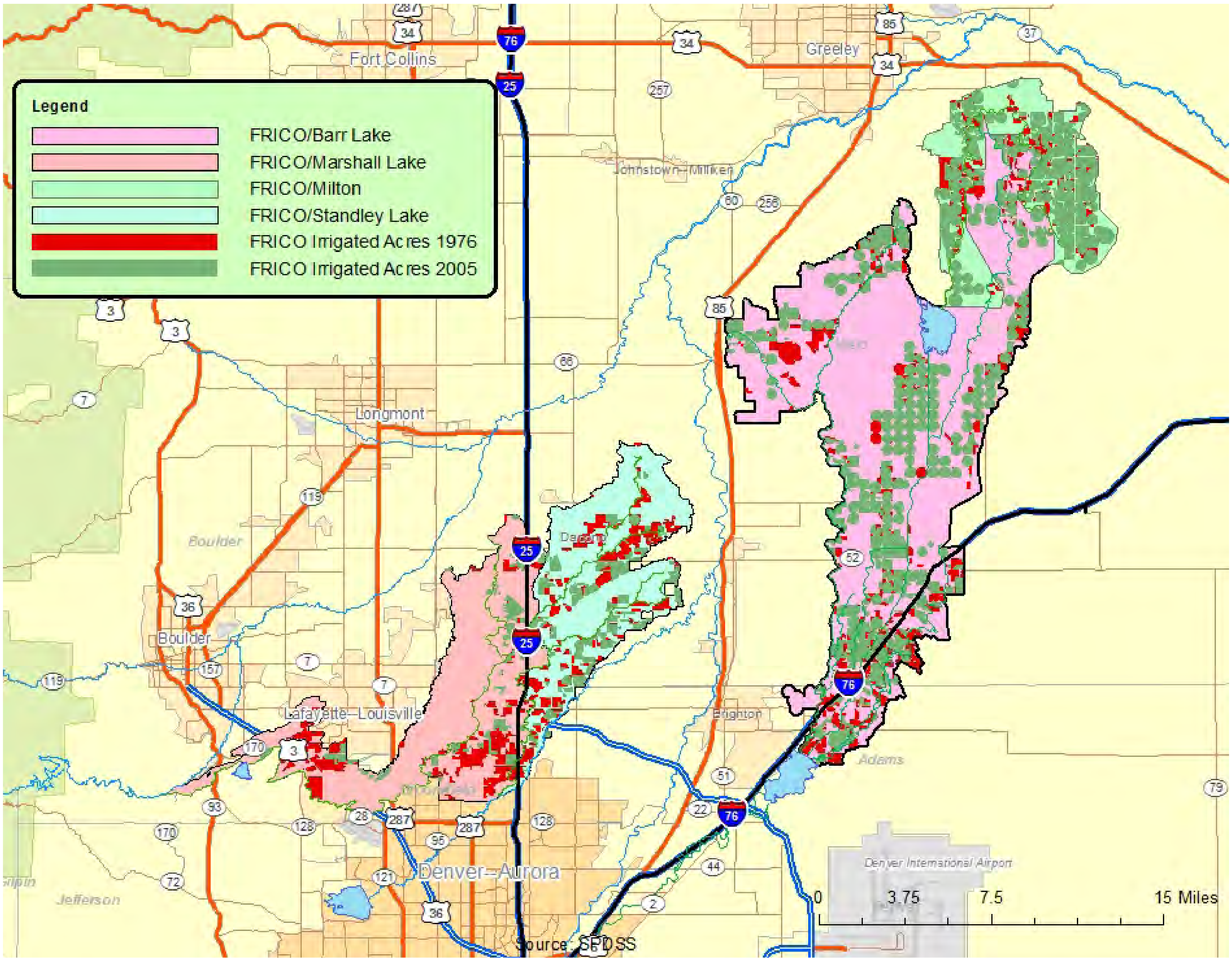
Source: Farmers Reservoir and Irrigation Company

Map 2-1. FRICO Divisions Service Area



Source: SPDSS

Map 2-2. FRICO Irrigated Acres 1976 and 2005



Source: SPDSS

2.2. Project Purpose

The primary purpose of this project is to evaluate and illustrate opportunities for FRICO Barr shareholders to realize economic value from their shares and associated water assets using methods other than a traditional agricultural transfer resulting in permanent dry-up, thus avoiding direct and third-party impacts associated with permanent dry-up such as weed and soil management and impacts to the local economy. This project identified and examined various alternative agricultural transfer techniques identified by the Colorado Statewide Water Supply Initiative (SWSI) Alternative Agricultural Technical Roundtable and an innovative shared water bank concept that could benefit both agricultural and M&I users without requiring any loss of agricultural irrigated lands or associated economic output. The identification and examination process involved active outreach and discussion with both the suppliers (the FRICO Barr shareholders) and the potential customers (the M&I users) in the greater Denver metro area of the South Platte basin. The intent is to develop a base of knowledge for both M&I providers and agricultural users in the South Platte basin that could potentially lead to agreements under the alternative processes developed in this project. Unlike other proposed alternative agricultural transfer methods and traditional water banks, this project will forward the understanding of the mechanism of shared water banking to administer, store and market excess M&I consumptive use water, resulting in an increase in agricultural supplies rather than a reduction in irrigated acres that would occur under all other alternative agricultural transfer methods. In addition, the information developed should have broad transferability elsewhere in Colorado.

2.3. Project Background

There have been and continue to be significant pressures to permanently transfer FRICO shares in all of its divisions to M&I use. Recent municipal acquisitions in the Standley Division have resulted in over 95 percent share ownership by M&I users in this division. Stricter, more rigid river administration and reservoir winter fill rules and recent legislation on well augmentation requirements have placed additional stresses on Barr shareholders. A recent water court decision in Case No. 02CW403 that involved the change of use of FRICO Barr division shares placed restrictions on Barr Lake releases and imposed other operational constraints. This court ruling (403 Decree), issued during the early stages of this ATM project, significantly impacted the willingness of FRICO agricultural shareholders to consider or enter into any ATM arrangement because they were facing curtailment of existing historical supplies and


Barr Lake, looking west

viewed any ATM as a further reduction in supplies and the ability to maintain profitable agricultural activity. An analysis of the 403 Decree limitations on FRICO operations is described in section 8.

Numerous Barr and Milton shareholders also irrigate with wells and are part of the Central Colorado Water Conservancy District and its augmentation subdistricts. These FRICO well users, like most other well users in the South Platte basin, have a significant and unfilled need for additional water supplies to augment well pumping.

Many of FRICO's Barr and Milton shareholders desire to continue irrigated agriculture but are having difficulty reconciling the low returns from irrigated agriculture and the prospect of reduced supplies as a result of the 403 Decree with the prospect of realizing a higher return on their asset if selling their shares for M&I use. FRICO has a long history of working cooperatively and successfully with M&I users. FRICO's relationships with M&I users include:

- Partnering with the City of Westminster on the enlargement of Standley Lake in the 1960s.
- Partnering with the City of Northglenn in the 1970s on a major and perhaps the first alternative agricultural transfer method — the FRICO-Northglenn exchange. This program was the recipient of state and national awards.
- Establishing the Four Way Agreement with the Cities of Northglenn, Thornton and Westminster that led to cooperative arrangements for storage, operations and canal improvements. These improvements resulted in better yield and operations for the agricultural shareholders.
- An agreement with the City of Louisville on storage in Marshall Lake.
- An agreement with the City of Lafayette on diversions from South Boulder Creek.
- Agreements with the City of Thornton and the South Adams County Water and Sanitation District on the use of the Burlington Canal.
- Agreements with the Town of Lochbuie and the City of Brighton on the use of Barr Lake shares and augmentation of Beebe Draw well pumping.

- An agreement with East Cherry Creek Valley and United Water and Sanitation Districts that has led to significantly reducing the South Metro gap identified in SWSI.

- An agreement with Denver Water for the provision of 5,000 acre-feet per year (AFY) of consumable water by Denver to FRICO that can be used for M&I purposes within the Denver metropolitan area.

- An agreement with South Adams County Water and Sanitation District for the sale of the 5,000 AFY of consumable water acquired from Denver that has led to significantly reducing the metro gap identified in SWSI.

Standley Lake Division Marketing Promotion, early 1900s

It is important to note a key competitive advantage that makes the use of alternative agricultural transfer techniques feasible for meeting Denver metro area demands. The FRICO system is situated such that it can provide water to numerous water providers in Adams, Arapahoe, Boulder, Denver, Douglas, Jefferson and Weld Counties. FRICO infrastructure currently has the capacity to physically provide water to many M&I providers with little or no additional infrastructure. In addition, with the use of exchanges and the infrastructure of providers, FRICO can provide additional supplies to many other providers in the region.

The recent 403 Decree, although resulting in some reductions in yields to Barr Lake shareholders, resulted in a ditch-wide quantification of allowable Barr Lake releases. This decree provides a known quantification of the yields and transfer limitations for Barr shares and limits the risk of potential M&I providers considering entering into an ATM arrangement for Barr shares.

The "shared water bank" concept developed in this project uses existing FRICO infrastructure to capture and store unused agricultural and municipal/industrial consumptive use that is available in relatively wet years. The resulting water would then be available to agriculture and municipal/industrial users. The bank would be managed and administered by FRICO. The shared water bank concept will allow for both intra- and inter-year banking opportunities. The potential for these opportunities exists due to FRICO's storage infrastructure. In the future this could also include FRICO's recharge capabilities. The 403 Decree and the resulting ditch-wide change identifies consumptive use, storage decrees and capacities, recharge capabilities, and the timing of return flows, providing technical and water transfer information that is not typically available on irrigation delivery systems in Colorado.

Spillway, Burlington Ditch, 1910.
Photo courtesy of Denver Public Library
Western History/Genealogy.

3. REGIONAL FARM, OPERATIONS, CROPLAND AND IRRIGATION OVERVIEW

One of the directives of the Colorado Water Conservation Board's (CWCB) Alternative Agricultural Transfer Methods (ATM) Grant Program is to develop methods that can be transferrable to other ditch systems and potentially other basins. A comparison was made of the Farmers Reservoir and Irrigation (FRICO) counties with the overall South Platte and Arkansas river basins. The South Platte and Arkansas basins differ little in terms of overall land acreage and acres farmed (Table 3-1). However, a larger percentage of South Platte agricultural land is dedicated to crops, and the South Platte has over two and a half times the irrigated farmland as the Arkansas basin. The South Platte has a higher density of operations, and, though the average farm operation in the South Platte is smaller, the average South Platte irrigated operation has more acreage than the average in the Arkansas basin. This is somewhat consistent with a smaller survey of South Platte irrigators (Pritchett 2008), which found that the average South Platte operations irrigated 383 acres of cropland, or 65 percent of the total cropland.

Table 3-1. Regional Statistics

	Arkansas	South Platte	FRICO counties
Farm operations	10,142	17,622	3,799
Land area (acres)	19,728,167	20,458,958	2,479,772
Farmland (acres)	13,508,463	14,466,150	2,033,229
(% land area)	*68%*	*71%*	*82%*
(Avg. acres/operation)	*1,331*	*820*	*535*
Cropland (acres)	3,936,801	7,210,483	970,254
(% total farmland)	*58%*	*66%*	*68%*
Irrigated farmland (acres)	471,521	1,236,913	315,401
(% total cropland)	*12%*	*17%*	*33%*
Operations (#farms)	2,511	5,118	1,302
(as % total operations)	*25%*	*29%*	*34%*
(Avg. irrigated acreage/operation)	*188*	*242*	*242*

Source: USDA (2007, 2008)

Compared to the rest of the South Platte, FRICO counties' irrigated operations are similar in average size of irrigated operations, but irrigate a much larger percentage of total cropland.*

* A weighted average of Weld and Adams Counties comprised the FRICO county statistics, based on the distribution of FRICO operations between the two Counties.

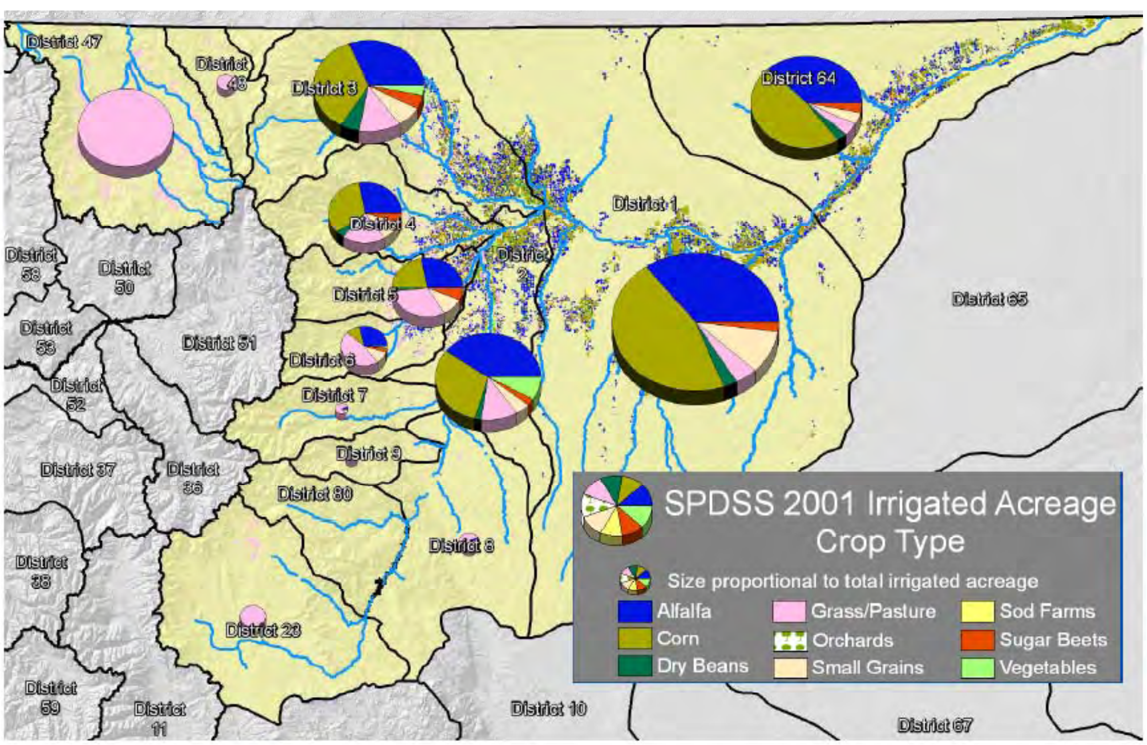
3.1. Crop Coverage

Relative to the Arkansas basin, the South Platte basin as a whole has a slightly more varied crop coverage, with a smaller percentage of acreage in corn and alfalfa and a larger percentage in small grains (Figure 3-1).* FRICO operators tend to have a much higher percentage of alfalfa acreage (52 percent) compared with the 29 percent representative of the South Platte basin (Figure 3-2).

Since 1976 the South Platte has witnessed a decline in overall irrigated acreage (Table 3-2). In terms of crop trends, the South Platte has seen an increasing percentage of alfalfa and small grains acreage and a decline in corn, dry beans, and grass pasture (except for the years 2001-2005) as shown in Figure 3-3. Despite the difference in alfalfa and corn acreage in FRICO counties, crop trends within FRICO are quite similar to the rest of the South Platte (Figure 3-2).

* Figure 3-1 indicates a large increase in alfalfa acreage for the South Platte basin and FRICO Counties for the year 2001, so Figure 3-1 may or may not be indicative of later alfalfa trends.

Figure 3-1. Crop Type (% Total Acres Harvested) as Percent of Total Cropland



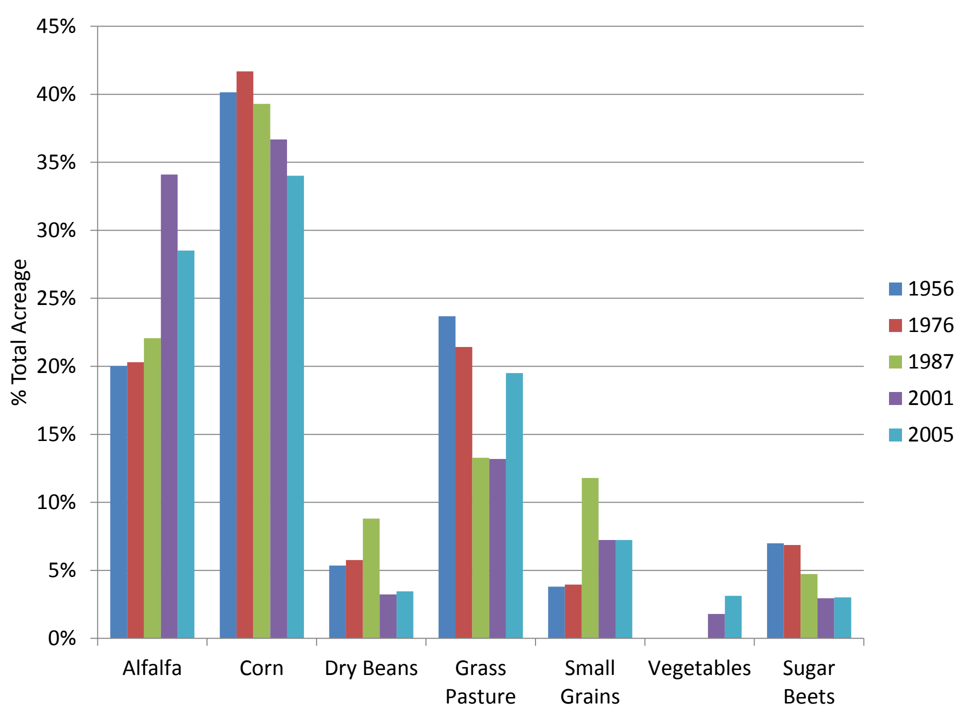
Source: CDSS (2007)

Table 3-2. South Platte Crop Acreage, 1956-2005

Crop Type	Acreage 1956	Acreage 1976	Acreage 1987	Acreage 2001	Acreage 2005
Alfalfa	196,734	206,362	217,892	310,521	238,920
Corn	394,342	423,683	387,976	333,943	285,055
Dry beans	52,542	58,523	86,966	29,401	28,974
Grass pasture	232,633	217,660	131,095	120,073	163,479
Orchard w/o cover	—	—	—	2,239	1,428
Small grains	37,402	40,192	116,448	65,849	60,613
Sod farm	—	—	—	5,246	8,198
Sugar beets	68,691	69,826	46,763	26,904	25,232
Vegetables	—	—	—	16,343	26,210
Total	**982,345**	**1,016,246**	**987,139**	**910,518**	**838,109**

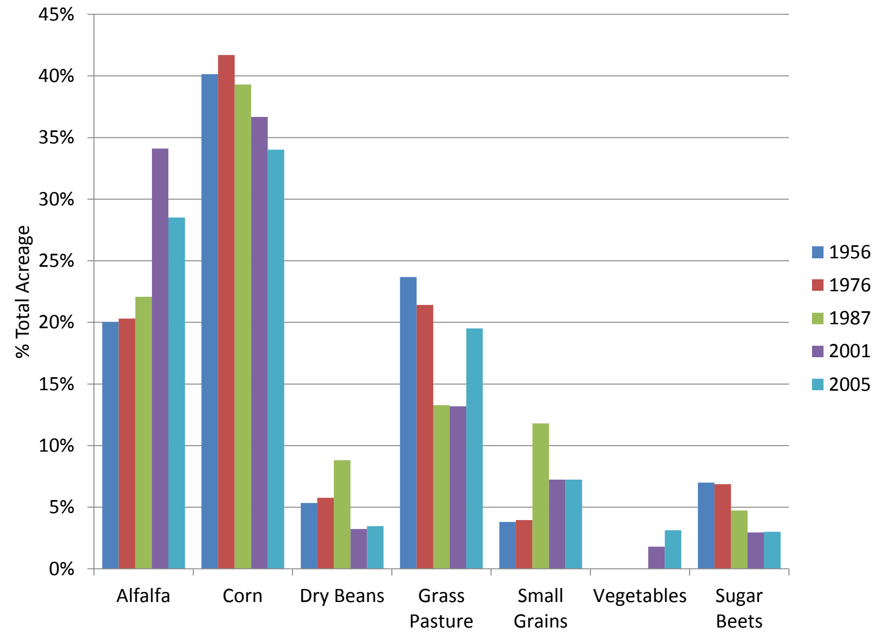
Source: CDSS (2007)

Figure 3-2. SPDSS Crop Trends - FRICO Counties Operations



Source: CDSS (2010)

Figure 3-3. SPDSS Crop Trends - South Platte



Source: CDSS (2010)

3.2. Operator Characteristics

Economically, South Platte basin operations differ markedly from Arkansas basin operations (Table 3-3). On average, South Platte operations are more profitable per acre and hold more assets per acre than the average Arkansas basin farmland acre. South Platte operations incur much higher production expenses, but these are likely recovered in the revenue stream of commodity sales. Overall, a larger percentage of South Platte operations operate with net profits.*

Note that the data below are based on all farm operations, not irrigated operations. This disparity in economic figures across basins may be attributed to a larger percentage of irrigated cropland in the South Platte basin, as irrigated agriculture is more profitable than non-irrigated cropland, on average.†

Arkansas Basin operators tend to be older, while the distribution of ages of FRICO county operators is shifted toward younger ages (Figure 3-4).

* Farms with total production expenses equal to the total of the market value of agricultural products sold, government payments and farm-related income are included as farms with gains of more than $1,000.

† State-level data on net farm income and commodity sales (on a per acre and per operation basis) shows higher productivity for irrigated land than non-irrigated cropland (2007 Census of Agriculture).

Table 3-3. Economic Characteristics of Operations

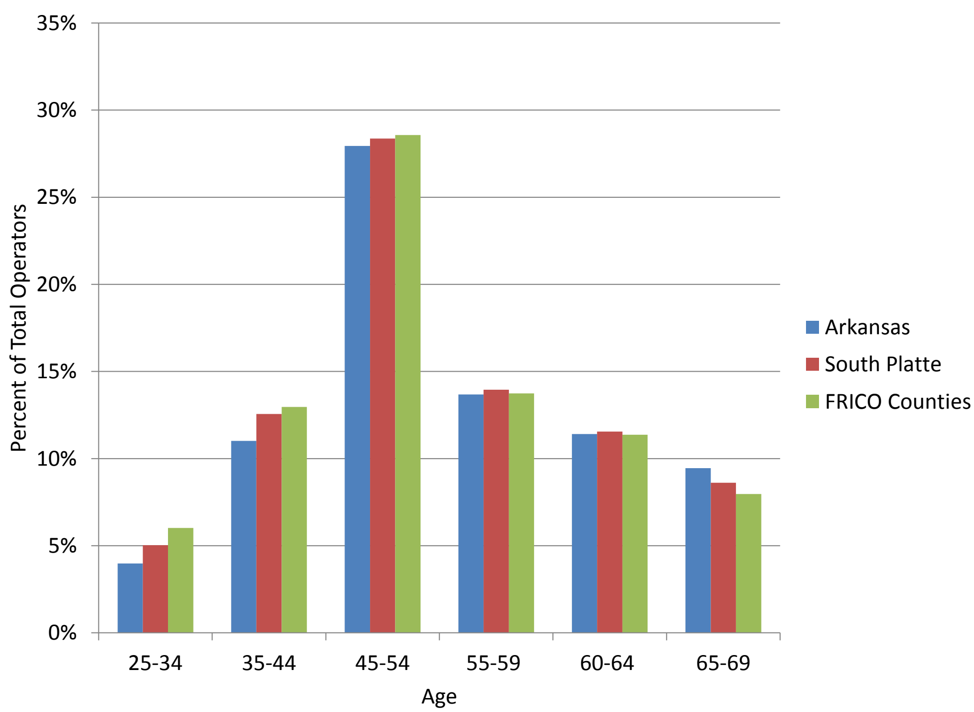
	Arkansas	South Platte	FRICO counties
Average net farm income[1] ($ / operation)	23,906	39,1729	49,956
Average net farm income ($ / farmland acre)	18	48	93
Average assets ($ / operation)	929,900	907,907	826,563
Average assets($ / farmland acre)	698	1,106	1,545
Production expenses ($/farmland acre)	71	275	653
Commodity sales, ($/farmland acre)	81	306	730
Operations with gain[2] (% total)	39%	42%	40%

[1] Net farm income is the operators' total revenue (fees for producing under a production contract, total sales not under a production contract, government payments and farm-related income) minus total expenses paid by the operators.

[2] Farms with total production expenses equal to the total of the market value of agricultural products sold, government payments and farm-related income are included as farms with gains of less than $1,000.

Source: USDA (2007)

Figure 3-4. Age Distribution of Operators



Source: USDA (2007)

Fewer South Platte basin operations are family owned, though a greater percentage of South Platte operators live on-farm (Table 3-4). Farming is reported as the primary occupation for 40-41 percent of all operators in both basins.* These figures are consistent with Pritchett (2008) South Platte data, where 39 percent of those with an off-farm job reported that farming was the primary occupation, defined as generating 50 percent or more of household income.

Compared with the Arkansas basin, where 70 percent of operators report being full owner, a larger percentage of South Platte operators (73 percent) are full owners of the operation (Figure 3-5). Eighty-two percent of operators surveyed by Pritchett reported being the owner or absentee owner. This is consistent with Colorado-wide census data, that operators of irrigated farms are more likely to have full tenure than non-irrigated farm operators.

South Platte operators tend to have fewer operators that have been managing the operation for ten or more years, though this could be a result of the younger average age of South Platte operators (Figure 3-6). FRICO county farmers, on average, are less experienced, younger and have fewer years managing the operation than other South Platte operators.

* Primary income is defined as the operator spent 50 percent or more of his/her work time during 2007 in farming or ranching.

Table 3-4. Operator and Operation Characteristics

	Arkansas	South Platte	FRICO counties	Pritchett
Age of operator	57.6	56.3	55.7	61.2
Family or individual farms (as % total farms)	83.0%	80.4%	80.2%	N/A
Off-farm characteristics (as % total farms)				
Farming primary occupation	40.8%	40.4%	40.8%	65.0%
Operators with 100 +days off-farm	50.4%	49.9%	50.6%	N/A
Operators with residence on farm	71.4%	74.1%	76.7%	N/A

Source: USDA (2007)

Figure 3-5. Tenure of Primary Operator

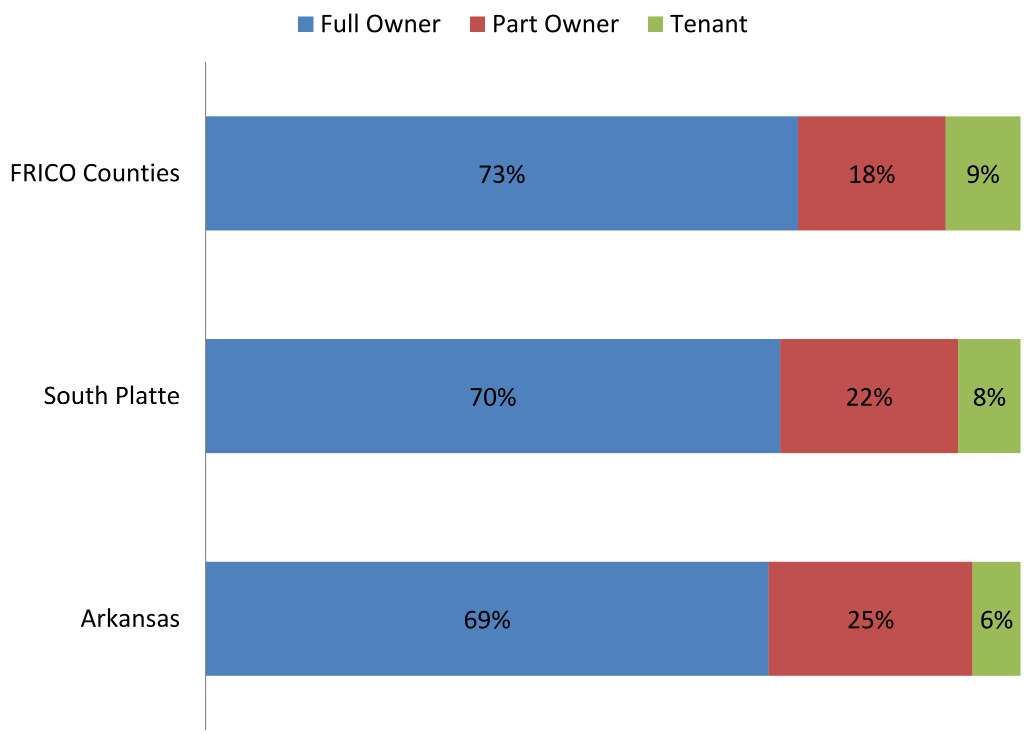
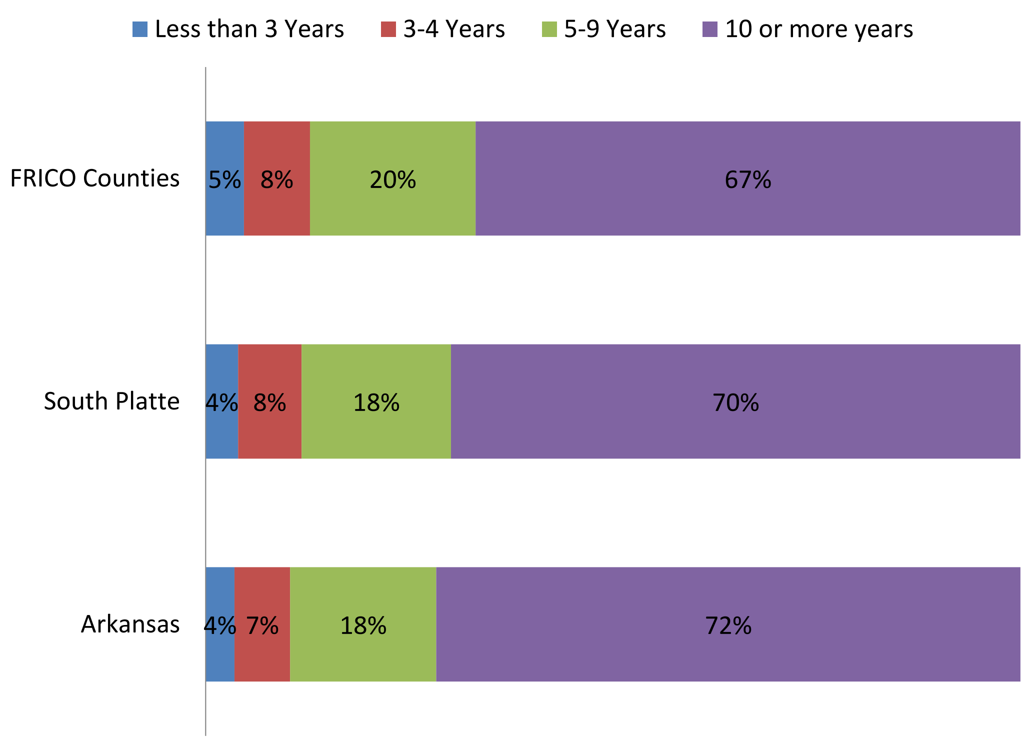


Figure 3-6. Operating Experience of Primary Operator



3.3. Farm Water Use and Irrigation Technology

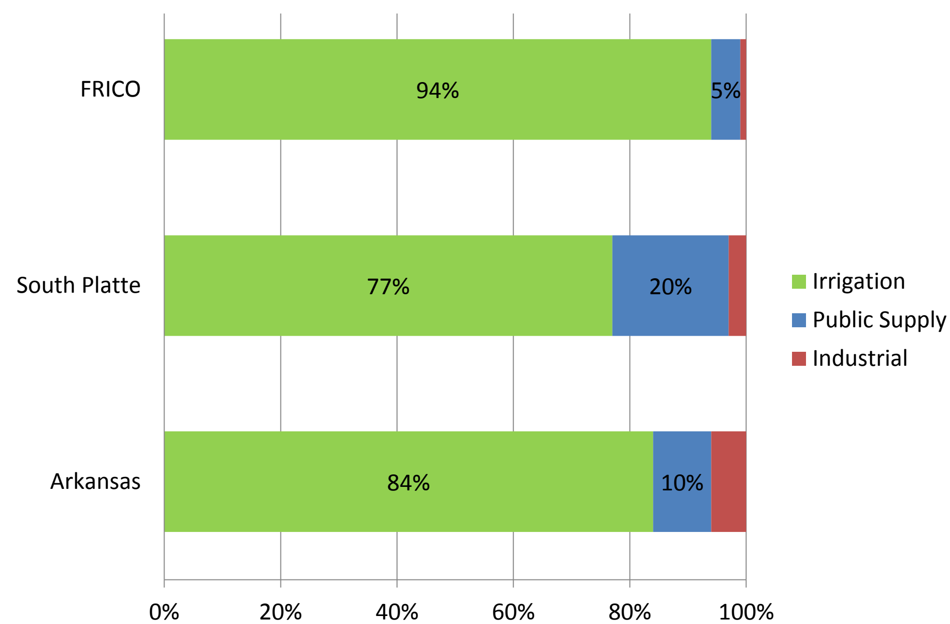
3.3.1. DIVERSIONS

Since the South Platte basin holds the largest metropolitan area in the state, a larger percentage of irrigation water is diverted to public supply relative to agriculture compared with FRICO counties within the South Platte and the Arkansas basins (Figure 3-7).

Over the past 50 years, groundwater as a percentage of the total South Platte water supply for irrigation increased from close to 15 percent to nearly 40 percent. As of 2007, the South Platte sourced over twice the percentage of irrigation water from groundwater, relative to the Arkansas basin counties (Figure 3-8 and Figure 3-9). FRICO counties' percentage of irrigation sourcing from groundwater is more similar to Arkansas basin counties than that of the South Platte average.

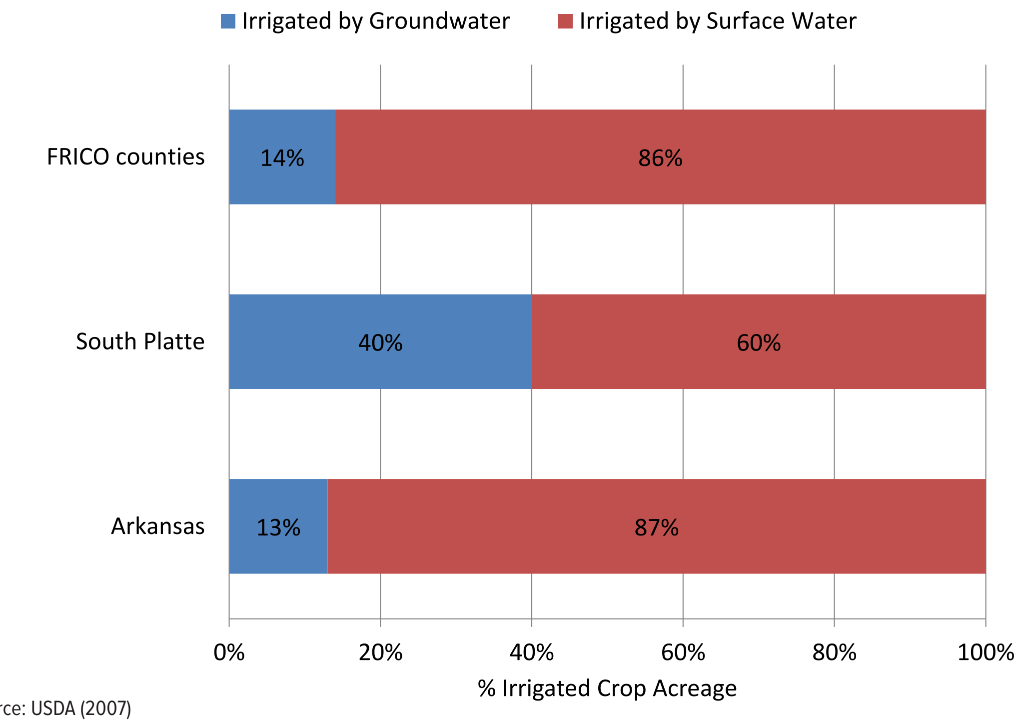
Pritchett (2008) found that 28 percent of irrigation water of surveyed South Platte operations was sourced from groundwater (Figure 3-10).

Figure 3-7. Destination of Basin-wide Surface Water Diversions



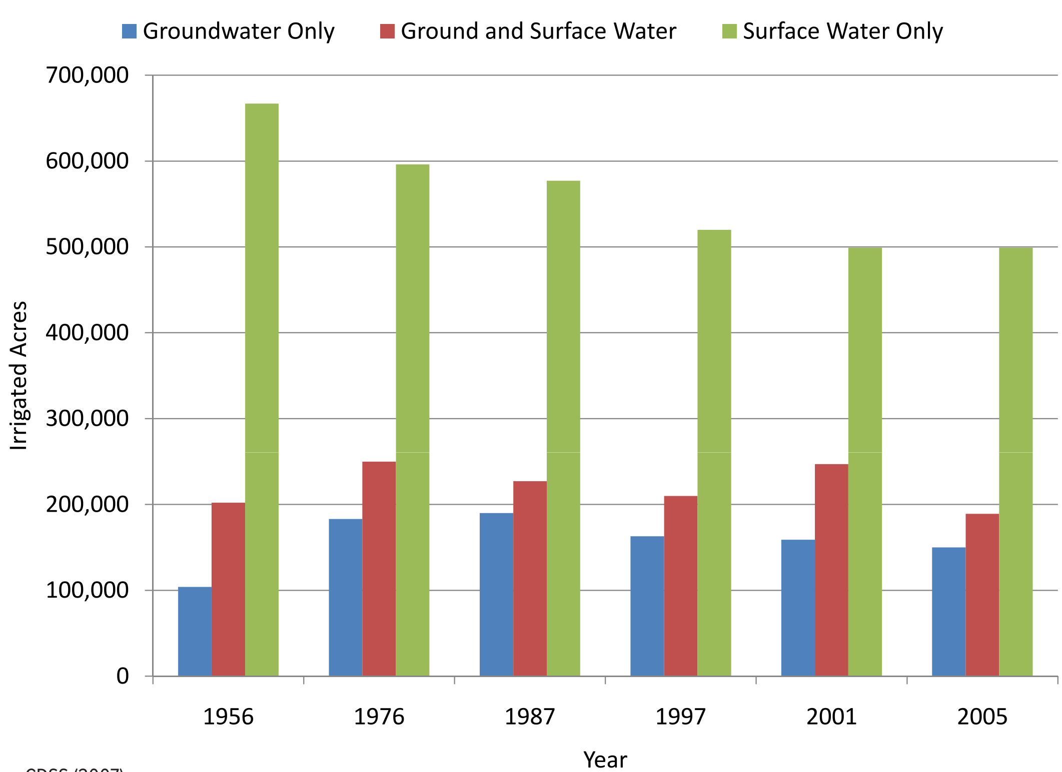
Source: USGS (2005)

Figure 3-8. Source of Irrigation, Census



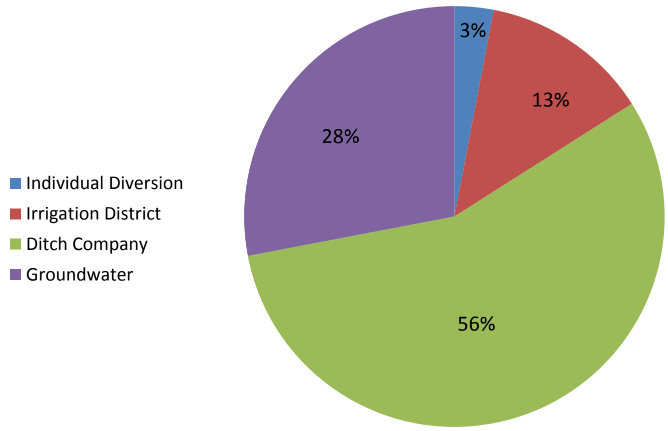
Source: USDA (2007)

Figure 3-9. Source of Irrigation: South Platte



Source: CDSS (2007)

Figure 3-10. Irrigation Source: South Platte Survey



3.3.2. TYPE OF IRRIGATION TECHNOLOGY

South Platte and FRICO counties irrigate up to three times as much acreage with flood irrigation compared to Arkansas basin counties, which sprinkler irrigate 75 percent of the irrigated acreage (Figure 3-11). This is consistent with FRICO figures in both Milton and Barr (Figure 3-12). Table 3-5 summarizes the differences between the South Platte relative to the Arkansas and the FRICO counties relative to the South Platte.

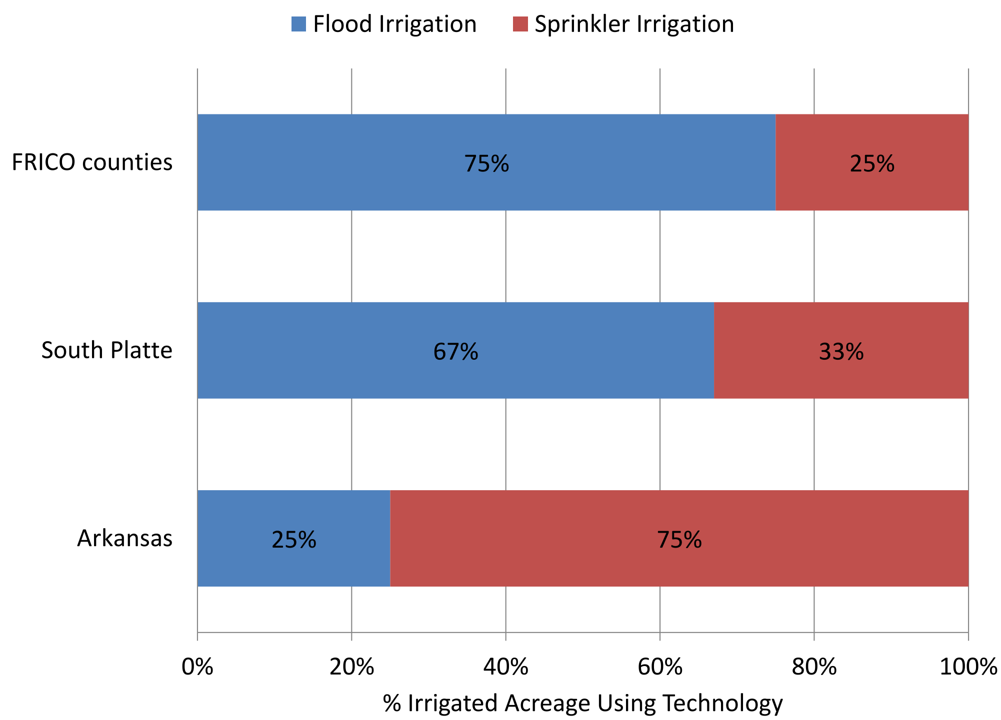
Observed trends over the past 50 years:

- Increase in cultivation of alfalfa and small grains.
- Decline in overall irrigated acreage.
- Increase in groundwater as irrigation source.

Table 3-5. Summary of Differences

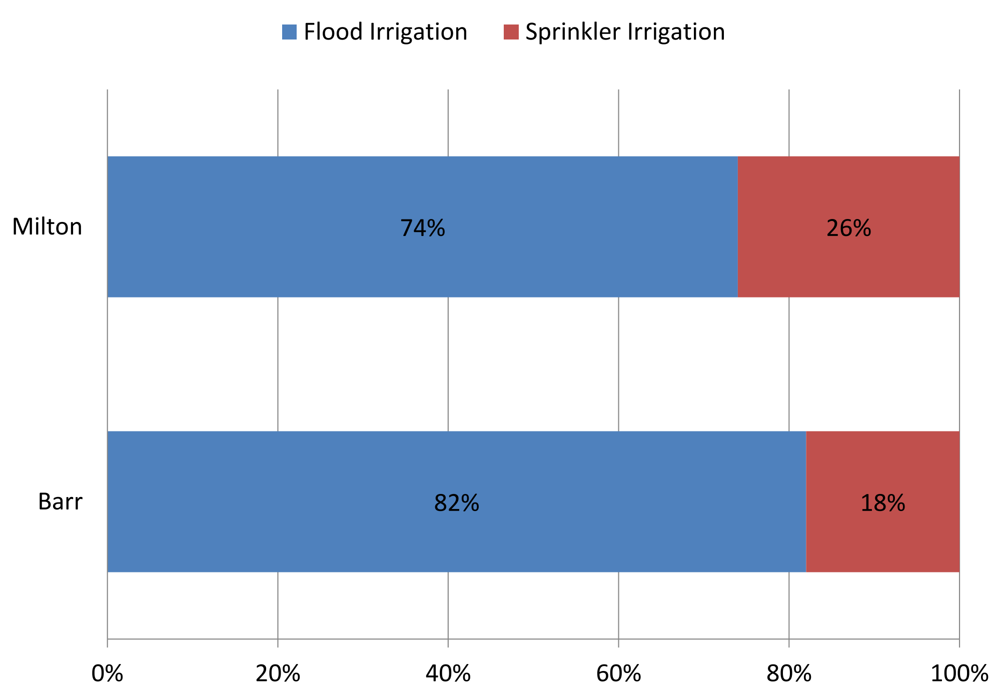
	South Platte relative to Arkansas	FRICO relative to South Platte
Irrigated acreage (as % cropland)	Higher	Higher
Crop mix	Similar	Alfalfa primary crop
Profits (per operation & acre)	Higher	Higher
Average operate age	Younger	Younger
Irrigation	Larger percentage to public supply	Less percentage to public supply
Flood or irrigation	Flood more prevalent	Flood more prevalent
Groundwater or surface water	Groundwater used more	Groundwater used less

Figure 3-11. Type of Irrigation Technology Used



Source: USGS (2005)

Figure 3-12. Irrigation Technology FRICO Survey



Standley Lake, Westminster, CO.

4. ALTERNATIVE AGRICULTURE TRANSFER METHODS SURVEY OF IRRIGATORS

4.1. Survey of FRICO Shareholders

A survey was administered to Farmers Reservoir and Irrigation Company (FRICO) Barr division shareholder farm operators in order to elicit preferences for different temporary and/or alternative water transfer mechanisms including leasing, interruptible water supply agreements, water leasing and a "shared" water bank concept. A copy of the survey "The Potential for Alternatives to Permanent Water Transfers" is provided in Appendix 1. The survey was also designed to collect demographic, farm and irrigation data to understand how preferences for leasing varied across participants of different backgrounds. The survey was administered at the beginning of a FRICO town hall-style meeting in August 2009 to roughly 50 attendees. Only 17 surveys were returned; most were incomplete. This meeting occurred soon after the water court issued its decree in the 403 Case. As a result, there was an elevated level of distress among the meeting participants and reluctance to discuss any alternative agricultural transfer methods.

Attendees voiced several general concerns with providing the information the survey requested, including the following:

- Attendees were concerned that this information would be used against them by cities during negotiations.
- Attendees indicated that their voice was not heard nor represented at the state level and were dubious that the survey would help in the end.
- When discussing prices at which they would be willing to lease, attendees either were uncertain (i.e. hadn't seriously considered it) or anchored to prices of other water transactions that they had heard, even though the circumstances and type of transaction of those transactions were very different.*

* Five hundred dollars per acre foot was the most common price indicated. It was later revealed that a number of participants indicated this price because they had heard others received this price for short-term leases with cities.

- Attendees were hesitant to consider the various alternatives because of a lack of experience and presumed that cities would take advantage of the farmers.

The latter two observations were especially important in the design of the market experiment, which further explored the role of the general public availability of price information (i.e., a "bulletin board") on water leasing and sale transaction prices (variability and mean) and the number of transactions. The experience with the survey highlighted the importance of the market experiment approach, which uses neutral participants to better isolate dynamics of an active leasing market.

4.2. Analysis of Thorvaldson/ Pritchett Survey Data

To garner further information on shareholder farm operator leasing preferences, data from a 2007 mail survey of farmers in the South Platte basin was analyzed in the context of FRICO operators. The survey was mailed in the fall of 2007 to farmers in the South Platte basin who had reported more than 50 acres of irrigated land in the 2002 Census of Agriculture. For more detail regarding the survey, including methodology and questions, see Thorvaldson (2010) or Pritchett et al. (2012).

The timing of the survey is important for several reasons. First, the survey occurred just after a change in well augmentation rules that resulted in a large number of wells being shut down. However, the survey was administered before the Alternatives to Agricultural Transfers Methods program began. Specific to FRICO, the survey was administered before the 403 water court ruling that impacted FRICO Barr Division shareholder water rights.

The survey consisted of two main sections: one consisting of a series of questions relating to the demographic and economic characteristics of the farmer and farm operation, and one containing a series of questions intended to elicit information about the farmer's view and willingness to participate in leasing programs.

Information identifying which respondents were FRICO shareholders was not available. However, using GIS software, a subset of the sample thought to be representative of FRICO shareholders was identified. This included those respondents that (a) had irrigated agriculture and (b) whose practices were located within the FRICO boundaries. The latter was accomplished by intersecting FRICO boundaries with location information provided by the respondents, indicating the general area in which their irrigated acreage was located.

A completed survey was returned by 329 respondents. Of these, 58 were identified as likely to be FRICO shareholders. Throughout the remainder of this section this subsample is referred to as FRICO respondents and all other respondents as non-FRICO respondents. While the approach adopted allows for the possibility that some respondents excluded (included) in the FRICO sample are (not) FRICO shareholders, the farm demographics (as reported in the survey) of those identified as FRICO respondents do not differ significantly from those presented earlier in Section 3, "Regional Farm, Operations, Cropland and Irrigation Overview."

As part of the survey, respondents were presented with a series of statements. On a scale of 1 to 5, they were asked to indicate their level of agreement with the statement: 1 indicating that they strongly disagreed, 2 disagreed, 3 neutral, 4 agreed, and 5 indicating that they strongly agreed. Tables 4-1 through 4-4 provide a summary of the responses for those identified as likely to be FRICO irrigators, including the percent who agreed (i.e., indicated by a 4 or 5), the percent who disagreed (i.e., 1 or 2) and the average rank across all respondents.

Table 4-1 contains information characterizing the subsample's general view of leases. The majority of respondents indicated that they agreed or strongly agreed with the notions that leases, between agriculture and cities (a) will help meet Colorado's future water needs and (b) were preferred over water rights sales. Relative to the non-FRICO sample (results not shown here), FRICO respondents were less likely to agree and more likely to disagree with the statements presented in Table 4-1. The average rank for both statements, for FRICO respondents, was significantly lower than that for non-FRICO respondents.

Table 4-2 contains information characterizing FRICO respondents' willingness to participate in lease programs and which types of lease programs they would be most willing to participate in. Slightly more than the majority of respondents indicated a willingness to participate in a leasing program and preferred leasing to selling water rights outright. The majority did not indicate a willingness to participate in a lease involving their senior water rights, nor were they willing to participate in a lease if the water would ultimately be used to support recreation or to maintain wildlife habitat. Overall, FRICO respondents had a lower average ranking and were less likely to agree to all of the statements presented in Table

Table 4-1. General View of Leases

	Agree (%)	Disagree (%)	Average Rank
Water leases between agriculture and cities will help meet Colorado's future water needs.	53.4	31.0	3.2*
Water leases are more beneficial to rural communities when compared to the sale of water rights.	65.5	8.6	3.6*

* Average rank for FRICO shareholders was significantly less than the average for the non-FRICO sample at 0.1.

Table 4-2. Willingness to Participate in a Lease

	Agree (%)	Disagree (%)	Average Rank
I am willing to participate in a water lease if paid enough.	56.9	19.0	3.4
I am willing to lease rather than sell my water rights.	56.9	17.2	3.4
I am willing to lease senior water rights and keep junior water rights.	34.5	25.9	2.9
I am willing to sign a lease in which the water is used to maintain instream flows for river system recreation.	24.1	48.3	2.4
I am willing to sign a lease in which water is used to maintain wildlife habitat.	29.3	37.9	2.7

Table 4-3. Lease Characteristics

	Agree (%)	Disagree (%)	Average Rank
A long-term lease (e.g., 10 years) is preferred to a short-term lease (e.g., 2 years).	25.9	50.0	2.5**
I am willing to incorporate a fallow period into my crop rotation if I am compensated enough.	62.1	17.2	3.4
I am willing to reduce my farm's consumptive water use, either by irrigating less or planting less water-using crops, in order to fulfill the conditions of a lease.	44.8	37.9	2.9**
I am willing to verify water use with a flow meter or other device if it is required by a lease.	55.2	24.1	3.3*
I prefer to lease all of my water rights rather than a smaller portion of my water rights.	22.4	44.8	2.5
I prefer a lease arrangement in which I have the first option to use the water if it is not needed by the water leaser.	79.3	6.9	4.0
I prefer one large lease payment instead of annual payments in a lease agreement.	19.0	39.7	2.5

* Average rank for FRICO shareholders was significantly less than the average for the non-FRICO sample at 0.10.

** Average rank for FRICO shareholders was significantly less than the average for the non-FRICO sample at 0.050.

4-2 relative to the non-FRICO sample; however, the differences were not significant.

Table 4-3 contains information pertaining to irrigator preferences on the details of leases. Overall, FRICO respondents indicated a preference for shorter leases in which they received annual payments (as opposed to a onetime payment) and retained a first right of refusal for using the water in the event that the leaser did not need the water. On average, FRICO respondents were significantly less likely to prefer long-term leases and to be willing to reduce their farm's consumptive use to fulfill the conditions of their lease.

Table 4-4 provides insight into the respondents' views toward the process for negotiating the lease. At the time of the survey (fall 2007), a majority of respondents indicated a willingness to negotiate either directly with a municipality or through, for example, a farmer-owned cooperative.

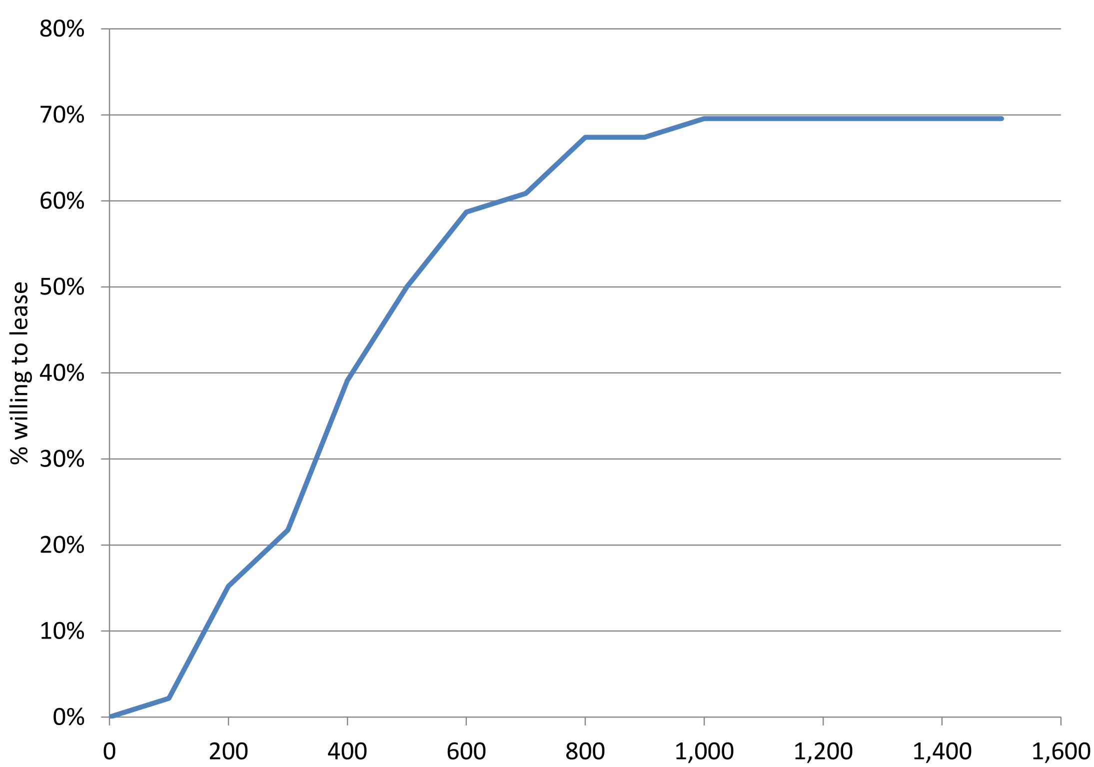
Respondents were also asked (in an open-ended format) the minimum lease payment per acre they would need to receive to forego irrigation for one year. Figure 4-1 illustrates, for those FRICO respondents not opposed to leasing (N=46), the cumulative percent of FRICO respondents willing to lease at various price levels.

Table 4-4. Type of Negotiation

	Agree (%)	Disagree (%)	Average Rank
I am willing to negotiate directly with a municipality to establish a water lease arrangement.	51.7	29.3	3.1
I am willing to work through another organization (e.g., a farmer-owned water cooperative) when signing lease arrangements.	50.0	25.9	3.2

The mean and median price required per acre leased was $722 and $400, respectively. These prices are slightly, but not significantly, lower than that indicated by non-FRICO respondents. Assuming each acre yields roughly 1.5 AF of consumptive use (CU), the mean and median price per AF of CU would then be $482 and $267, respectively.

Figure 4-1. Cumulative Percent of FRICO Respondents Minimum Lease Payments Required to Forego Irrigation for One Year



Burlington-O'Brian Bifurcation.

5. WATER MARKET EXPERIMENT OVERVIEW AND RESULTS

5.1. Introduction and Background

Growth in water demand over the past 30 years across municipal, industrial and environmental users has resulted in considerable pressure to reallocate water out of agriculture, a development that is expected to continue for decades. For example, population along Colorado's Front Range is projected to double by 2050, resulting in an increase in urban water demands of more than 1 million acre-feet (AF) per year (CDM 2011). A significant portion of this increase may be met by reallocating water from agricultural to urban users. The question of interest is how best to reallocate the water.

Increasingly, market institutions are being proposed as the answer. Supporters of water markets argue that such markets allow for the reallocation of water from low- to high-valued activities, resulting in greater efficiency of water use (Howitt and Hansen 2005). Traditionally, throughout the western United States, water rights markets have served as the primary vehicle through which water has been reallocated across uses (Saliba 1987). In such cases a water market transaction corresponds to a permanent transfer of the right to divert water, referred to as the "water rights markets."

Critics of water rights markets cite third-party impacts associated with the permanent transfer of water out of agriculture and the accompanying impacts to rural communities (Council 1992; Hanak 2003; Howe and Goemans 2003; CWCB 2010). Such transfers often lead to the permanent dry-up of agricultural land (sometimes called "buy-and-dry"), and the loss of water as an input to agricultural production leads to lower yields, revenues, and economic activity within the community. For example, current forecasts for Colorado predict that up to 700,000 acres, or roughly 30 percent, of irrigated agricultural land, may be removed from production due to the permanent transfer of water rights from agricultural to municipal users (CDM 2011).

In addition, the loss of water rights decreases borrowing opportunities for irrigators (e.g., for capital improvements) and reduces the local tax base as property values fall with the sale of the water right. In theory, these losses could be offset by revenues brought in from the sale of the right; however, agricultural users who have sold their water rights often do not reinvest the proceeds in the local community and instead repay their debt and/or move away (Howe et al. 1990).

In response to concerns surrounding the resulting third-party impacts, academics, politicians and planners are advocating the development of alternatives to transfers that result in permanent dry-up. While the details differ, these alternatives largely amount to creating opportunities for the temporary transfer of water, referred to as "leasing markets." Markets for temporary transfers of the water itself, advocates argue, provide an alternative to traditional buy-and-dry water rights transfers. They allow for the temporary reallocation of water to urban users during periods of drought, while lessening the negative impacts to rural agricultural communities by allowing irrigators to retain ownership of the water rights and irrigate in years that cities do not need the water (Council 1992; Hanak et al. 2010).

To date, leasing markets have been proposed or exist in every western state. While informal leasing across similar uses (e.g., irrigator to irrigator) is common, few examples of active leasing markets that involve trading of water across uses (e.g., irrigator to municipality) exist (Clifford et al. 2004). Two recent developments, however, suggest that this might change. First, in locations where opportunities for leasing across uses already exist, water utilities are increasingly using leasing markets as part of the process for acquiring supply (Brown 2006). Second, in areas where leasing markets currently do not exist, attempts are being made to eliminate existing institutional barriers that prevent their use, either by reforming existing institutions or by actively promoting leasing as a preferred alternative to traditional transfers. In either case, a transition from traditional water rights markets to reallocating water across uses to a system that incorporates both water rights and water leasing markets is underway.

There is little information available to policy makers and potential participants on the performance of alternative water markets, despite the fact that a number of studies summarizing historical market conditions are available. The objective of this FRICO alternative ATM study is to fill this void and to examine efficiency and water distribution impacts associated with introducing leasing markets, specifically accounting for the potential interactions of leasing markets with existing water rights markets.

The limitations of the existing literature are largely due to a lack of quality data and insufficient available data for comparing the efficiency and water distribution implications of different institutional settings. Few active leasing markets exist (Clifford et al. 2004), and the markets that do exist are unique in design, which makes it difficult to derive generalizable results from their study (Brozovic et al. 2002). Also, in addition to a limited number of active markets, transactions information is often not reported accurately and/or in detail. While detailed quantity data on transferred water rights is often available, price information is typically not

(Brookshire et al. 2004). Trades are often conducted in informal settings, and participants are hesitant to reveal transaction information for fear that it will be used against them at some point in the future.

An additional data issue stems from the distinction between markets for water rights and markets for water leasing. Previous theoretical, simulation and experimental work has focused on these markets in isolation, ignoring the potential for interaction between the two. Studies that examine the impact of the introduction of leasing markets within a system in which water rights markets already exist are not readily available.

To overcome these data problems, laboratory market experiments are used. Using a laboratory experiment to study the impact of institutional changes in water markets is appropriate, since such changes in the real world are notoriously slow, costly to implement and often irreversible (Murphy et al. 2000) and thus difficult to study with nonexperimental data (Tisdell 2011). Also, experiences with seemingly similar institutional changes in markets for other goods might not be helpful either, since physical and legal nuances associated with the allocation of water tend to create water market environments that are unique and often more complicated than other market settings (Brewer et al. 2007).

Through this market analysis experiment, the following research question is addressed:

How does the introduction of active water leasing markets in addition to water rights markets impact rural communities (via changes in water use and water right ownership), overall efficiency and the distribution of profits across water users?

The experimental design addresses all three components of the research question with the assumption of "all other things being equal" conditions. In our experiment, subjects participate in a water market setting in which they can make permanent and temporary transfers of water. Given the experimental parameters, which are scaled down from real-world parameters, water markets can be compared with and without unrestricted leasing opportunities on efficiency, prices of water rights, and allocation of water use. Some traders are stand-ins for urban users and some for agricultural users, and in each market session agricultural users can transfer water rights permanently to urban users. However, only in half of all markets are agricultural users also able to transfer water temporarily to urban users and vice versa. In the set-up, users of one type are always able to transfer water temporarily among themselves.

The experimental design reflects several major unique characteristics of many water market environments, particularly those in the western United States:

1. Water markets generally tend to be thin with a large number of potential agricultural participants and only a few municipalities. Thin

markets are due to geographic constraints resulting from institutional and physical constraints associated with moving water around. Tisdell (2011) provides recent experimental evidence of the importance of market thinness on the effectiveness of different forms of leasing markets.

2. Water rights markets, in particular, tend to be dominated by a few municipal buyers and a large number of potential agricultural buyers (Saliba 1987). The vast majority of water rights market transactions involve agricultural users selling water rights to municipalities (Howe and Goemans 2003).

3. A significant gap between the value of water in agriculture and for municipal and industrial users exists, which suggests opportunities for trade; municipal uses are valued up to 10 to 24 times more than agricultural uses (Howe et al. 1986; Hamilton et al. 1989; Nichols et al. 2001; Brewer et al. 2007).

4. Water rights transactions in the western U.S. occur largely through informal markets in which buyers and sellers search for one another (Howe and Goemans 2003).

5. A considerable amount of leasing already occurs; high transactions costs associated with transferring water (or water rights) across uses, however, means that most leasing activity occurs within user groups (Brozovic et al. 2002; Hanak et al. 2010; Libecap 2010). In the United States, most leasing across uses (of water that has not already been permanently transferred) currently occurs as part of larger federal projects. Examples include the leasing of Colorado-Big Thompson shares and the California Drought Water Bank in which the state of California transfers water on a temporary basis (from willing sellers) using the California State Water Project or Central Valley Project.

It is widely believed that introducing leasing markets will slow the transfer of water rights out of agriculture, increase water use in agriculture and improve overall efficiency of water use relative to not allowing trading of any kind of water rights or allowing only water rights transactions. In interviews conducted with policy makers, utility managers and irrigators about their willingness to participate in leasing markets and their preferences surrounding a variety of alternative market structures, two themes emerged:

1. Irrigators, while generally welcoming the idea of keeping more water in agriculture, were concerned that cities would ultimately take advantage of them.

2. Irrigators were uncertain about how active leasing markets would impact the value of their water rights relative to the increased profits associated with increased production and leasing income.

5.2. Experimental Market Design

The experiment is designed to give insights into the effects of water rights leasing agreements in addition to permanent water rights transfers. Discussion of the experiment is split into two parts: the basic setup and the variable “treatment” design. The following discussion highlights how the design that is presented relates to real-world conditions.

5.2.1. MARKET SETUP

Eight subjects interact in two markets and in five independent “rounds,” whereby each round consists of three “years.” Each year consists of two trading periods (TP), one for each market (permanent water transfers and leasing). After three years, the round ends, and a new round begins with conditions starting over. An experiment timeline is presented in Figure 5-1. While the terms “market for water” and “market for water rights” were used in the instructions, neutral terms like “Trader 1,” “Trader A” and “buying” were employed instead of the more loaded terms “cities,” “farmers” and “leasing.” The instructions for the experiment that were provided to participants are included in Appendix 2.

The eight subjects are split into two groups. Group 1 (Traders 1 and 2) represent cities. Group 2 (Traders A-F) represent agricultural producers. Group 2 consists of three different “types” of producers: Type 1 corresponds to low-value producers (Traders A and B), Type 2 to medium-value

Figure 5-1. Experiment Timeline

Round 0 (practice round)	
Practice Year 1	Practice Year 2
TP 1	TP 1
TP2	TP2

Round 1		
Year 1	Year 2	Year 3
TP 1	TP 1	TP 1
TP2	TP2	TP 2

Round 2		
Year 1	Year 2	Year 3
TP 1	TP 1	TP 1
TP2	TP2	TP 2

Round 3		
Year 1	Year 2	Year 3
TP 1	TP 1	TP 1
TP2	TP2	TP 2

Round 4		
Year 1	Year 2	Year 3
TP 1	TP 1	TP 1
TP2	TP2	TP 2

Round 5		
Year 1	Year 2	Year 3
TP 1	TP 1	TP 1
TP2	TP2	TP 2

producers (Traders C and D) and Type 3 to high-value producers (Traders E and F). Group 1 consists of only one type of player. This split was designed to reflect the fact that most water markets tend to be thin with a large number of potential agricultural participants and only a few municipalities (Saliba 1987; Howitt and Hansen 2005).

The two markets include a market for permanent water rights transfers and a market for water (water "units"), which is representative of a leasing market. For each player type, water is used as input into production of another good, which generates profits. Each year has four stages: two trading periods and two announcement periods.

Trading Period 1 (TP1): Eight subjects interact in a market for permanent water rights, in which the two subjects of Group 1 (cities) are buyers and the six subjects of Group 2 (farmers) are sellers. Each trader can make an offer to any trader in the other group by offering an ask (sellers) or bid (buyers). A trader can also accept (or reject) the offer received from another trader. Nobody can see an offer except for the two traders directly involved.

Restricting the direction of transfers was done to simplify the experiment and reflects historical market activity throughout the West. While technically farmers are allowed to purchase and cities are allowed to sell water rights (usually subject to charter restrictions), the vast majority of water right transactions involve municipal and industrial buyers and agricultural sellers.

Climate Announcement Period: The state of nature in each year, categorized as dry, normal or wet, together with the number of water rights owned after TP1, determines the amount of water each subject is endowed with at the beginning of the second trading period. During this period the state of nature is announced and participants are presented with climate conditions for that year, a reminder of how many water rights they currently own and the amount of water they will be endowed with at the beginning of the second trading period. The water condition in each year is "dry" with a probability of 0.2, "normal" with a probability of 0.6 and "wet" with a probability of 0.2. The probabilities are independent across years. If the year is dry, normal or wet, each water right yields one, two or three water units, respectively (see Table 5-1).

Table 5-1. Probability of State of Nature and Correspondence between Water Rights and Water

	Type of Year		
	Dry	Normal	Wet
Probability	0.2	0.6	0.2
Water units per water right	1	2	3

The states of nature used in the experiment were chosen randomly for the first session.

Trading Period 2 (TP2): Subjects trade units of water ("water leases"). Here, all types of traders, cities and farmers can buy and sell water units but, depending on the treatment, not necessarily across groups (see the section *Treatments* discussion). The process of making an offer works similarly to the process in TP1, except that a trader must now clarify if making an ask offer or a bid offer.

Yearend Announcement Period: At the conclusion of TP2, profits are calculated and posted. Water owned at the end of TP2 is automatically used for the production of another "good." Total annual profits correspond to the sum of (1) earnings from the production of the other good, (2) net revenues from TP1 and (3) net revenues from TP2. The profit calculations are presented and explained below.

Market Experiment Instructions to FRICO Board and Staff

5.2.2. TREATMENTS

A two-variable by two-variable (2x2) treatment design was used (see Table 5-2). The main treatment variable is whether subjects are able to trade water across groups in TP2 (i.e., they have the ability to lease water to and from players in the other group). A second treatment variable is the existence of a "bulletin board," where prices in both trading stages are posted. Due to constraints, the effect of the bulletin board treatment variable will be analyzed at a later time.

Table 5-2. Experimental Treatments	**No Bulletin Board** **(prices and identities of traders in TP1 and TP2 are known only to the two parties involved in the trade)**	**Bulletin Board** **(all prices and identities of traders in TP1 and TP2 are shown to everybody)**
Restricted Leasing (RL) **(subjects of Group 1 cannot lease water to or from subjects of Group 2 in TP2)**	**RL-NOBULL** This baseline treatment represents the status quo in many areas in the western United States where leasing across types of uses is, for legal or institutional reasons, very limited, and prices for water rights and actual water are typically not publically reported. In all treatments, subjects of Group 1 ("cities") can trade with all subjects of Group 2 ("farmers") in TP1, the market for permanent water rights; in TP2 of the baseline treatment, however, the subjects of Group 1 can trade only with each other, and subjects of Group 2 can also trade only with each other ("restricted leasing," or RL). This reflects existing institutional constraints and/or transactions costs, which make it difficult for farmers to lease to cities and the other way around. Also, all prices are kept secret ("no bulletin board," or **NoBull**); only the parties involved in a trade know about the price in their trade.	**RL-BULL** Trading in TP2 is limited as in the baseline treatment, but the prices of all trades in TP1 and TP2 are publicly announced (offers, unless resulting in a trade, are not made public). The motivation for this treatment comes from two sources. First, irrigators indicated in conversations with the authors that they were extremely sensitive to the possibility that their willingness to lease would be "reported back" to cities. Second, in the western United States information about water trading activity is typically not public, which according to some observers enables the side with market power to "pick off" trading parties on the other side.
Unrestricted Leasing (UL) **(subjects of Group 1 can lease water to or from subjects of Group 2 in TP2)**	**UL-NOBULL** Prices are kept secret as in the baseline treatment, but there are no limitations ("unrestricted leasing," or UL) to trades in TP2. In addition to buying/leasing from one another, subjects of Group 1 can buy/lease from subjects of Group 2 and the other way around.	**UL-BULL** This treatment combines the unrestricted leasing market with a bulletin board with publicly announced prices.

5.2.3. MARGINAL VALUE FUNCTIONS AND WATER RIGHTS ENDOWMENTS

Table 5-3 shows the marginal value functions for all four trader types (all prices are in "tokens," with 120 tokens equal to $US 1). "Value" of water for a city reflects the value to industrial users and homeowners; value of water for an agricultural user mirrors the production value from an output, for which a unit of water is an input. As an example of how to interpret the numbers in this table, consider the first two numbers in the Group 1, Year 1 column (top left corner), 110 and 100. The first unit of water is worth 110 to a city; the second unit is worth an *additional* 100 for the city, given that the city owns already one unit.

The functions of marginal value for each additional unit of water were chosen to reflect several real-world properties relating to how urban and agricultural users value water. First, the value of water is increasing over time in urban areas throughout the West as a result of population growth (Brewer et al. 2007). In line with this the productive value of water to cities in the experiment increases each year (Table 5-3, Group 1, Years 1-3 columns). The same is not true for agricultural users, who in the experiment have the same marginal value function for all three years. Second, the cities have a relatively steep curve for the marginal value of each additional water unit, with a marginal value of 0 starting at a certain threshold (which changes over the years). Again, this is not true for agricultural users, who have a small value for all units. Third, cities value their first units much higher than agricultural users (Griffin and Boadu 1992; Brewer et al. 2007). Fourth, even though agricultural users value their water much less than cities, there is a considerable variation in values among them as well: certain products have a higher marginal value of water than others. In the experiment, this is reflected by the three different types of agricultural users. Traders of Type 3 (Group 2), for example, value their 6th unit at 14 tokens, which is much less than cities (60 in the first year, 140 in the third year) but considerably higher than traders of Type 1 (Group 2).

Table 5-3. Water Marginal Value Functions

Quantity	Group 1 (cities)			Group 2 (agriculture)		
	Year 1	Year 2	Year 3	Type 1 (low-value) each year	Type 2 (med-value) each year	Type 3 (high-value) each year
1	110	150	190	11	16	19
2	100	140	180	9	14	18
3	90	130	170	7	12	17
4	80	120	160	5	10	16
5	70	110	150	3	8	15
6	60	100	140	1	6	14
7	50	90	130	1	4	13
8	40	80	120	1	2	12
9	30	70	110	1	2	11
10	20	60	100	1	2	10
11	10	50	90	1	2	9
12	0	40	80	1	2	8
13	0	30	70	1	2	7
14	0	20	60	1	2	6
15	0	10	50	1	2	5
16	0	0	40	1	2	4
17	0	0	30	1	2	4
18	0	0	20	1	2	4
19	0	0	10	1	2	4
20	0	0	0	1	2	4

Members of Group 1 (cities) start each round with an endowment of two water rights, which corresponds to two units of water in dry years, four units in normal years and six units in wet years. Members of Group 2 start with an endowment of five water rights (5, 10 or 15 units of water in dry, normal and wet years, respectively). This imbalance of water rights at the beginning of a round loosely reflects the current distribution of water rights and water use throughout the West, where in normal years roughly 80 percent of water/water rights is controlled by agriculture (Kenny et al. 2009).

FRICO Board and Staff participating in Water Market Experiment

Together with the strong differences in marginal values of water across groups, this initial distribution implies that there are gains from trade. It also ensures that given the purchase of a "reasonable" number of water rights cities have in dry years a higher value for additional units of water than farmers, but in wet years farmers might have a higher value.

For clarification, consider the following example. Assume that Trader 1, in TP1 of year 1, bought three water rights in addition to the two that were originally endowed. If now year 1 turns out to be dry, starting in TP2 Trader 1 has five units of water, one for each water right. Trader 1's value of a 6th unit of water, 60, is much higher than the value any farmer has for any unit of water, and indeed that is true for a 7th, 8th, 9th and 10th unit of water as well.

If instead year 1 turns out to be normal, then Trader 1 starts TP2 with 10 units of water and might want to buy only one more unit of water, which has a value of 10. But if year 1 is a wet year, then trader 1 owns 15 units of water, four of which have a value of zero. Trader 1 would like to sell those four units, and if able to sell to traders from Group 2 (in the UL treatments), then there will be traders for whom the value of those units is (slightly) higher than zero.

5.3. Results

The results are organized around addressing the three research question's components:

1. What impact does the introduction of unrestricted leasing have on rural communities?

2. To what extent does unrestricted leasing lead to efficiency gains?

3. Who are the winners/losers associated with introducing unrestricted leasing?

The answer to question 1 rests largely on the impact unrestricted leasing, relative to restricted leasing, has on water use and water rights ownership. All else equal, it is assumed that rural communities that own more water rights and have greater productivity (especially in high-value agriculture) have stronger economies. Thus, changes in water use and water rights ownership across the restricted and unrestricted leasing treatments are examined.

The impact on efficiency is analyzed by examining changes in total profits by round across treatments. We examine differences in profits in two contexts. First, we estimate the change in total profits based on the allocation of water at the start of TP2: what impact does UL have on total profits, independent of its impact on the water rights market? Second, changes in overall profits are evaluated for both the RL and UL treatments relative to each other and production under the initial endowments.

Next, question 3 is answered by examining differences in the distribution of profits between cities and farmers across treatments. As part of this it is explored how water rights prices are impacted by the introduction of UL and the resulting impact on the total profits of farmers in particular.

Differences across treatments are compared using the two-group t-test, which evaluates difference in means across two samples, the null hypothesis being that no difference exists. Significance levels are presented for two-sided tests in most instances. In those cases where differences were not significant under a two-sided test but are for the one-sided test, that result is indicated by "significantly greater/lesser at α" as compared to the more conservative "significantly different at α."

The subjects for the experiment were recruited in undergraduate classes at Colorado State University in the spring of 2010. A total of 224 subjects participated in 28 markets, seven markets with four treatments and eight subjects each per treatment. The experiment was programmed and conducted with the software z-Tree (Fischbacher 2007).

5.3.1. IMPACT OF UNRESTRICTED LEASING ON RURAL COMMUNITIES: CHANGES IN THE DISTRIBUTION OF WATER RIGHTS OWNERSHIP AND WATER USE

5.3.1.1. WATER RIGHTS OWNERSHIP

At the beginning of each round approximately 12 percent (4 out of 34) of all water rights were owned by cities (Group 1), while agricultural users (Group 2) were endowed with the remaining 88 percent. Result 1 summarizes the effect of introducing water rights and leasing markets on water right ownership.

Result 1. **Relative to restricted leasing, unrestricted leasing results in a greater percent of total water rights being retained by agricultural users.**

Table 5-4 presents the percent of water rights owned by agricultural users at the end of each round, across each of the four treatments.

In all treatments, trading led to a significant reduction in the percent of water rights owned by agricultural users. The share of rights held by agriculture fell from 88 percent to 34-50 percent. However, different treatments result in vastly different decreases. In particular, unrestricted leasing opportunities reduced the number of water rights transferred far more compared to the treatments where such opportunities did not exist ($p<0.001$). This result is consistent with prior theories and the beliefs of those arguing in favor of leasing markets.

In a properly functioning market one would expect the reallocation of water rights to be from the lowest- to highest-value users (Colby 1990), which means that low-, medium- and high-value production agriculture should be responsible for transferring the most, second most, and least amount of water rights, respectively. Conversely, we would expect to see, in a well-functioning market, a reduction in the total number of water rights transferred (e.g., from a reduction in municipal demand for water rights) to come primarily from High Ag. Not surprisingly, and reaffirming that participants understood the experiment overall, this is consistent with the second and third findings.

Table 5-4. Percent of Water Rights Owned by Agricultural Users at the End of Each Round*

	Restricted %	Unrestricted %	Total %
No Bulletin	33.9[a]	50.1[a,c]	42.0
Bulletin	37.1	40.4[c]	38.8
Total	35.5[b]	45.2[b]	

* In all cases, percent of water rights owned by agriculture significantly different from 88% at 0.001.

* Neither relative ranking nor significance changed when considering only rounds 3, 4 and 5.

[a-c] Significantly different at 0.001.

Result 2. **Both water rights and water leasing markets lead to the reallocation of water rights from low- to high-value uses.**

Result 3. **Relative to restricted leasing, unrestricted leasing results in a greater number of water rights retained by high-value agricultural users.**

Table 5-5 provides support for these two results by showing a breakdown of the number of water rights sold by type of agricultural water user across the restricted and unrestricted leasing treatments. The sum of each column corresponds to the total number of water rights transferred from agricultural to urban users.

Table 5-5. Total Number of Water Rights Sold per Round by Group*

	Restricted Leasing	Unrestricted Leasing
Low Ag	6.89[a]	6.34[b]
Med Ag	5.80[a]	5.54[b,c]
High Ag	5.24[d]	2.73[c,d]

* in all cases, the number of water rights sold was significantly different from zero at 0.001.

[a] Significantly different at 0.025.

[b] Significantly different at 0.025.

[c] Significantly different at 0.001.

[d] Significantly different at 0.001.

Across both treatments, low-value production agriculture accounts for a greater number of sales, followed by medium- and high-value production agriculture. These differences are statistically significant across both treatments with the exception of the difference between med and high-value agriculture under restricted leasing. Providing support for Result 3, the introduction of unrestricted leasing led to a greater percentage of water rights being retained by high-value agricultural producers. In fact, high-value agricultural producers are the only group for which we observe a statistically significant difference in the number of water rights sold across the RL and UL treatments ($p<0.001$). Both of these findings are consistent with expectations and with arguments in favor of using market instruments for reallocating water.

5.3.1.2. WATER USE

If neither water rights nor leasing markets existed, agriculture would receive 88 percent of the total water available. By comparison, it is optimal to have 55.8 percent of available supplies, on average, used in production by agriculture. Table 5-6, which shows the percentage of total available water used in production by agriculture across each of the treatments, is the basis for Result 4.

Result 4. **Relative to restricted leasing, unrestricted leasing leads to more water used by agricultural users.**

Agricultural water use, relative to RL, was greater under UL. This difference is significant across both the bulletin and no-bulletin board treatments. Two factors are responsible for this difference. First, under UL, cities

Table 5-6. Water Units Used in Production by Agriculture as Percent of Total Water Available, by Round*

	Restricted Leasing	Unrestricted Leasing
No Bulletin	50.1%[b]	59.3%[b,e]
Bulletin	49.4%[c]	53.0%[c,e]
Total	49.7%[a]	56.1%[a]

* in all cases, water use was significantly different from initial endowment at 0.001.

[a&b] Significantly different at 0.001.

[c] Significantly greater at 0.1.

[d] Significantly different at 0.075.

[e] Significantly different at 0.005.

Table 5-7: Average Percent of Total Water Used by Group by Round*

	Restricted Leasing %	Unrestricted Leasing %
Low Ag	12.4[a]	12.9[d]
Med Ag	15.2[a,b,f]	17.1[d,f]
High Ag	22.2[b,c,g]	26.2[e,g]
City	50.3[c,h]	43.9[e,h]

* In all cases, water use was significantly different from initial endowment at 0.001.

[a-e] Significantly different at 0.001.

[f] Significantly different at 0.05.

[g] Significantly different at 0.001.

[h] Significantly different at 0.001.

purchase fewer water rights. As a result, they were endowed with less water at the beginning of TP2. Second, in normal and wet years, under unrestricted leasing, they are able to lease excess supplies back to agricultural users.

Overall more water was used for production in agriculture when the bulletin board was not present. This was primarily driven by the effect of having no bulletin board under the UL treatment. This result likely follows from the fact that agricultural players retained a greater share of total water rights when the bulletin board was not present under the UL treatment (see Table 5-6).

Results 5 and 6 complement Results 2 and 3 and again illustrate the attractiveness to rural communities of utilizing market institutions in reallocating water.

Result 5. **Both water rights and water leasing markets lead to the reallocation of water from low- to high-value users.**

Result 6. **Relative to restricted leasing, unrestricted leasing slows the redistribution of water from medium- and high-value agricultural users to cities.**

Table 5-7 provides a breakdown of total water use by round across each group.

Relative to initial endowments, more water was allocated to higher-valued uses across both the RL and UL treatments (i.e., cities received more than high-value farmers, high-value farmers more than medium-value farmers, etc.). These differences were statistically significant across each type/group in both the RL and UL treatments and speak to the potential benefits of markets as instruments for the reallocation of water.

Collectively, Results 1, 3, 4 and 6 suggest that introducing leasing markets will slow the reallocation of water and water rights from agricultural to municipal users. These findings are consistent with widely held beliefs surrounding the impacts of introducing leasing markets on water rights ownership and water use, and support the claims of those advocating leasing markets as a means of minimizing the economic impacts to rural economies associated with traditional permanent water rights transfers.

5.3.2. IMPACT OF UNRESTRICTED LEASING ON EFFICIENCY OF WATER USE: DIFFERENCES IN TOTAL CONDITIONAL AND UNCONDITIONAL PROFITS

Results 2 and 5 indicate that introducing unrestricted leasing opportunities might lead to increases in the efficiency of water use. To see whether this is indeed the case, the impact of leasing and water rights markets on overall efficiency, both relative to each other and relative to the initial endowment of water rights, is evaluated. Of particular interest is the relative efficiency gain associated with adding leasing markets on top of water rights markets. As is common in experimental economics, the sum of individual profits is used as a representation of efficiency.

5.3.2.1. LEASING EFFICIENCY GAINS

The impact of both restricted and unrestricted leasing on total profits is examined. In each round the ratio of actual production profits relative to total "conditional" production profits is calculated. Actual production profits in a round are equal to the sum of all individual profits across the round. Conditional production profits are the production profits that would have materialized if leasing activity (restricted or unrestricted) had *not* been allowed in TP2.

A ratio greater (less) than 0 indicates that leasing activity, restricted or unrestricted, increased (decreased) total production profits relative to not allowing any trading to occur in TP2. This measure isolates the effect of leasing opportunities on overall profits.

Result 7. **Dependent on the endowment of water at the beginning of Trading Period 2, unrestricted leasing results in greater increases in the efficiency of water use relative to restricted leasing.**

Support for Result 7 comes from Table 5-8, where the average leasing efficiency gain is presented across the RL and UL treatments. The average from all rounds, as well as for only rounds 3, 4 and 5, is presented in this table. This is done because a majority of participants indicated in a postexperimental survey that they fully understood the experiment after the completion of round 2, which is consistent with the observed difference in the averages across all rounds versus rounds 3, 4 and 5. While overall less than 5 percent of trades in TP2 could be considered "mistakes," those

Table 5-8. Average Leasing Efficiency Gain*

	Restricted Leasing %	Unrestricted Leasing %
All Rounds	1.4[a]	2.3[a,c]
Rounds 3, 4 and 5	1.5[b]	3.1[b,c]

* All changes were significantly different than 0 at the 0.001 level.

[a] Unrestricted leasing significantly greater at 0.06.

[b] Unrestricted leasing significantly greater at 0.025.

[c] Significantly different at .03

mistakes were primarily made by cities in the *Bull-UL* treatment during rounds 1 and 2.

Consistent with expectations, leasing (restricted or unrestricted) leads to efficiency gains relative to production associated with the endowment of water at the beginning of TP2. Also expected, greater leasing efficiency gains are observed under the unrestricted treatment.

5.3.2.2. OVERALL PRODUCTION EFFICIENCY GAINS

An obvious shortcoming of the above approach (and in studies that focus on each market in isolation) is that it fails to account for the impacts of unrestricted leasing on the market for water rights; in other words, it assumes that traders in TP1 do not take into account what will happen in TP2. In reality, traders can be expected to be more forward-looking in TP1, in the experiment as well as in the real world.

Ultimately, the introduction of unrestricted leasing can lead to a change in the initial endowment of water at the beginning of TP2, making the above comparison across treatments misleading. While unrestricted leasing adds flexibility in the reallocation of water, the initial distribution of water at the beginning of TP2 may be more or less efficient depending on activity in the water rights market. Thus, the relevant metric for evaluating the impact of UL (relative to RL) on efficiency is a comparison of total profits at the end of each round to the production profits that would have resulted if trading activity in neither TP1 nor TP2 was allowed.

Result 8. **Unrestricted leasing does not result in additional increases in overall efficiency relative to restricted leasing.**

Table 5-9. Average Total Efficiency Gain*

	Restricted %	Unrestricted %	Total %
No Bulletin	76.2	77.9	77.1
Bulletin	76.2	75.0	75.6
Total	76.2	76.5	

* All changes were significantly greater than zero at 0.001. None of the differences across treatments were significantly different from zero.

Support for Result 8 is found in Table 5-9, which presents the average percent change in total production profits relative to endowed production profits across all rounds.

Statistically significant efficiency gains were achieved by allowing water to be reallocated in some fashion. However, somewhat surprisingly, there were no significant differences in overall production profits across the restricted and unrestricted leasing treatments.

This result is contrary to the motivation behind introducing leasing markets, namely, that they would lead to a more efficient allocation of water across years. Why did unrestricted leasing not result in an increase in overall efficiency relative to restricted leasing? Table 5-10, which documents the net flow of water leased by agricultural users to cities across each of the three different types of years, helps explain this result.

On average, cities ended up owning two to three fewer water rights over the course of a round under UL. As a result, during dry years cities began TP2 with two to three fewer units of water. Cities overcame this by leasing an average of 2.2 units of water during dry years. This result is consistent with the real-life practice of firm yield supply planning, where cities purchase water rights (and develop storage capacity) sufficient to withstand severe drought. It is also consistent with the idea that cities could use leasing markets as an alternative means of firming supplies (as opposed to purchasing additional water rights). In short, whether through water rights purchases or leasing water, under drought conditions city players acquired roughly the same amount of water regardless of whether or not leasing was restricted.

Table 5-10. Net Quantity of Water Leased from Agriculture to Cities

	Restricted	Unrestricted
Dry	0[a]	2.2[a]
Normal	0[b]	-.92[b]
Wet	0[c]	-4.26[c]

[a] Significantly different at 0.001.

[b] Significantly different at 0.025.

[c] Significantly different at 0.001.

Inefficiencies in water use (relative to the optimal allocation) under RL came largely from cities having too much water in normal and wet years. Under UL cities owned fewer water rights, meaning that in normal and wet years they began TP2 with less water. Moreover, as indicated in the last two rows of Table 5-10, in normal and wet years, they were able to lease still-existing excess supplies to irrigators. However, the overall impact on total production profits of this reallocation was minimal given that in normal and wet years, at the margin, the production value of additional units of water in agriculture is low. In the real world, this is especially the case in areas where irrigators are located downstream of cities. In the experiment, city water valuated at zero was not made available to farmers. In practice these excess supplies would flow downstream to irrigators.

Result 7 suggests that given an initial allocation of water, the ability to lease across uses leads to efficiency gains. Result 8, however, suggests that adding leasing markets on top of water rights markets is unlikely to result in significant gains in production profits.

5.3.3. WHO WINS AND WHO LOSES? IMPACT OF UL ON THE TOTAL PROFITS AND THE DISTRIBUTION OF PROFITS ACROSS PLAYER TYPES

As suggested earlier in this section, the benefits of adding unrestricted leasing to already active water rights markets lie largely in the reduction of impacts to rural communities (in the form of increased agricultural production and water rights ownership) as opposed to overall efficiency gains. The relevant question then becomes: which parties bear the cost of maintaining agricultural production and saving rural communities? Result 9 speaks to this question, highlighting the change in profits for cities and agricultural players across RL and UL.

Result 9. Relative to restricted leasing, unrestricted leasing results in higher total profits for cities and lower total profits for agriculture.

This result follows from Tables 5-11 and 5-12, which report average total profits by player type across each of the four treatments.

Not surprisingly, total city profits were higher under UL relative to RL; the difference is statistically significant overall and under the *NoBull* treatment. For cities, increased profits stem, in part, from (a) not having to purchase as much water and (b) being able to lease excess supplies in normal and wet years. The former has to do with their options for firming supplies (i.e., augmenting drought year supplies) across RL and UL. Under RL, cities have only one option: purchase additional water rights. In effect, they have to buy water ever year as opposed to just those years when they are short.

Table 5-11. Total City Profit per Round

	Restricted	Unrestricted	Total
No Bulletin	5,782.74[a]	6,308.86[a,c]	6,045.80
Bulletin	5,670.54	6,064.06[c]	5,867.30
Total	5,726.64[b]	6,186.46[b]	

[a] Significantly different at 0.002.

[b] Significantly different at 0.02.

[c] Significantly greater at 0.1.

* neither relative ranking nor significance, across either player type, changed when only considering rounds 3,4 and 5, with the exception of the comparison of Bulletin to No Bulletin for cities under the Leasing sample which was no longer significant.

Table 5-12. Total Ag Profits per Round

	Restricted	Unrestricted	Total
No Bulletin	2,133.09[b]	1,691.14[b]	1,912.11
Bulletin	2,252.97[c]	1,807.69[c]	2,030.33
Total	2,193.03[a]	1,749.41[a]	

[a] Significantly different at 0.01.

[b] Significantly different at 0.002.

[c] Significantly greater at 0.075.

* Neither relative ranking nor significance, across either player type, changed when only considering rounds 3, 4 and 5.

By comparison, total agricultural profits were lower when leasing was unrestricted. This difference was statistically significant overall and when focused on the *Bull* and *NoBull* treatments separately. Publicizing transactions in the *Bull* treatment had opposite effects on city and agricultural profits. City profits were lower on average when the bulletin board was present; however, the difference was not significant with the exception of when leasing was unrestricted. Alternatively, agricultural profits were higher, although not significantly so, when trading activity was publicized. The effect of the bulletin board on city and agricultural profits was largely a result of the impact of the bulletin board on prices which led to higher prices for irrigators.

Overall, agricultural players were worse off when given the option to lease water to cities. To better understand the driving factors behind these changes, recall that total profits are equal to the sum of net income from the water rights market, net income from the leasing market, and total production profits. Table 5-13 provides a breakdown of total profits for each of the four player types across the RL and UL treatments.

Consistent with the explanations above, the increase in total profits for cities is largely explained by reduced expenditures on water. While production profits were not significantly different across the two treatments, total net expenditures on water were roughly half, a statistically significant difference.

Total profits were significantly lower for each of the three agricultural groups under the UL treatment. Why did this occur? As indicated in Result 10, for all three groups, lower revenues from water rights sales were the primary cause.

Table 5-13. Decomposition of Profits by Type of Activity

	Low Ag		Med Ag		High Ag		City	
	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted
Net WR Inc	369.03[a]	206.03[a]	381.40[b]	190.80[b]	346.07[c]	137.04[c]	-1,096.50[d]	-533.87[d]
Net Leasing Inc	38.67	30.41	38.74[e]	5.63[e]	-77.41[f]	-17.94[f]	0	-18.10
Production Profits	152.40	154.74	305.37[g]	323.06[g]	642.11[h]	725.26[h]	6,823.14	6,738.43
Total	560.10[i]	391.19[i]	725.51[j]	519.49[j]	910.77[k]	844.36[k]	5,726.64[l]	6,186.46[l]

[a&b] Significantly different at 0.01.

[c] Significantly different at 0.001.

[d] Significantly different at 0.002.

[e] Significantly different at 0.05.

[f] Significantly different at 0.001.

[g] Significantly less at 0.075.

[h] Significantly different at 0.002.

[i&j] Significantly different at 0.01.

[k] Significantly greater than at 0.1.

[l] Significantly different at 0.02.

Result 10. **For agricultural traders, unrestricted leasing leads to losses in revenue from water rights sales that more than offset gains in net leasing income and production profits.**

The impact of UL on net leasing revenues and production profits differed across each of the three irrigator types. However, consistent across all three groups was that losses in revenues from water right sales were the predominant factor driving the reduction in overall profits.

Why did revenues from water rights sales fall so much? For medium- and high-value producers, the reduction in revenues from water rights sales can be explained, in part, by the fact that they sold fewer water rights. However, this is not the case for low-value agricultural users where the impact of UL is illustrated best. Revenues from water rights sales fell by 40 percent for low-value producers under UL. This occurred despite the fact that they sold the same number of water rights across the restricted and unrestricted treatments (Table 5-5).

Table 5-14. Average Price per Water Right by Year

Year	Restricted	Unrestricted
1	60.72[a]	40.15[a]
2	49.90	38.68
3	38.28[b]	19.02[b]

[a] Significantly different at 0.05.

[b] Significantly different at.0001.

Table 5-14 presents the average price per water right by year across RL and UL. The fall in revenues from water rights sales is attributable to lower water rights prices. There are two explanations for this. One possibility is that UL impacted the timing of when water rights were sold. For example, if under RL all water rights were sold in year 1 and under UL they were all sold in year 3, we would expect the average price per water right to fall. Analysis of the data, however, reveals no significant differences in when low-value irrigators sold their water within a round.

The other explanation is related to a change in bargaining power across the RL and UL treatments. The transition from RL to UL effectively doubles the number of potential water suppliers cities can acquire supply from in any given year. Evidence of this comes from the fact that cities were able to earn roughly the same amount of revenues from production under unrestricted leasing, yet the cost to acquire the water was half when allowed to supplement water rights purchases with water leases. Alternatively, for irrigators the loss in revenues from water rights transactions exceeds any gains in production profits and added revenue associated with being able to lease to cities.

5.4. Conclusion

The reallocation of water from agricultural to urban users has traditionally occurred via water rights markets. Increasingly, leasing markets are being promoted as an alternative to permanent transfers. Proponents argue that leasing markets offer potential efficiency gains and the opportunity to reduce the negative impacts to rural communities associated with the permanent transfer of water out of agriculture.

This market experiment provides empirical evidence, obtained through laboratory experiments, of the effect of introducing leasing markets in areas where water rights markets already exist. Three salient points emerge from the analysis. First, consistent with expectations, unrestricted leasing, relative to restricted leasing, leads to a reduction in the quantity of water rights transferred out of agriculture and increases the quantity of water used in production by agricultural users. Together, these two results support the notion that leasing markets will likely benefit rural communities.

Irrigated field in Colorado.

The second finding has to do with the impact of leasing on efficiency. Unrestricted leasing did not significantly increase overall efficiency relative to only allowing water rights markets. This result differs from widely held beliefs and previous studies. Unlike previous analyses, this study accounts for the effects of leasing markets on activity in water rights markets. Regardless of the institutional setup, cities acquired supplies sufficient to meet demands during dry conditions. When leasing was not allowed they did so by purchasing "extra" water rights, consistent with the practice of firm-yield planning. When leasing was allowed, cities purchased fewer water rights and relied more on the leasing market to firm supplies during drought years. Thus, under RL, potential efficiency gains existed because cities had too much water in normal and wet years. However, given the low production value associated with agricultural production (relative to city use) and the abundance of water in wet years, the marginal gains associated with the ability to reallocate water to agricultural users in normal and wet years were relatively small and had a small, statistically insignificant impact on overall efficiency. This result highlights the importance of modeling both markets simultaneously.

The first two results suggest that the benefits of leasing lie largely in reducing impacts to rural communities. Who bears the cost of saving rural communities? Results presented here suggest that the cost might largely be borne by agricultural water rights owners. While production profits and revenues from leasing increase for agricultural players under the unrestricted leasing treatment, these gains are more than offset by lost revenues from the sale of water rights. As is the case in real life, the true value of water rights to agricultural users lies in the potential sale to cities. Absent leasing markets, two things happen. First, demand for water rights from cities falls with the introduction of a substitute water supply option. Second, the introduction of leasing markets effectively doubles the number of potential sellers of "water." Together these two factors depress market prices for water rights.

6. ALTERNATIVE AGRICULTURE TRANSFER METHODS SURVEY OF MUNICIPAL & INDUSTRIAL PROVIDERS

6.1. Introduction and Summary of M&I Survey

The water market experiment described in Section 5 of this report provided an approach utilizing laboratory market experiments to study the impact of institutional changes in water markets. A survey was designed and conducted of various municipal and industrial (M&I) water providers to evaluate attitudes and willingness to participate in various leasing arrangements and alternative transfer mechanisms. The survey was based on alternative agriculture transfer methods (ATMs) identified in the Farmers Reservoir and Irrigation Company (FRICO) Barr and Milton shareholder surveys. The electronic survey was developed by DiNatale Water Consultants with an initial survey review and comments provided by the project team, Todd Doherty, Colorado Water Conservation Board (CWCB), the Intrastate Basin Compact Committee (IBCC) Alternative ATM subcommittee and other reviewers. The survey was administered online, both via e-mail and through the online site SurveyMonkey.com, to M&I providers in the South Platte basin representing potential customers of water from alternative agriculture transfer methods. Responses were collected over a two-month period from 23 water utilities and water providers. A full list of survey respondents is located under the "General Survey Respondent Demographics" (Table 6.1). A copy of the survey and graphs and tables for each survey response is provided in Appendices 3 and 4. The M&I survey results should be compared with the water market experiment results and findings to determine commonalties and contradictions.

Colorado agriculture, early 1900s

The purpose of the survey was to collect information on attitudes of M&I water providers regarding agricultural transfers and traditional water leasing and their willingness to consider alternatives to traditional water rights transfers that typically result in the permanent dry-up of irrigated land. The survey responses provided insight into perceptions of alternative ATMs and the next steps needed to facilitate successful alternative transfers. Individual water provider's responses have not been reported. Instead, results are aggregated by category, such as service area population, total raw water demand or geographic area. Analysis and conclusions of the survey responses and the significance for alternative ATMs are presented along with suggestions for next steps and areas of study.

6.2. General Survey Respondent Demographics

Survey respondents comprised mainly water utilities within municipal governments (57 percent) and water or water and sanitation districts (31 percent). Figure 6-1 shows the categorical classification of survey respondents. The other response was from a water conservancy district.

The M&I water providers that responded to the survey varied in size. Table 6-1 lists the survey respondents.

The current and projected population buildout service area of the survey respondents is presented in Figure 6-2. As can be seen in the chart, currently the populations served by providers are fairly evenly split with the majority of the populations between 25,000 and greater than 125,000. However, in the future the majority of M&I providers expect to serve populations greater than 125,000.

Table 6-1. List of Survey Respondents

Provider
Arapahoe County Water and Wastewater Authority
City of Arvada
City of Aurora
City of Boulder
Centennial Water and Sanitation District
Denver Water
East Cherry Creek Valley Water and Sanitation District
City of Fort Collins
City of Greeley
Town of Johnstown
City of Lafayette
Lefthand Water District
City of Longmont
City of Louisville
City of Loveland
Parker Water and Sanitation District
Public Service Company
South Adams County Water and Sanitation District
St. Vrain and Left Hand Water Conservancy District
City of Thornton
Tri-Districts (East Larimer County, Fort Collins-Loveland and North Weld County Water Districts)
United Water and Sanitation District
City of Westminster

Figure 6-1. Type of Water Utility/Water Provider - Survey Respondents

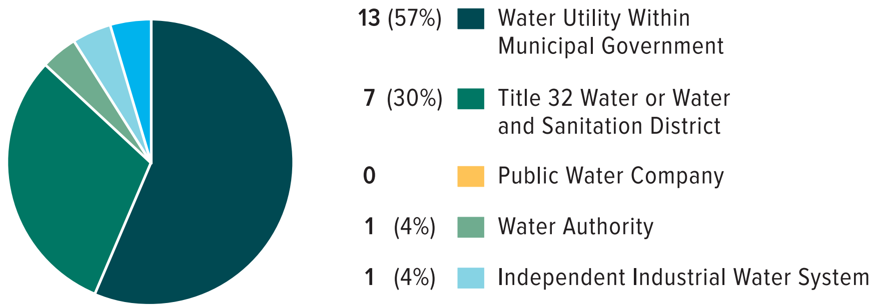


Figure 6-2. Current and Projected Buildout Service Area Population

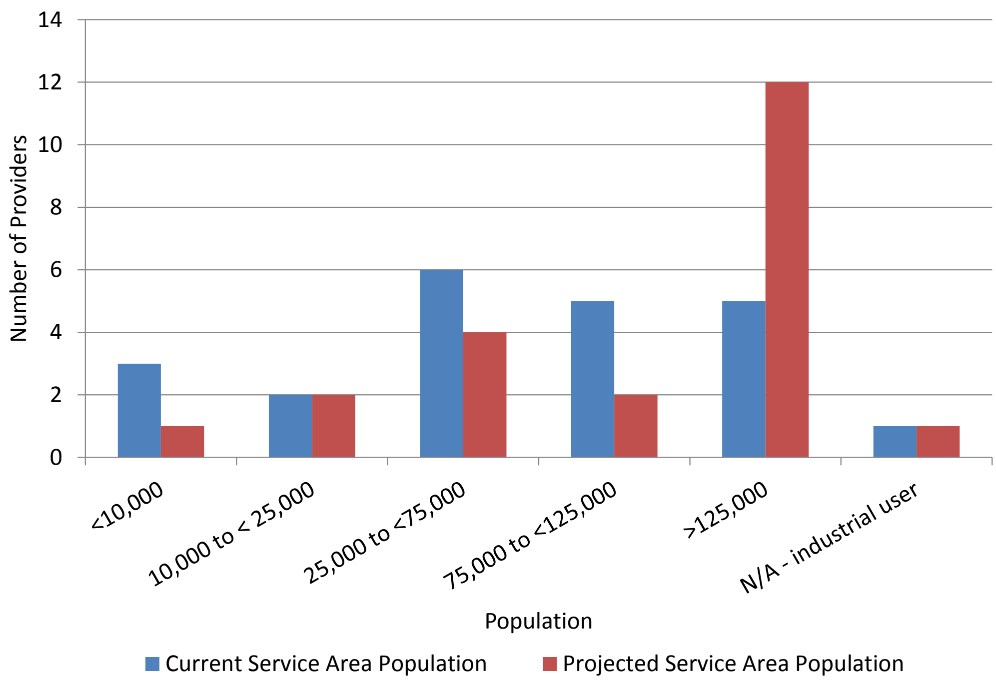
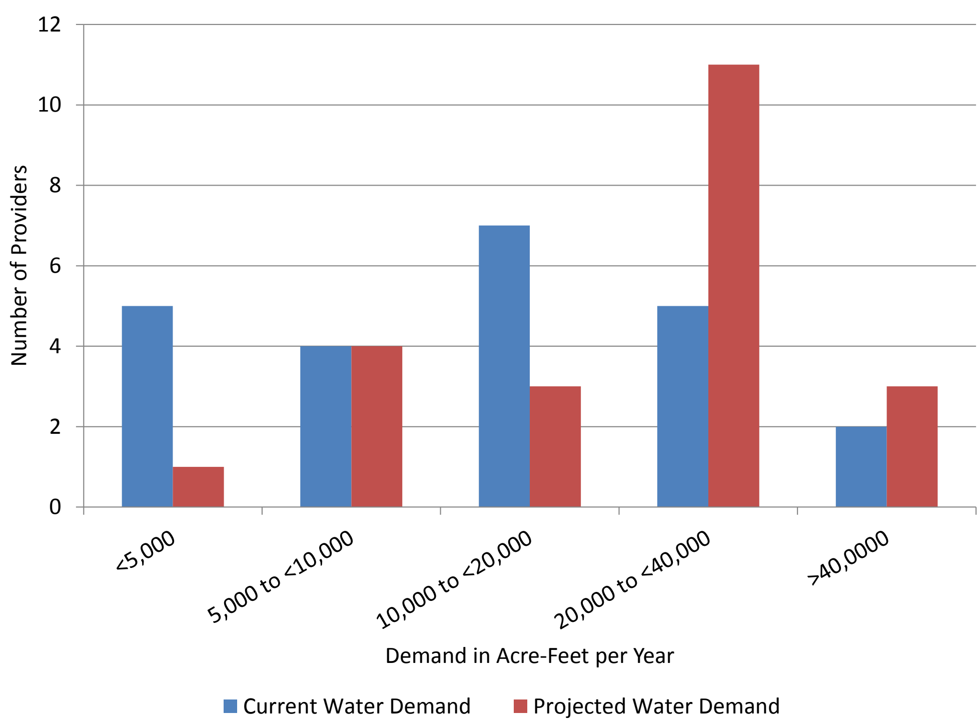


Figure 6-3. Current and Projected Total Raw Water Demand at Buildout



A similar comparison of current and projected buildout in terms of raw water demand is shown in Figure 6-3. As with population, currently raw water demand has a more even distribution, but in the future a majority of M&I providers project that their raw water demand will range between 20,000 and 40,000 acre-feet (AF) per year.

Figure 6-4. Additional Agricultural Water Rights Transfers Part of Plans

Are additional agricultural water rights transfers a part of your current plans to meet future demands?

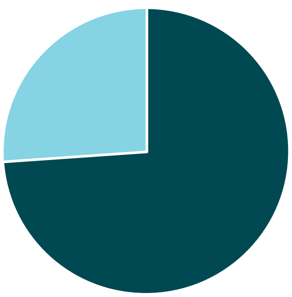
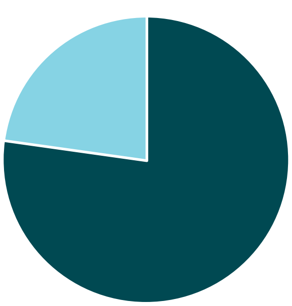


Figure 6-5. Require Dry-up Covenants When Acquiring Agricultural Water Rights (of Those Respondents Who Will Acquire Additional Agricultural Water Rights)

Do you typically require dry-up covenants when acquiring agricultural water rights?



6.3. Current Alternative Agriculture Transfer Practices

After collecting general information about the type, size and capacity of survey respondents, the survey focused on current agricultural water rights acquisitions and transfer practices. Of all respondents, 74 percent will have additional agriculture water rights transfers as part of their current plans to meet future demands, as seen in Figure 6-4.

When acquiring agricultural water rights, 77 percent of the total respondents typically require dry-up covenants. This group includes those providers for whom additional agricultural water rights transfers are not part of their plan to meet future demands. When those respondents who do not acquire additional agricultural water rights transfers were removed from the results, 76 percent of those who acquire additional agricultural water typically require dry-up covenants when acquiring agricultural water rights, as shown in Figure 6-5.

When asked whether the challenges and uncertainty in permitting a future water supply project affect a water provider's decision to acquire and transfer agricultural water rights, 50 percent of the survey respondents answered that they purchase agricultural water rights as a matter of normal planning, as shown in Figure 6-6.

To better understand the motivations behind evaluating water supply development, providers were asked to identify the most important factor when evaluating water supply development and acquisitions. On a scale of 1 to 5, they were asked to indicate their level of agreement with the

Figure 6-6. Challenges and Uncertainty in Permitting a Future Water Supply Project Affect Your Decision to Acquire and Transfer Agricultural Water Rights

Do the challenges and uncertainty in permitting a future water supply project affect your decision to acquire and transfer agricultural water rights?

5 (23%)	Yes, will acquire agricultural rights rather than face the costs and uncertainties in environmental permitting
6 (27%)	No
0	Do not plan to acquire additional agricultural rights
11 (50%)	We purchase agricultural water rights as a matter of normal planning

statement; 1 indicating that they strongly disagreed, 2 disagreed, 3 neutral, 4 agreed, and 5 indicating that they strongly agreed. The top three most important factors (in order of importance) are certainty and reliability of yield, permanency of supply and ownership of water rights as listed in Table 6-2 with the average rank.

The full list of factors and their ranks are shown in Figure 6-7.

The fourth most important factor was "other," which received an average rank of 4.00. Specific comments received for the other category include:

1. Expansion of use issues are important.
2. Feasibility of constructing infrastructure.
3. Cost of infrastructure, location of water rights and effects on surrounding areas.

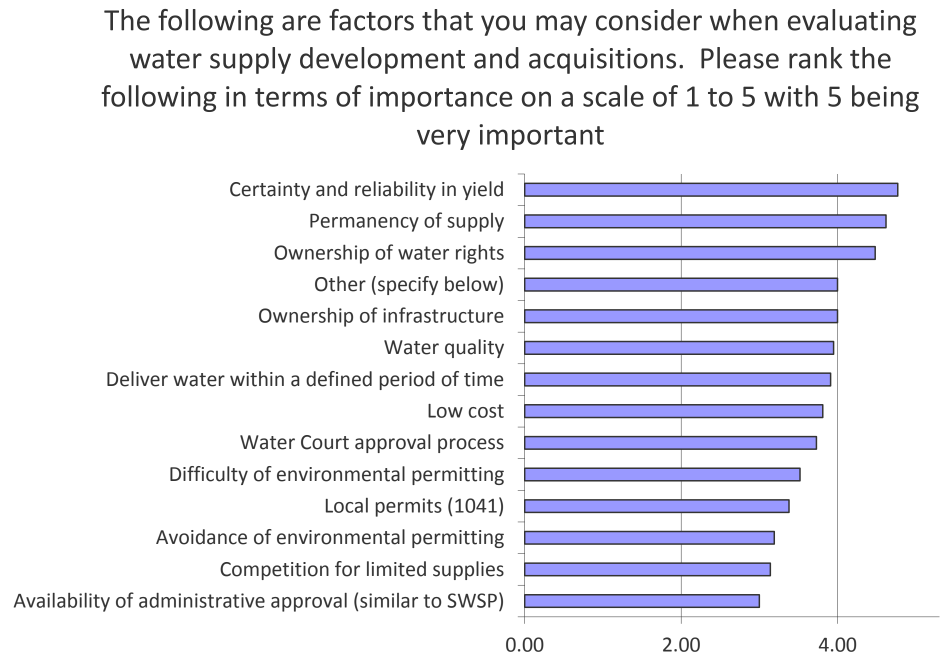
Table 6-2. Top Three Factors Water Providers Consider When Evaluating Water Supply Development and Acquisitions

Factor	Average Rank
Certainty and reliability in yield	4.77
Permanency of supply	4.62
Ownership of water rights	4.48

6.4. Alternative Agriculture Transfer Methods

Survey questions focused on various lease back agreements and alternative ATMs (interruptible water supply agreements, rotational fallowing, limited irrigation and shared water bank). The M&I providers were queried on their familiarity with the specific alternative ATMs, the likelihood of including the ATM as part of their future water supply

Figure 6-7. Factors Water Providers Consider when Evaluating Water Supply Development and Acquisitions



portfolio and the top three most important factors preventing M&I providers from entering into the specific ATM.

6.4.1. LEASE BACK AGREEMENTS

"Lease back agreements" involve agricultural water rights that are purchased by an M&I provider and leased back to the original seller for a period of years as part of the initial water rights acquisition agreement. As can be seen in Figure 6-8, 27 percent of the providers do not enter into lease back agreements and 27 percent occasionally enter into lease backs. The remaining 46 percent of the providers regularly use lease back arrangements.

One provider noted that it currently uses lease back arrangements with local farmers to keep the farms in production. That practice will continue until the provider decides to use these water rights for other use. This practice may include renewal clauses to the extent that the supply is still a surplus. Figure 6-9 shows the typical length of a lease that M&I providers enter into for lease back agreements. The typical length of lease back agreements was an even split of less than five years or varying.

Figure 6-8. Lease Back Agricultural Water Rights to Original Seller

Do you **lease back** agricultural water rights that are purchased by your utility to the original seller for a period of years as part of the water rights acquisition agreement?

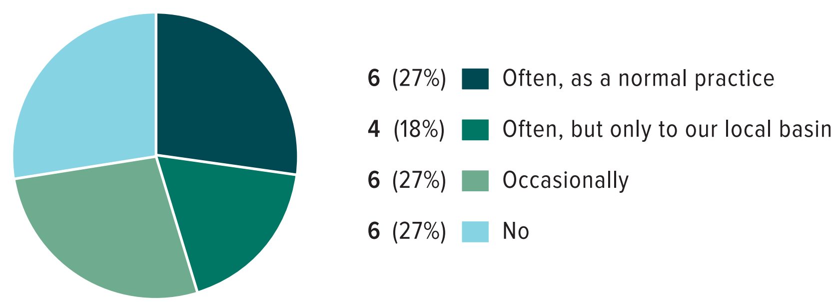
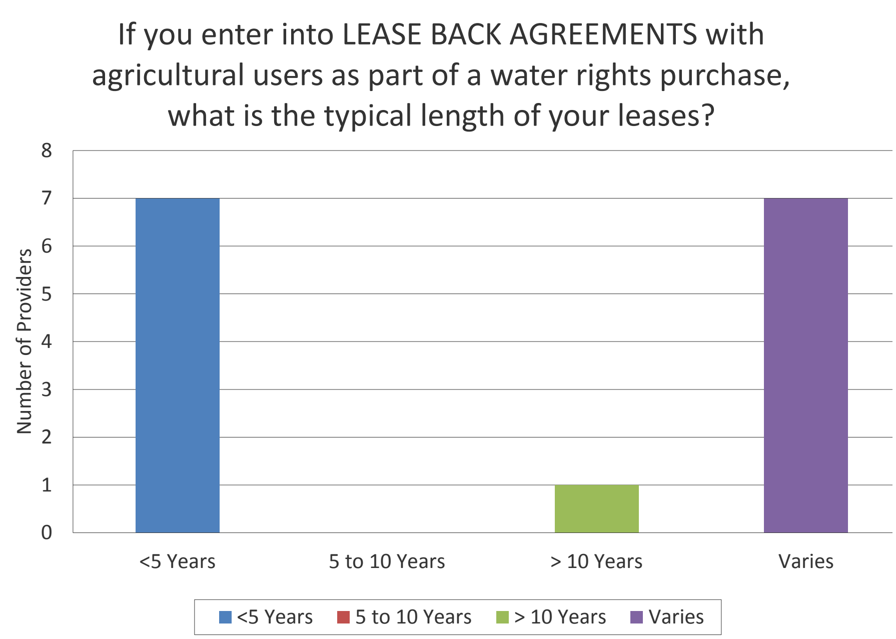


Figure 6-9. Typical Length of Leases for Lease Back Agreements



6.4.2. SURPLUS LEASES

"Surplus leases" are water supplies that have been determined to be surplus until water demand reaches a certain level, allowing a utility to enter into multiyear contracts to lease these surplus supplies to agricultural users. "Annual rentals of surplus leases" refers to rentals of Colorado-Big Thompson (C-BT) or native water that is not needed in that one year and annually rented on a first come first served basis. More respondents enter into annual rentals of surplus supplies, 52 percent, than enter into surplus leases, 26 percent, as shown in Figures 6-10 and 6-11, respectively. This may be due to the shorter contract period and the reduced risk of leasing water for one year compared to a longer period.

Figure 6-10. Annual Rentals of Surplus Supplies

Do you enter into **annual rentals of surplus supplies** for Rentals of C-BT or native water that is not needed in that one year and rented on a first come, first served basis?

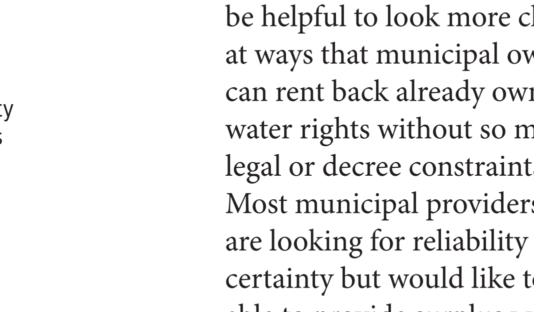
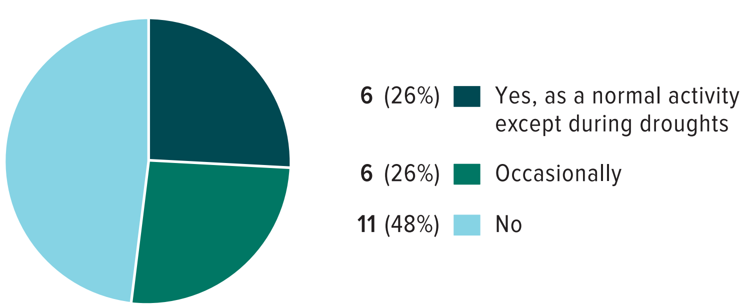


Figure 6-11. Surplus Leases

Do you enter into **surplus leases** for water supplies that have been determined to be surplus until development reaches a certain level, allowing the utility to enter into multiyear contracts to lease these surplus supplies to agricultural users?



One M&I provider commented: "Many providers have surplus water in most years and only need additional supplies during critical drought years. To keep viable agricultural economies, it may be helpful to look more closely at ways that municipal owners can rent back already owned water rights without so many legal or decree constraints. Most municipal providers are looking for reliability and certainty but would like to be able to provide surplus water for agricultural use if the system allowed it."

While many providers indicated they may lease water back to agricultural users, they are less prone to lease water from agricultural users. As shown in Figure 6-12, only 15 percent and 14 percent of providers leased agricultural water supplies FROM agricultural users before or after the 2002 drought, respectively. The number of providers that leased water from agricultural users during the 2002 drought only increased to 25 percent.

Annual rentals to agricultural users had a typical per AF lease charge of $20-$39/AF with some costs less than $20/AF and some as high as $40-$60/AF. Annual ditch assessments also are a typical lease charge to agricultural users. The rates for the typical per AF lease charge from agricultural users were on average much higher, at more than $300/AF. Figure 6-13 shows the comparison between leasing from and leasing to agricultural water users.

As can be seen in Figure 6-13, the price per acre-foot of water is typically less when M&I providers are leasing to agricultural users (either annual ditch assessment or less than $100/AF) while the price when leasing from agricultural users is usually much higher (more than $200/AF).

6.4.3. EXTENDED PERIOD WATER LEASES

An "extended period water lease" refers to an agreement between a water provider and an agricultural user where the water provider enters into a lease with the agricultural user to lease all or a portion of the irrigator's water rights annually for a defined period of time. The resulting yield to the M&I provider each year would depend on the yield of the specific water rights that were leased. Under this form of agreement, the irrigator

Figure 6-12. Leased Water Supplies **from** Agricultural Users to Supplement Supply

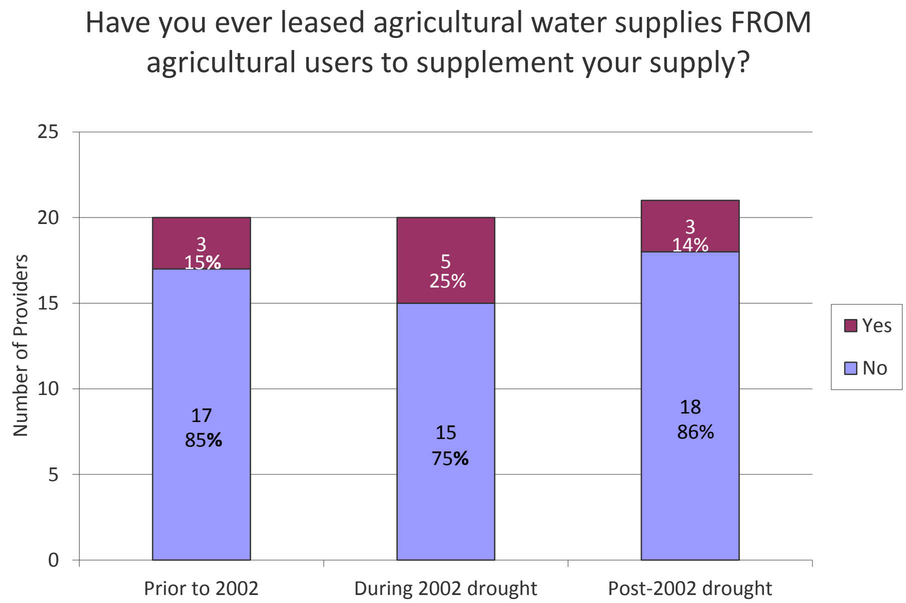


Figure 6-13. Typical per AF Charge for Leased Agricultural Water Supplies (Both **to** and **from** Agricultural Users)

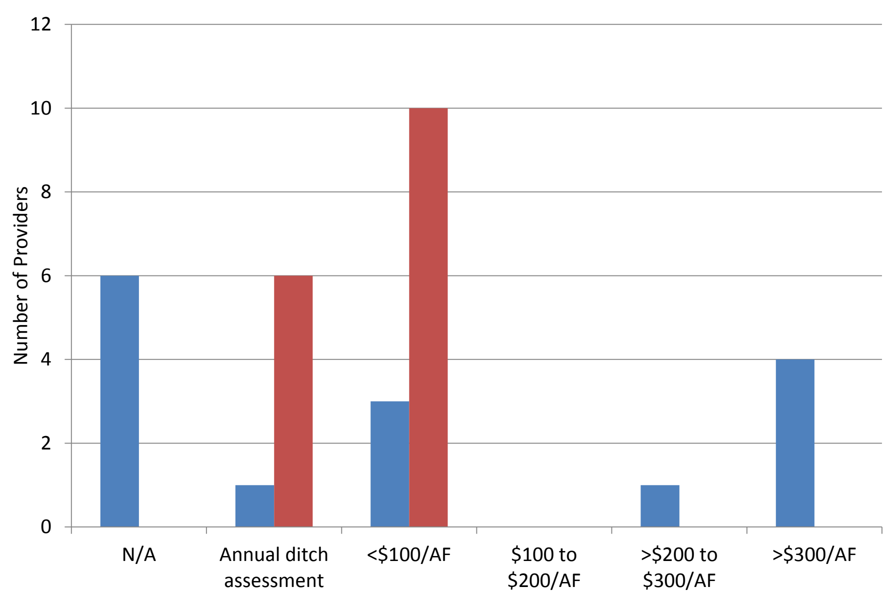


Figure 6-14. Familiarity with Concept of Extended Period Water Leases

How familiar are you with the concept of “extended period water leases”?

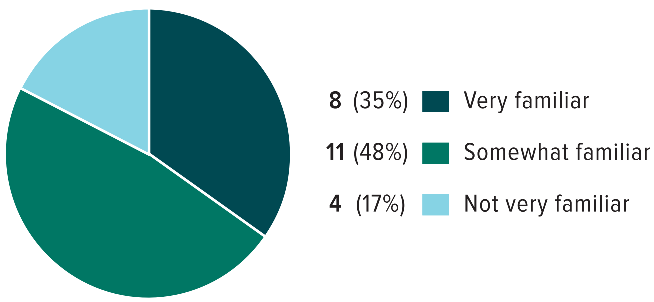


Figure 6-15. Likelihood that Extended Period Water Leases Will Be Part of Utility’s Future Water Supply Portfolio

How likely is it that extended period water leases will be a part of your utility’s future water supply portfolio?

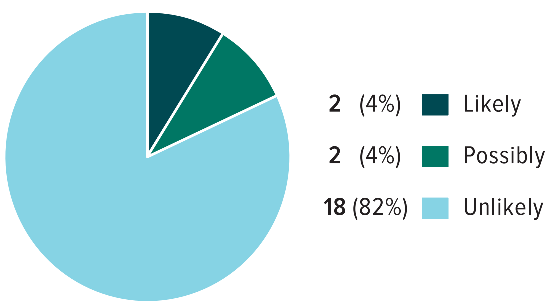


Table 6-3. Top Three Factors Preventing Water Providers from Entering into Extended Period Lease

Factor	Average Rank
1. Need a permanent water supply	4.57
2. Would prefer to own all agricultural water rights	4.33
3. Unwilling to develop supplies that may not be permanent at end of lease	4.20

retains ownership of the leased water right. Survey participants had some familiarity of the extended period water lease, and only 17 percent were not very familiar, as shown in Figure 6-14. However, the providers indicated that they were not likely to include extended period water leases as part of a utility’s future water supply portfolio (82 percent unlikely), shown in Figure 6-15.

Providers identified the top three most important factors preventing respondents from entering into an extended period lease listed in Table 6-3, with their average rank. The factors identified support and align well with the respondents’ comments below.

M&I providers were not likely to enter into extended period water leases for the following reasons:

1. A permanent supply is very important, and water providers need long-term certainty.

2. One M&I organization has no intention of entering into leases of agricultural water, so the factors listed were not relevant.

3. Another provider indicated that it does not need extended period water leases.

4. The ability to lease back to agriculture after purchase at the end of a lease is very important to another M&I provider.

5. Because of the huge cost of developing the facilities necessary to transport and treat the water (plus storage for delayed return flows), the need to have a permanent supply for taps and the expected completion for sources in the future, one provider would only be interested in permanent arrangements. This provider would not necessarily have to have ownership of the water rights but would need certainty on the volume and price of water for the same reasons stated above. It would probably need the agricultural water only in drought periods and would seek a partnership arrangement that made agricultural use sustainable and provided

permanent drought supply for the city. Dry-up would not be necessary but new legislation for water courts to approve creative arrangements might be needed.

6.4.4. INTERRUPTIBLE WATER SUPPLY AGREEMENTS

"Interruptible water supply agreements" (ISAs) may consist of temporary, long-term or permanent arrangements in which agricultural water is transferred for other purposes in other locations while irrigation is temporarily suspended. Exercising an ISA is typically triggered on an as-needed basis and could include dry-year needs, drought recovery needs and even wet-year needs. An ISA would include limitations as to the frequency in which the supply could be exercised throughout the term of the agreement. Current law (Section 37-75-309 CRS) allows the State Engineer to administratively approve temporary ISAs as long as they are not triggered more than three times in a 10-year period. A longer-term ISA that could involve more frequent interruption of the agricultural use would require water court approval. The terms of such an ISA are within the parties' discretion, as is the schedule of payments that might reflect the frequency or repetition of exercising the option. Ninety-five percent of respondents were at least somewhat familiar (50 percent) or very familiar (45 percent) with the concept of interruptible water supply agreements, shown in Figure 6-16. However, this familiarity does not translate into acceptance as a practice, as no provider indicated it was likely and 45 percent would possibly include interruptible water supply agreements in the utility's future water supply portfolio. Approximately half (55 percent) stated it was unlikely that they would enter into an ISA (Figure 6-17).

The top three most important factors preventing respondents from entering into interruptible water supply agreement are listed in Table 6-4, with their average rank.

Figure 6-16. Familiarity with Concept of Interruptible Water Supply Agreements

How familiar are you with the concept of "interruptible water supply agreements" described above?

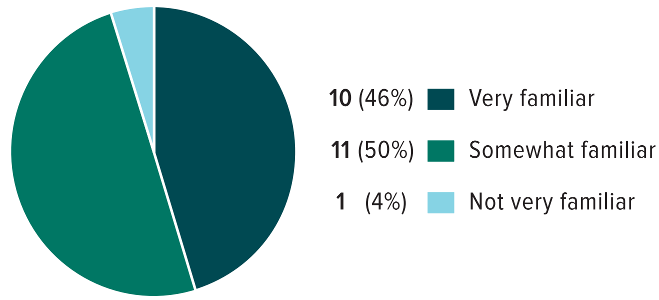


Figure 6-17. Likelihood that Interruptible Water Supply Agreements Will Be Part of Utility's Future Water Supply Portfolio

How likely is it that interruptible water supply agreements will be a part of your utility's future water supply portfolio?

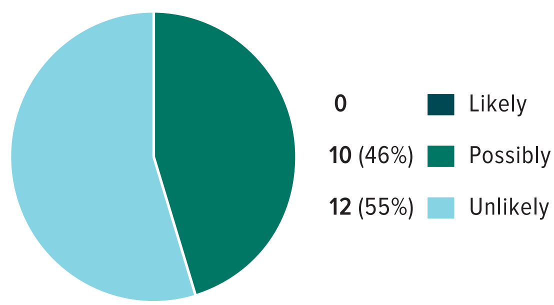


Table 6-4. Top Three Factors Preventing Water Providers from Entering into Interruptible Water Supply Agreement

Factor	Average Rank
1. Would prefer to own all agricultural water rights	4.14
2. Need a permanent water supply	4.00
3. Unwilling to develop supplies that may not be permanent at end of agreement period	3.70

Figure 6-18. Familiarity with Concept of Rotational Fallowing

How familiar are you with the concept of "rotational fallowing" described above?

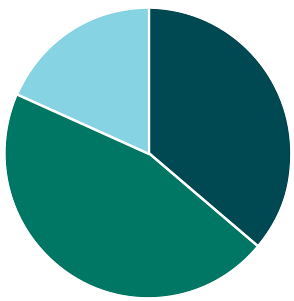


Figure 6-19. Likelihood that Rotational Fallowing Will Be Part of Utility's Future Water Supply Portfolio

How likely is it that rotational fallowing agreements will be a part of your utility's future water supply portfolio?

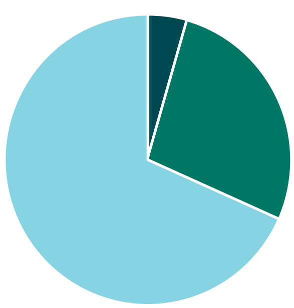


Table 6-5. Top three Factors Preventing Water Providers from Entering into a Rotational Fallowing Agreement

Factor	Average Rank
1. Need a permanent water supply	4.30
2. Would prefer to own all agricultural water rights	4.15
3. Unwilling to develop supplies that may not be permanent at end of agreement period	4.10

Specific providers listed reasons for not including this alternative ATM:

1. It has been our experience that these work better going the other way. We buy transfer, and lease back.

2. We would pursue this as a way to "tap" into an augmentation supply during an extreme drought.

3. Boulder County has tied up much of the agricultural water in this area in open space and is not inclined to do interruptible supply agreements.

6.4.5. ROTATIONAL FALLOWING

"Rotational fallowing" is an alternative means of freeing up agricultural water without a permanent dry-up. A rotational fallowing agreement between a water provider and a group of agricultural users would require each member of the group of agricultural users to agree not to irrigate for a period of time over the course of the agreement. Each member of the irrigator group would fallow on a rotating basis. Water would be made available to the water provider on a negotiated schedule. For example, if five agricultural users signed a five-year rotational fallowing agreement, each irrigator would take a turn *not* irrigating in one year out of five. The M&I user would obtain an annual yield, with this yield coming from a different agricultural user each year. Similar to extended period water leases, respondents had good familiarity with the concept of rotational fallowing. Eighty-two percent of M&I providers surveyed were at least somewhat familiar (46 percent) or very familiar (36 percent) with rotational fallowing (Figure 6-18). However, the majority of M&I providers, 68 percent, would be unlikely to include this method in their future water supply portfolio for various reasons. Additional results are shown in Figure 6-19.

The top three factors preventing respondents from entering into a rotational fallowing agreement are the same as with extended period water leases and interruptible water supply agreements. All three factors are listed in Table 6-5 with their average rank.

Specific reasons stated by individual providers for not including rotational fallowing into a utility's future portfolio include:

1. We would not sell taps based on a temporary supply of water because of the permanent nature of the demand. Unless this, and some of the other methods discussed here, could be done on a permanent basis, they raise significant concerns for raw water supply planning.

2. If we enter into a rotational fallowing agreement, it will be for a known volume of water that is guaranteed in perpetuity. We would not enter into any agreement that can be terminated.

3. Infrequent need for additional supplies is very important in determining feasibility.

4. None of the proposed arrangements would work for our situation. We need a permanent arrangement with certainties on volume and price, but would not need to dry up land or have ownership. In other words, it seems this survey is being done to justify a desired approach and this response is that the desired approach won't work.

6.4.6. LIMITED IRRIGATION

A different concept that has been proposed to meet M&I needs via agricultural transfers while minimizing impacts to local agricultural production is a concept called "limited irrigation." Limited irrigation, also sometimes termed deficit irrigation, would involve an agreement between a water provider and an agricultural user where only a portion of the historical consumptive use associated with a parcel would be transferred to the water provider. A portion of the historical water supply would be left on the historically irrigated land to provide for a limited irrigation

Figure 6-20. Familiarity with Concept of Limited Irrigation

How familiar are you with the concept of "limited irrigation" described above?

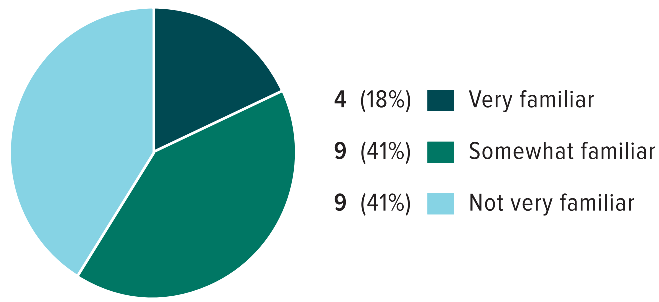


Figure 6-21. Likelihood that Limited Irrigation Will Be Part of Utility's Future Water Supply Portfolio

How likely are limited irrigation strategies to be a part of your future water supply portfolio?

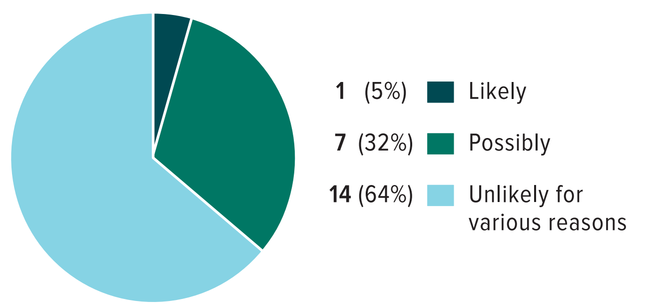


Table 6-6. Top Three Factors Preventing Water Providers from Entering into a Limited Irrigation Agreement

Factor	Average Rank
1. Prefer to transfer all of water and lease back a portion of the transferred water for a defined period of time	3.60
2. Concerned about the water court process	3.53
3. Would not consider this concept as part of future acquisitions and transfers	3.26

supply, for example, a dryland crop such as grain or allow one cutting of hay of alfalfa. This could potentially result in the avoidance of the need to revegetate the land. More respondents were not very familiar (41 percent) with the concept of limited irrigation as an ATM, as shown in Figure 6-20. It is not known if the lack of familiarity by the majority of respondents, 64 percent, was a contributing factor in responses that providers were unlikely to include limited irrigation strategies into their future water supply portfolio, as shown in Figure 6-21.

The top three most important factors preventing respondents from entering into a limited irrigation agreement are listed in Table 6-6, with their average rank. It is important to note that the factors available to choose from were different from those in previous categories (i.e., extended period water leases, interruptible water supply agreements and rotational fallowing).

Comments were not provided by respondents for limited irrigation, so further insight cannot be gained into ideas and thoughts behind survey responses.

Figure 6-22. Familiarity with Concept of Shared Water Bank

How familiar are you with the concept of a "shared water bank" as described above?

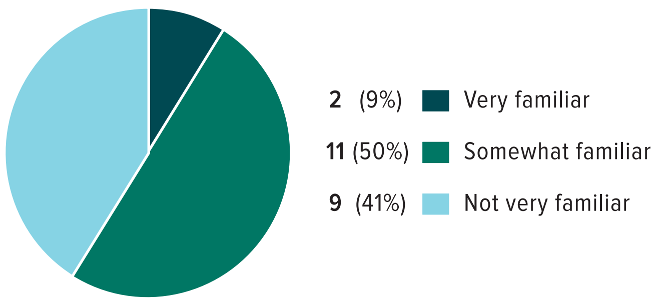
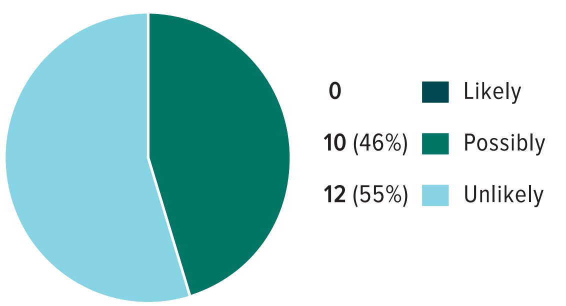


Figure 6-23. Likelihood that a Shared Water Bank Will Be Part of Utility's Future Water Supply Portfolio

How likely are shared water banks to be a part of your future water supply portfolio?



6.4.7. SHARED WATER BANK

A "shared water bank" is a concept where a water provider would provide surplus supplies to an irrigation company for storage and reoperations of this surplus water. In return the water provider would have the right, for a defined period of time, to reclaim a portion of the surplus water that was previously provided to the ditch company. In effect, the ditch company would be providing storage for the water provider's surplus supplies in return for a portion of the supplies. As with limited irrigation arrangements, it is not known if the lack of familiarity by the majority of respondents, 41 percent, with a shared water bank (Figure 6-22) was a contributing factor in responses that providers were unlikely to include the concept of a shared water bank than with other alternative ATMs. Possibly due to this unfamiliarity, none of the respondents indicated that they are likely to include a shared water bank

Table 6-7. Top Three Factors Preventing Water Providers from Entering into a Shared Water Bank Agreement

Factor	Average Rank
1. Needs to result in a substantially lower cost than developing or acquiring additional storage	3.80
2. Would prefer a perpetual agreement	3.70
3. Would prefer a long-term arrangement >30 years	3.47

in part of their future water supply portfolio, and less than half (45 percent) would possibly include it, shown in Figure 6-23.

The top three most important factors preventing respondents from entering into a shared water bank agreement are listed in Table 6-7, with their average rank. Again, it is important to note that the factors available to choose from were different from those in previous categories (i.e., extended period water leases, interruptible water supply agreements and rotational fallowing).

Additional comments were not provided by M&I providers about the shared water bank concept, so further insight cannot be gained into ideas and thoughts behind survey responses.

6.5. Survey Evaluation

Overall the respondents rated the survey an average rating of 3.9 out of 5.0. They thought the survey questions were easy to understand with an average rating of 4.0 out of 5. They also considered the questions to be generally unbiased. On a scale of 1 to 5, with 5 being "all of the questions were unbiased," the average rating was 4.0. Of the possible bias present in the questions, 32 percent of respondents felt that questions were biased for promoting alternative agriculture transfers.

Hay stacker, Colorado, early 1900s

6.6. Analysis of Results

6.6.1. MOST IMPORTANT FACTORS WHEN EVALUATING WATER SUPPLY DEVELOPMENT AND ACQUISITIONS AND CONSIDERING ALTERNATIVE AGRICULTURE TRANSFER METHODS

The top three most important factors considered when evaluating water supply development and acquisitions were:

1. Certainty and reliability in yield.

2. Permanency of supply.

3. Ownership of water rights.

Survey respondents were consistent with answers, as these factors were echoed throughout the survey as factors preventing providers from entering into specific alternative ATMs.

As noted in Tables 6-3, 6-4, 6-5, 6-6 and 6-7, for a majority of the alternative agriculture transfer methods the top three most important factors preventing respondents from entering into arrangements were:

1. Need a permanent supply.

2. Would prefer to own all agricultural water rights.

3. Unwilling to develop supplies that may not be permanent at end of agreement period.

This suggests that M&I providers are most concerned with permanency, reliability and ownership of water rights. If a permanent supply is not guaranteed or a consistently reliable, provider-owned supply available, survey respondents are not likely to enter into alternative agriculture transfer agreements. One provider commented, "I think the concept is good in trying to figure out on a state wide basis how to meet all water users' needs. It only works for us if it is perpetual, as I don't want to burden my replacement 100 years from now."

6.6.2. OVERALL ATTITUDE AND PERCEPTION OF ALTERNATIVE AGRICULTURE TRANSFER METHODS

While the majority of respondents are at least somewhat familiar with almost all alternative agriculture methods (extended period water leases, interruptible water supply, rotational fallowing, limited irrigation and shared water bank), they generally tended to be unlikely to include such methods in their future water supply portfolio. To compare the familiarity of an alternative ATM concept with the likelihood of including that ATM in their future water portfolio, Table 6-8 shows the percentage of M&I providers that were either somewhat or very familiar with the an ATM concept and the positive likelihood, either possibly or likely, that an M&I provider would include the alternative ATM in their water portfolio. The ATMs in the table are ranked from most to least likely to be adopted.

Table 6-8 provides interesting insight into survey responses. Although M&I providers had the most familiarity with the interruptible water supply agreement concept, and ISA had the highest percentage of respondents who would possibly consider it in their future portfolio, none of the survey respondents were likely to include this alternative ATM in their future portfolio. The shared water bank concept received a similar response for likelihood to be included in future portfolios, although M&I providers were less familiar with the concept. Extended period water leases had the highest percentage, 9 percent, of M&I providers that were likely to include it in their future portfolio; however, this ATM concept had the lowest percentage, 32 percent, of overall consideration for future portfolios as shown in the last column, "% M&I Providers Considering to include ATM in future portfolio."

Table 6-8. Familiarity of ATM and Likelihood of Including ATM in Portfolio

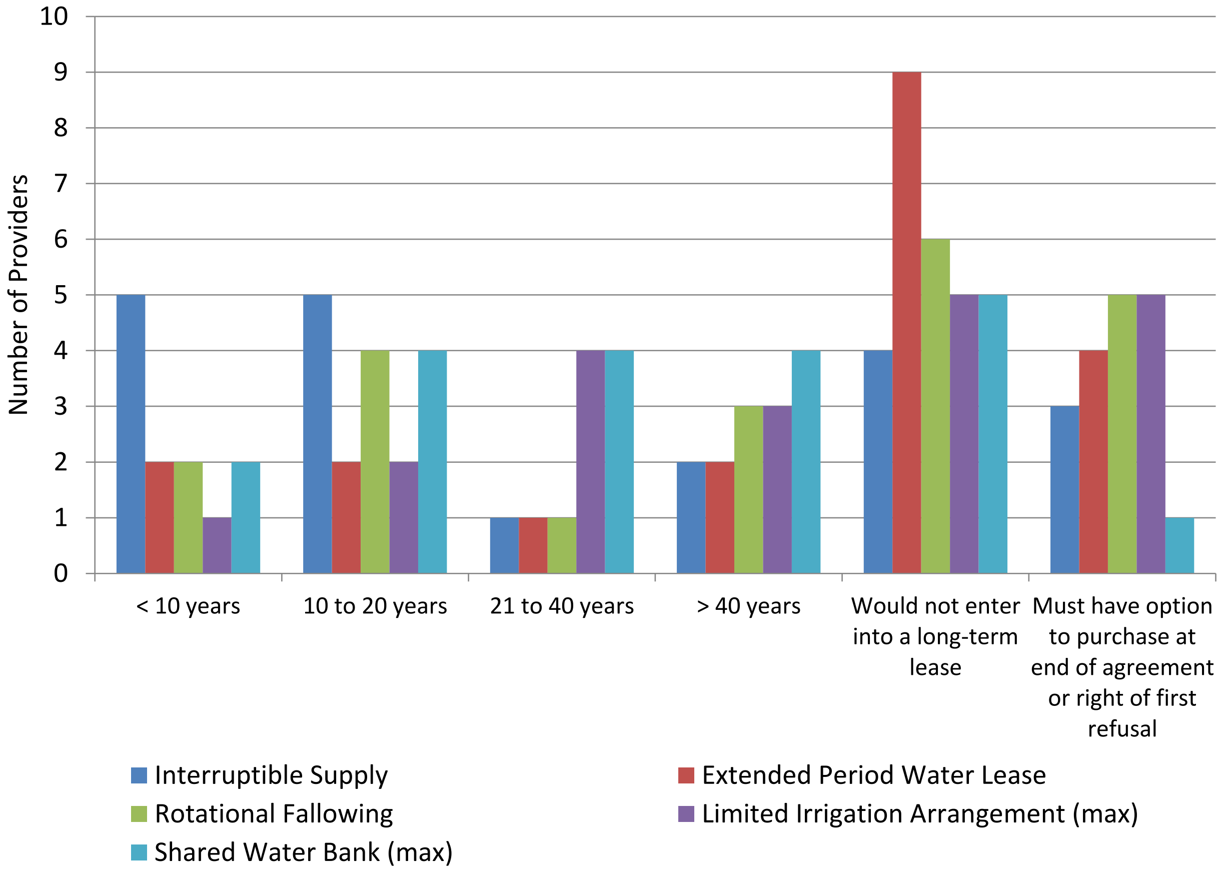
Alternative Agriculture Transfer Method (ATM)	% M&I Providers "Somewhat Familiar" with ATM concept	% M&I Providers "Familiar" with ATM concept	Total % M&I Providers at least "Somewhat Familiar"	% M&I Providers Possibly to include ATM in future portfolio	% M&I Providers Likely to include ATM in future portfolio	% M&I Providers Considering to include ATM in future portfolio
Interruptible Water Supply Agreement (ISA)	50	45	95	45	0	45
Shared Water Bank	50	9	59	45	0	45
Limited Irrigation	41	18	59	32	4	36
Rotational Fallowing	46	36	82	27	5	32
Extended Period Water Lease	48	35	83	9	9	18

6.6.3. NUMBER OF YEARS CONSIDERED FOR ALTERNATIVE AGRICULTURE METHOD LEASES

M&I providers were asked to identify the minimum or in some cases maximum number of years they would consider for each alternative ATM agreement. Figure 6-24 shows a comparison of all of the responses for the various ATMs.

Most notably, Figure 6-24 illustrates the following results. The majority of respondents would not enter into a long-term agreement for an extended period water lease. For this ATM the second-highest ranked reason for providers' unwillingness to enter into an extended period water lease was the need to have the option to purchase or right of first refusal at the end of the agreement. There is a similar trend in responses for rotational fallowing and limited irrigation arrangements. Of the alternative agriculture methods that survey respondents would consider for a minimum number of years, the majority of M&I providers would enter into an interruptible supply agreement for either less than 10 years or for 10 to 20 years. While the majority of M&I providers indicated they would not enter into a long-term lease for a shared water bank, there was an equal distribution between providers that would consider this ATM for periods between 10 to 20 years, 21 to 40 years and more than 40 years.

Figure 6-24. Minimum (Maximum) Number of Years Considered for Alternative Agriculture Method Leases



6.7. Conclusion

The above survey results show M&I providers preferences and views on select alternative ATMs. The overall findings for the 22 surveyed M&I providers can be summarized as follows:

1. The majority of M&I providers (74 percent) intend to acquire and transfer agricultural water rights as part of their normal planning.

2. The uncertainty and cost of new water development projects is not a major driver for providers acquiring agricultural acquisitions.

3. Water providers are most familiar with interruptible supply agreements, rotational fallowing and extended period water leases, but none of these or the other alternative ATMs are likely to be used as part of future water supply planning.

4. The most important factors for providers when evaluating water supply development and acquisitions and also the primary limitations when evaluating ATM arrangements were:

    a. The need for a permanent supply.

    b. Ownership of water rights, or preference to own all agricultural water rights.

    c. Need for certainty and reliability in yield.

    d. Unwillingness to develop supplies that may not be permanent at the end of the agreement period.

7. EVALUATION OF SHARED WATER BANK ALTERNATIVE AGRICULTURE TRANSFER METHOD

The various alternative agricultural transfer methods (ATMs) were described in Section 6. The municipal and industrial (M&I) survey responses confirmed that there is general knowledge by M&I water providers of extended period water leases, interruptible supply agreements and rotational fallowing. There is less knowledge of limited irrigation and shared water banking as alternative methods to meet M&I demands while limiting the permanent dry up of irrigated agricultural land. Limited irrigation is the subject of other Colorado Water Conservation Board (CWCB) funded alternative ATM grant projects.

As noted, the recent water court decision in 02CW403 (403 Decree) resulted in limitations and likely reduced water supply for the Farmers Reservoir and Irrigation Company (FRICO) Barr division shareholders. As a result, there was a general unwillingness by shareholders to enter into ATM discussions that would result in reduced water supply. The shared water bank structure, as described and analyzed in this section, is an alternative ATM that is designed to provide additional firm yield for M&I providers via cooperative relationships with agricultural users that do not result in a reduction in irrigated acreage, even temporarily. The shared water bank is intended to result in increased supplies for agriculture and firmed supplies for M&I users by better use of M&I surplus supplies

7.1. Shared Water Bank Concept

Municipalities often have excess supplies as they plan for growth and expand their water supply portfolio to meet projected increases in demand. In some instances, these entities do not have sufficient storage on-line to capture these supplies, in which case water is lost to other downstream users. Many irrigation companies and irrigation districts, like the Burlington Ditch, Land and Reservoir Company (Burlington) and FRICO utilize reservoirs to supplement their direct flow supplies during the irrigation season. Operations of these reservoirs often follow a well-defined pattern of use, and there is space available at specific times of the year that could potentially be used by municipalities to store excess supplies. For the purposes of this discussion, excess supplies are M&I water supplies that are available for diversion or use but are surplus to the immediate use of the water user and cannot be stored or otherwise carried over in the water user's system due to lack of storage capacity. Excess supplies may consist of consumable effluent, stored water that will be spilled or water rights, either direct flow or storage that could be diverted if there were demand or available storage.

A shared water bank concept was developed that explores ways for agricultural and municipal interests to work collaboratively to share existing infrastructure, excess supplies and available storage space in order to enhance supply reliability during a drought. Under this concept an M&I provider would provide excess supplies to an agricultural entity for storage in its system. This water may be stored for a pre-determined period of time and then may be called upon by the M&I provider when needed. In return, the agricultural entity would receive a pro-rata portion of the excess water and/or compensation for the use of its storage space. This type of water sharing strategy could be mutually beneficial because it makes better use of unused supplies and existing facilities and allows municipalities to defer construction of new storage projects until needed. A discussion of possible water banking scenarios that could be implemented with FRICO and nearby municipal entities follows.

7.2. Potential Candidates

7.2.1. CANDIDATE M&I USERS

The City of Thornton (Thornton) and South Adams County Water and Sanitation District (SACWSD) were contacted to determine how much excess water they project to have in the near term (5-20 years) that might be available for use in a shared water bank concept. These municipalities were selected because they own shares in the Burlington Company that have been changed to municipal use; therefore, they have facilities including gravel pits and recharge ponds that are already interconnected with Burlington and FRICO facilities. Thornton and SACSWD currently receive their Burlington share water via turnouts off the Burlington Canal. These turnouts are approximately 3.6 miles and 6.8 miles, respectively, from the Burlington Canal headgate on the South Platte River. These municipalities already coordinate operations and accounting with Burlington and FRICO; therefore, they have a good working relationship which would facilitate establishing and implementing a shared water bank concept. These entities also have excess supplies that are available primarily in average and wet years that they are unable to capture and store because they currently have insufficient storage space available, and supplies have been acquired to meet much higher future water demands. Both municipalities are adding storage to their systems through the acquisition and development of gravel pits located along the South Platte River mainstem; however, these pits are not anticipated to come on-line in the near term. The time line for bringing these gravel pits on-line is uncertain because it is driven in part by market conditions for the aggregate material.

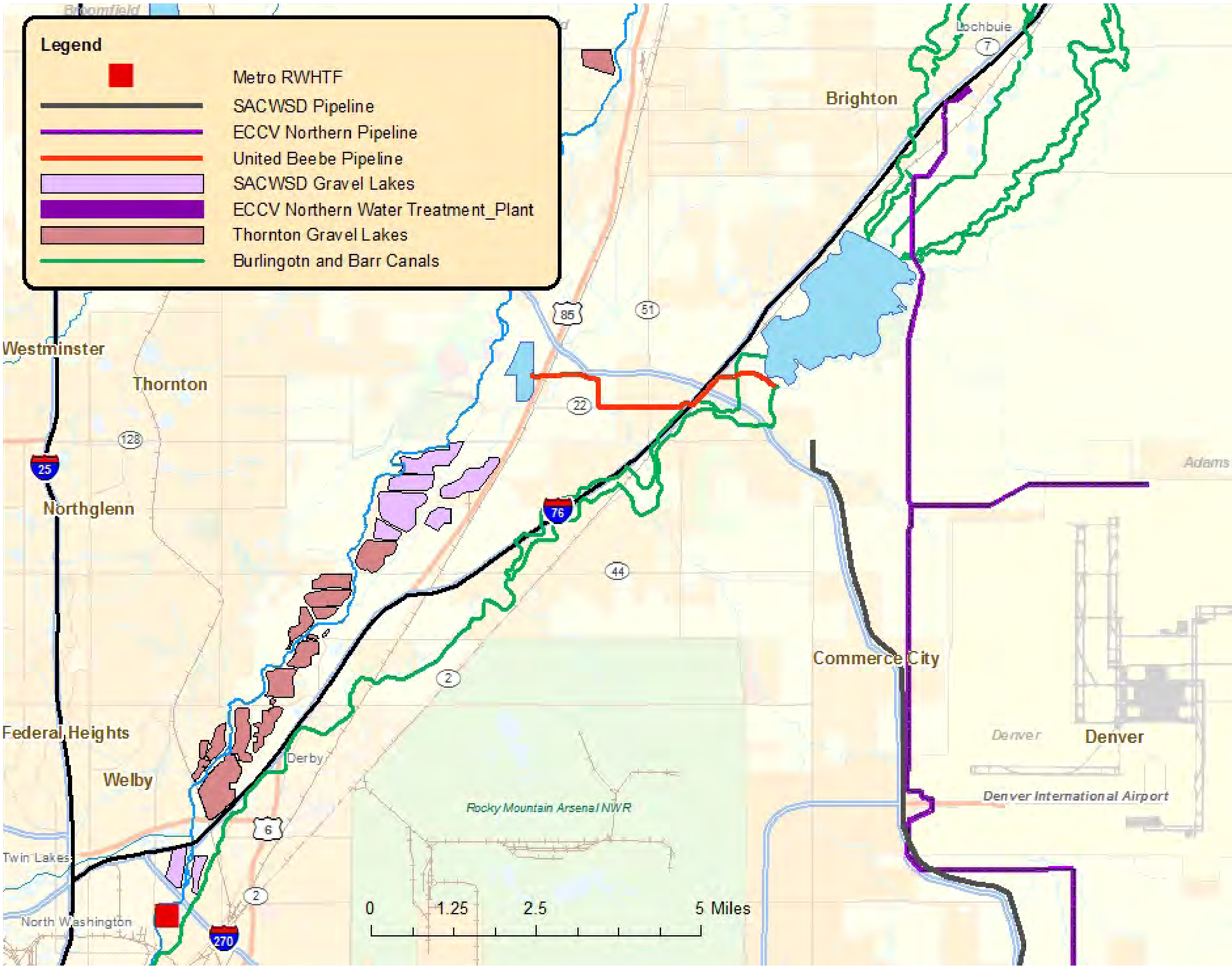
7.2.2. CANDIDATE IRRIGATION COMPANY

The Burlington Canal diverts from the South Platte River in Adams County. The present day Burlington Canal results from the enlargement of approximately 5 miles of the original Burlington Canal and the construction of the 12.3-mile O'Brian Canal to connect the enlarged Burlington Canal to Barr Lake. The Burlington Canal is used to deliver water to Burlington stockholders in the Little Burlington Ditch, to Burlington and FRICO shareholders through Barr Lake, and to the Henrylyn Irrigation District (Henrylyn) through the Denver-Hudson Canal, which bifurcates from the Burlington Canal just upstream of Barr Lake. The capacity of the Burlington Canal is approximately 900 cubic feet per second (cfs). The Burlington Canal also receives water from the Robert W. Hite Treatment Facility (RWHTF) via the Metro pumps, both located on the east side of the South Platte River approximately 1.5 miles downstream from the Burlington Canal diversion. Map 7-1 shows the location of Thornton's and SACWCD's South Platte Gravel Pits, United No. 3 Reservoir and United Beebe Pipeline, the Burlington Canal and Barr Lake

Barr Lake, which is owned and operated by Burlington and FRICO, is situated in the upper section of the Beebe Draw. Water is delivered into Barr Lake via the Burlington Canal. Barr Lake's decreed capacity is approximately 30,500 acre-feet (AF). Water is released from Barr Lake for delivery to FRICO and Burlington shareholders through the East and West Burlington Extension Canals, Speer Canal, Beebe Canal, Bowles Seep Canal, Neres Canal and the East Neres Canal. The Bowles Seep and East Neres Canals divert from the Beebe Canal downstream from Barr Lake. The Beebe Canal collects seepage and storm water in the Beebe Draw, as the alignment of the canal is in the lowest part of the draw. The Beebe Canal can also be used to convey water to Milton Lake because it extends from Barr Lake to Milton Lake. Most of the lands irrigated with water released from Barr Lake are situated in the Beebe Draw; however, some lands irrigated via the Neres and East Neres Canals are situated in the Box Elder Creek basin and some lands irrigated by the Speer Canal are situated in the main stem South Platte basin.

Milton Lake, which is owned and operated by FRICO, is located approximately 19 miles downstream from Barr Lake in the lower portion of the Beebe Draw in Weld County. Milton Lake stores and regulates water diverted from the South Platte River through the Platte Valley Canal and

Map 7-1. Thornton, South Adams County WSD, United and FRICO facilities

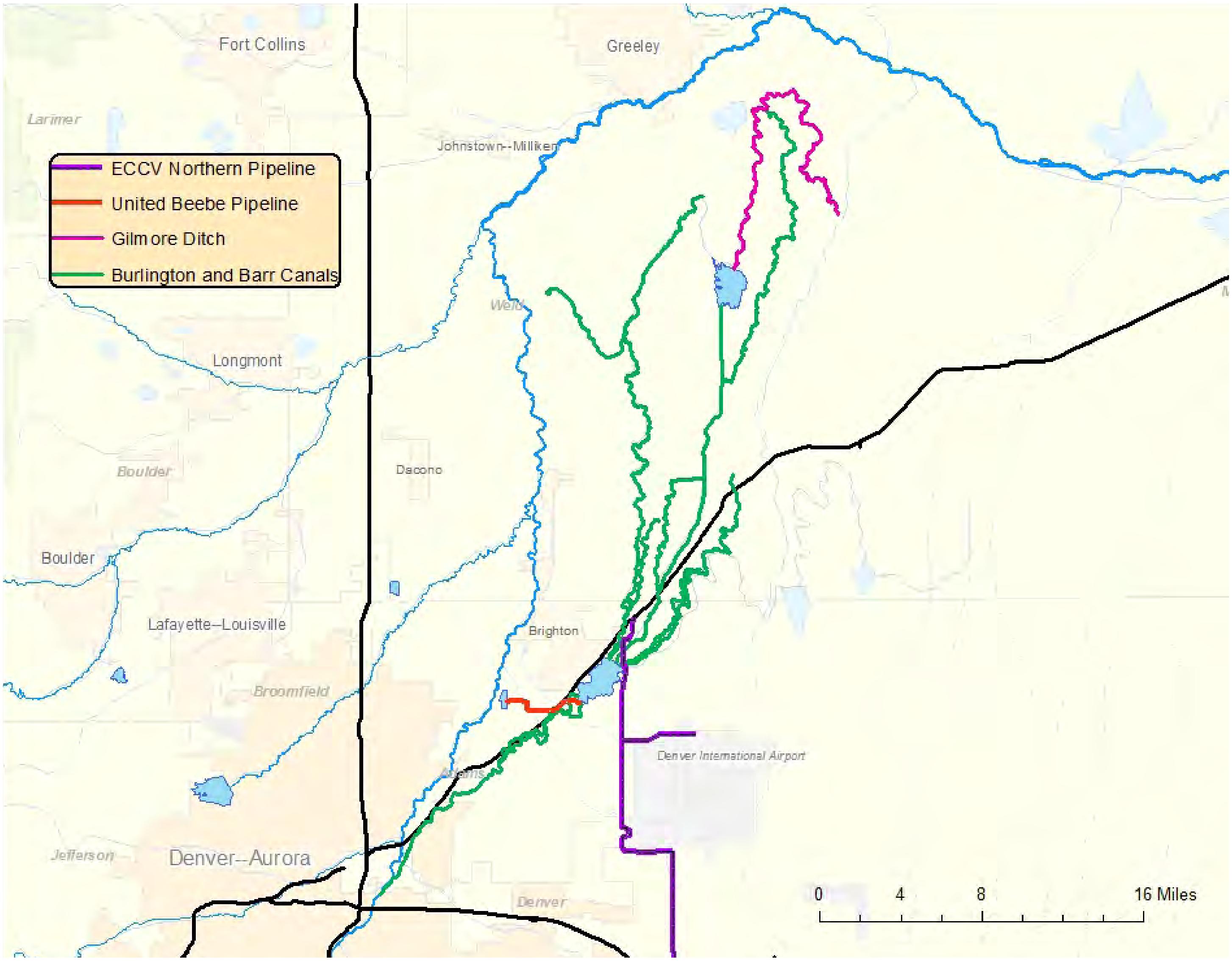


Source: SPDSS

also water diverted into the Burlington Canal, delivered through Barr Lake and released down the Beebe Canal. The capacity of Milton Lake is approximately 21,695 AF, excluding dead storage. Water is released from Milton Lake into the Gilmore Canal for delivery to Milton Lake shareholders. Figure 7-2 shows Barr and Milton Reservoirs, the Barr Lake Ditches and the Gilmore Canal that is fed from Milton Reservoir.

Barr Lake and Milton Lake are filled during the nonirrigation season, which typically starts on November 1. These reservoirs are at their lowest stage in September and October at the end of the irrigation season and are typically full by late March to early April at the start of the irrigation season. These reservoirs are used to supplement FRICO's direct flow water rights, with the bulk of releases occurring later in the irrigation season in July and August when flows in the South Platte River are lower. During these months, the amount physically and legally available under FRICO's

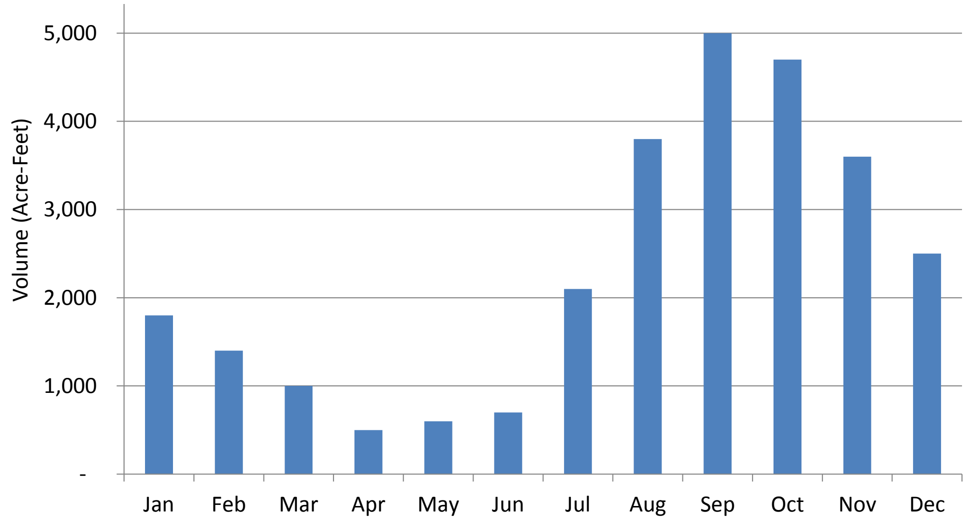
Map 7-2. FRICO Barr and Milton Ditches



Source: SPDSS

direct flow water rights is much more limited. FRICO makes allocations of “charge” water to its shareholders each spring based on water stored in Barr Lake at that time and the expected reservoir and delivery losses, which consist of evaporation and seepage. Once the allocations are made for the year, that amount of water will be delivered to shareholders essentially on demand with the measurement of the deliveries being made at the shareholders’ headgates on the Barr Lake delivery canals. Based on this typical schedule of operation, there is often space available in Barr Lake in late May to early June when releases from storage start and continue through at least February. Space available for other supplies is mostly limited from March through May when the reservoirs are frequently being filled to capacity. Figure 7-1 shows the historical end-of-month contents (or average monthly EOM) for Barr Lake and the unused capacity.

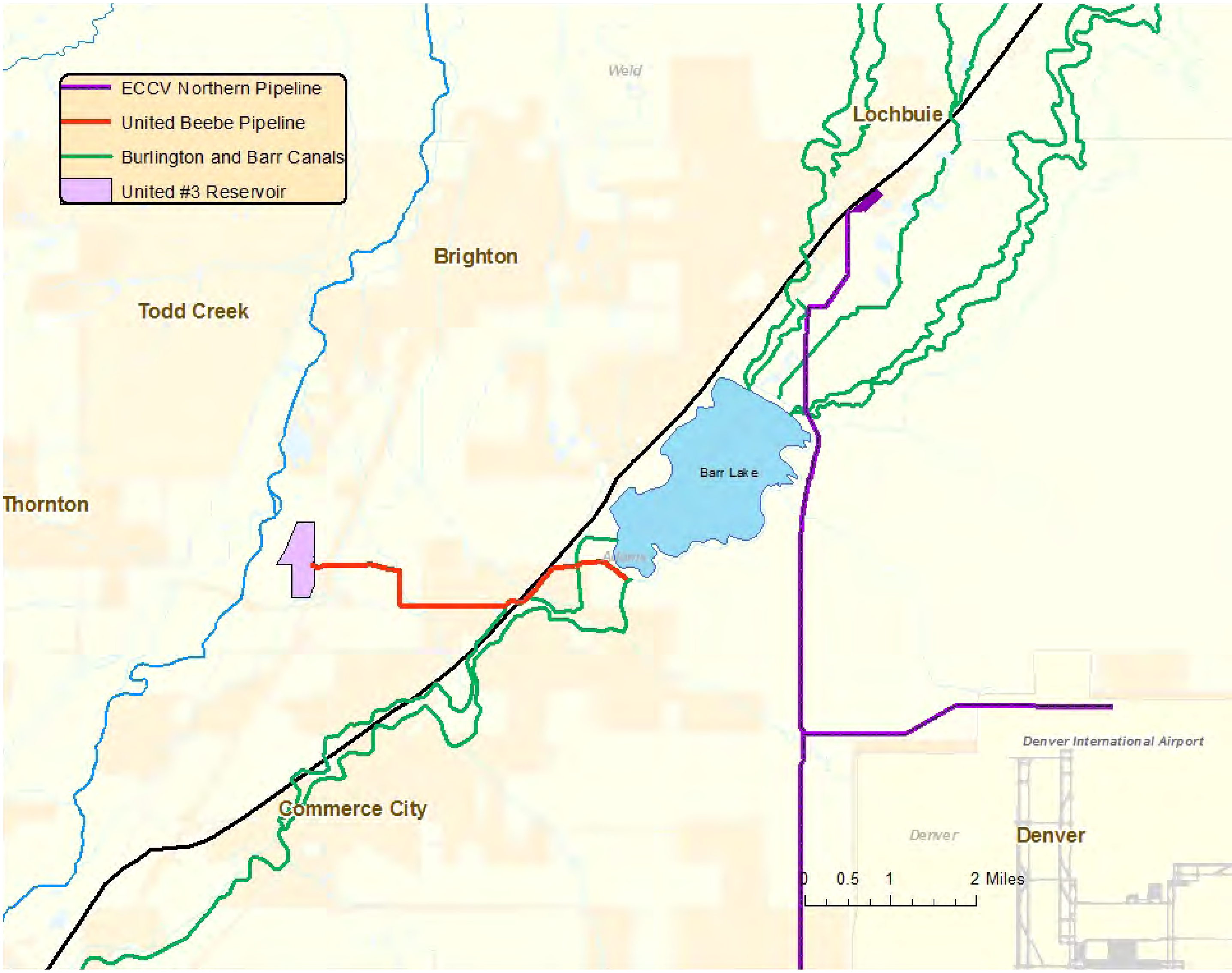
Figure 7-1. Estimate of Average Monthly Space Available in Barr Lake




United No. 3 South Platte River diversion

FRICO, Burlington and Henrylyn also own 2,000 AF of space in United Reservoir No. 3 (United Reservoir), which is an off-channel reservoir located in Adams County downstream of the Fulton Ditch headgate. United Reservoir is maintained by United Water and Sanitation District (United). This reservoir is under final completion. United Reservoir is filled via the United Diversion Facility No. 3, which is located on the South Platte River approximately 14 miles downstream of the Burlington Canal headgate. The United Beebe Pipeline, shown in Map 7-3, extends three miles from United Reservoir to the Burlington Canal immediately upstream of Barr Lake. The Beebe Pipeline is used to convey water from United Reservoir to Barr Lake. United will be constructing facilities to release water from United Reservoir back to the South Platte River. FRICO would need to acquire capacity in these facilities in order to be able to release water from their storage space to the South Platte River. Of the 2,000 AF of storage space, FRICO owns 933 AF, Burlington owns 400 AF, and Henrylyn owns 667 AF. United Reservoir was decreed as an alternate place of storage for Burlington and FRICO's senior storage rights and for FRICO's junior 2002 multipurpose water right in Case No. 02CW403.

Map 7-3. United Reservoir and United Beebe Pipeline



Source: SPDSS

7.2.3. EXCESS WATER SUPPLIES AVAILABLE FOR BANKING

The City of Thornton provided monthly data summarizing excess supplies that were available for water years 2000 through 2009. Thornton's excess water consists of consumable effluent that is discharged at the RWHTF, downstream of the Burlington Canal but upstream of United Diversion Facility No. 3. This effluent was surplus to any return flow obligations that Thornton had at the time, and it did not have the demand or storage facilities to carry over this water for a later use. As shown in Table 7-1, a total of 5,650 AF per year of excess water was available on average, ranging from a low of 0 AF in 2002 to a high of 10,703 AF in 2009. In general, the amount of excess effluent is greatest in the months of March through October and lowest from November through February. Thornton stated that these excess supplies would not be available in the long-term (beyond 20 years), as it eventually develops its extensive gravel lake system and demands increase to the level that it will need all of its excess supplies.

The excess water that Thornton has available is generally greatest in above-average and wet years and lowest in dry years such as 2002. The benefit to Thornton of a shared water bank concept would be the ability to store excess water in a year like 2001 for release in a dry year like 2002.

Table 7-1. Excess Water Available from Thornton

Month	Average Excess Water (AF)
Nov	348
Dec	291
Jan	342
Feb	309
Mar	530
Apr	654
May	520
Jun	643
Jul	498
Aug	408
Sep	491
Oct	615
Total	**5,650**

Table 7-2. Average Excess Water Available from SACWSD

Year	Excess Water Available (AF)	Year	Excess Water Available (AF)	Year	Excess Water Available (AF)
2010	1,915	2024	1,836	2038	1,387
2011	2,586	2025	2,012	2039	1,394
2012	1,036	2026	3,792	2040	1,428
2013	915	2027	3,296	2041	1,444
2014	1,379	2028	2,954	2042	666
2015	1,509	2029	2,757	2043	2,169
2016	1,362	2030	2,446	2044	1,750
2017	1,286	2031	2,153	2045	1,518
2018	1,196	2032	2,524	2046	712
2019	630	2033	3,754	2047	1,005
2020	1,770	2034	4,057	2048	522
2021	946	2035	2,150	2049	2,103
2022	0	2036	1,111	2050	1,728
2023	685	2037	1,285		
				2010–2050 Avg	**1,736**

SACWSD provided data summarizing the annual excess water that would be available for water years 2010 through 2050 based on a pattern of historical hydrology. These values reflect the projected amount of excess augmentation supplies, including effluent, consumptive use credit and recharge accretion credits. As shown in Table 7-2, a total of 1,736 AF per year of excess water was available on average, ranging from a low of 0 AF in 2023 to a high of 4,057 AF in 2034. SACWSD stated that these excess supplies would not be available in the long-term as it eventually develops its extensive gravel lake and recharge system and demands increase to the level that it will need all of its excess supplies.

7.3. Shared Water Bank Scenarios

Two shared water bank scenarios were considered that involve delivering Thornton's excess water to FRICO in exchange for delivering a portion of it back to Thornton when called for within a certain time frame. Thornton was used as the candidate municipal entity since its estimated excess supplies are a greater average annual volume than SACWSD's excess supplies. These scenarios are presented next. It is important to note that Thornton's recent historical excess water supplies are used solely as an illustrative modeling example and Thornton has not offered these supplies to FRICO under a shared water bank concept.

7.3.1. SCENARIO 1: STORAGE OPTION

Thornton would provide excess water to FRICO that would be stored in FRICO's pro-rata share of space in United Reservoir. FRICO's pro-rata share of space in United Reservoir is 933 AF, and Thornton would be allowed to store up to half of the space available, 466 AF. The maximum amount that could be stored would be a negotiated amount and could be higher or lower; however, a limit of 466 AF was considered for this analysis. Thornton would be allowed to store this water for up to two years after which the water would revert to FRICO. The length of time that Thornton could store water would also need to be negotiated and could be higher or lower; however, a limit of two years was considered for this analysis. If Thornton releases any portion of its water within two years or water is lost to evaporation, it may refill United Reservoir No. 3 with excess water when available up to a maximum of 466 AF. At any time Thornton has excess water that it wants to deliver to storage in United Reservoir No. 3, it must provide an equivalent amount to FRICO and deliver it to FRICO's remaining storage space in United Reservoir. For example, if Thornton delivers 100 AF to United No. 3, 50 AF of this delivery would be credited to FRICO. It was assumed that a minimum of 50 AF would be pumped into United Reservoir in any month. Pumping less than that amount would be cost prohibitive.

Moser recharge pond

Thornton would incur the cost of pumping excess water diverted at United Diversion Facility No. 3 for both Thornton and FRICO. Pumping costs at current power rates will vary from $25 per AF to over $70 per AF depending upon the volume pumped, the timing of pumping within a billing cycle and the pumping rate and number of days pumped within a billing cycle. Under this scenario, the cost to Thornton would be the excess water it would need to provide to FRICO and the cost of pumping water at United Diversion Facility No. 3. Assuming that Thornton is unable to lease all of its excess supplies to another user, there would likely be little to no lost income associated with providing a portion of its excess supplies to FRICO. Under this scenario, FRICO would receive additional water from Thornton; however, FRICO would relinquish use of half of its storage space at United Reservoir that could otherwise be filled with its own water rights. Excess water that is provided to FRICO would be available to increase deliveries (i.e., the allocation) to shareholders beyond any limitations imposed by the 403 Decree.

7.3.2. SCENARIO 2: RECHARGE OPTION

Under Scenario 2, the operations for Thornton in terms of storage and releases of its excess water are similar to Scenario 1. It was assumed that FRICO would divert its portion of the excess water at the Burlington Canal and store it in Barr Lake to avoid pumping costs at United Diversion Facility No. 3. Sufficient excess capacity must exist in the Burlington Canal and Barr Lake for FRICO to take delivery of excess water.

FRICO is generally able to fill Barr Lake under its own senior storage decrees in most years; therefore, excess water stored in Barr Lake would most likely not benefit FRICO unless it was released to recharge prior to filling. Since this water would be subject to spilling when Barr Lake typically fills in the spring, it was assumed this water would be released for recharge during the winter months. Water would be released to the Bowles Seep Canal and Moser pond for recharge with the higher priority being the Moser pond. Recharge accretions that accrue back to the Beebe Canal could be available for delivery to the East Neres Canal for irrigation to the extent that the timing of accretions matches the historical delivery schedule for that canal. The additional amount delivered to the East Neres Canal could potentially increase the supply available in Barr Lake by using these accretions to meet shareholder deliveries in the East Neres Canal rather than releasing water from Barr Lake into the Beebe Canal for delivery to the East Neres Canal. The capture of these recharge accretions in the East Neres Canal may allow FRICO to increase the allocation or increase deliveries to other shareholders along the remaining canals by reducing the release out of Barr Lake to the East Neres Canal.

7.3.3. MODEL DEVELOPMENT AND ASSUMPTIONS

An Excel spreadsheet model was developed to test the feasibility and benefits of the shared water bank scenarios. The model operates on a monthly time step and simulates operations over a period of four years. The model is configured to simulate an average year followed by a sequence of dry or below-average years similar to 2001 through 2004. Therefore, years one through four in the model represent 2001 through 2004. The facilities incorporated in the model include the following:

United Reservoir: United Reservoir No. 3 was modeled with a total volume of 933 AF, which is FRICO's share of the total storage. The model simulation was started with an empty reservoir. United Reservoir is not yet on-line; therefore, a stage-area-capacity chart is not available. If United Reservoir No. 3 is constructed as a nonjurisdictional reservoir, it will have a total capacity of approximately 3,180 AF. It is anticipated that the reservoir will have multiple storage accounts owned by other entities. Since these accounts will be operated independently of FRICO's storage account, it is difficult to estimate the pro-rata share of evaporative loss that will be allocated to FRICO's storage account. To simplify the analysis, it was assumed that the remaining storage space in the reservoir that is not used by either FRICO or Thornton for storage of excess supplies remains half full throughout the model run. Evaporation and seepage losses were allocated to the excess water based on the pro-rata portion stored in Thornton's and FRICO's modeled accounts relative to the total amount in the reservoir. Evaporation losses from United Reservoir were estimated based on the net evaporation rates shown in Table 7-3 and the monthly surface area calculated in the model. Average monthly net evaporation rates were derived from an analysis completed by Duane Helton for Case No. 02CW105. United Reservoir will be lined; therefore, there will be no losses due to seepage.

Table 7-3. Monthly Net Evaporation Rates

Month	Net Evaporation (ft)
Nov	0.15
Dec	0.00
Jan	0.00
Feb	0.00
Mar	0.21
Apr	0.34
May	0.45
Jun	0.54
Jul	0.56
Aug	0.51
Sep	0.38
Oct	0.26
Total	**3.40**

Barr Lake: Barr Lake was modeled with a total volume of 30,057 AF. Historical end-of-month contents were used to reflect operations of the reservoir for irrigation purposes as well as to estimate the amount of space remaining that could potentially be available for storage of excess water provided by Thornton. To simulate conditions in an average year followed by a sequence of dry or below-average years, historical end-of-month contents for the period from 2001 through 2004 were used (Figure 7-9). Evaporation losses from Barr Lake were estimated based on the net evaporation rates shown in Table 7-3 and the monthly surface area calculated in the model. The end-of-month surface area is calculated in the model based on historical end-of-month contents plus the excess water stored in Barr Lake. The seepage loss was assumed to be a constant 10 cfs based on information provided by FRICO. Evaporation and seepage losses were allocated to the excess water based on the pro-rata portion stored in that account relative to the total amount in the reservoir.

Burlington Canal: The Burlington Canal was modeled with a total capacity of 900 cfs. The average ditch loss from the headgate to Barr Lake varies depending on the time of year and the flow rate in the canal. Based on more accurate flow data available since a weir was installed on the Burlington Canal near 120th Street, the ditch loss typically ranges from about 10 percent to 20 percent; therefore, an average ditch loss of 15 percent was assumed for the model. To simulate conditions in an average year followed by a sequence of dry or below-average years, historical monthly diversions for the period from 2001 through 2004 were used to determine the remaining space that would be available for excess water. Historical diversions as measured at the Sand Creek gage were obtained from the State Engineer's Office.

Beebe Pipeline: The Beebe Pipeline is modeled with a capacity of 12 cfs, which reflects FRICO's share of the total capacity in that pipeline. FRICO also has the ability to use additional space in the Beebe Pipeline on a space-available basis. The manner in which other users may use the Beebe Pipeline is uncertain; therefore, FRICO cannot rely on additional space being available, so use of its pro-rata share of the pipeline capacity was limited to 12 cfs.

Barr Lake Delivery Canals: Water is released from Barr Lake to the East and West Burlington Extension Canals, Speer Canal, Beebe Canal, Bowles Seep Canal, Neres Canal and the East Neres Canal. Excess water delivered to Barr Lake could potentially be released to one or more of these canals for recharge. Based on conditions imposed by the decree in Case No. 02CW403, recharge credit can only be claimed at times that no other water is being run in these ditches. These ditches are generally not diverting from November through March; therefore, it was assumed that water could be released from Barr Lake for recharge in February and March. Water would likely be recharged as close to the end of the storage season as possibly to coincide with "charging" the ditches for the irrigation season and to maximize the recharge accretions that would accrue to the Beebe Canal during the irrigation season. The amount and timing of recharge accretions to the Beebe Canal was determined based on unit response functions (URFs) for each canal that was established in the decree for Case Nos. 02CW404 and 03CW442. To simplify operations, it was assumed that water released for recharge would be delivered to the Bowles Seep Canal because that canal is frequently used for recharge purposes and there is more than sufficient recharge capacity available to accommodate the excess water that would be provided to FRICO in these scenarios. Based on information provided by FRICO, water can be recharged in the Bowles Seep Canal at a maximum rate of five cfs. It was assumed that water released from Barr Lake for recharge would experience a five percent evaporative loss.

Moser Recharge Pond: The Moser recharge pond is owned by FRICO and is located in Section 7, T. 1S, R. 66W in Adams County. This recharge pond was brought on-line in 2009. Water is delivered to the Moser pond off of the Bowles Seep Canal. Water could potentially be delivered to this pond year-round assuming it is not being used for recharge of other sources of water such as FRICO's 84W090 water right. Since the pond is used relatively infrequently because the 84CW090 water right is typically only available for diversion during periods of no call, the recharge capacity of that pond was not reduced to reflect potential recharge of other sources of water. The current recharge capacity of the Moser pond is approximately 3 cfs. It was assumed that water would be released from Barr Lake for recharge in February and March to maximize the recharge accretions that would accrue to the Beebe Canal during the irrigation season.

Supply and Demand: It was assumed that Thornton's excess water from 2001 through 2004 would be available for storage in United Reservoir and/or Barr Lake. Under Scenario 1, it was assumed that both Thornton and FRICO would store their portion of the excess water in United Reservoir, whereas in Scenario 2, FRICO would store its portion of the excess water in Barr Lake. In year 2, both Thornton and FRICO would release their excess water from United Reservoir. It was assumed that Thornton would try to meet a demand of 100 AF/month from May through September with this supply. Thornton's demands are typically highest in those months. In Scenario 1, FRICO would take delivery of its water via the Beebe Pipeline through Barr Lake and would try to meet a demand of 100 AF in June and 200 AF in both July and August. Irrigation demands are typically highest in those months. Since FRICO's portion of the excess water is stored in United Reservoir in Scenario 1, this water can be carried over from year to year since there is no concern that it would be spilled from Barr Lake. In Scenario 2, FRICO would release all of its excess water for recharge every spring to prevent spilling that water. In year 3 of the simulation, FRICO and Thornton would refill their storage in United Reservoir and/or Barr Lake. In year 4 of the simulation, Thornton would not release its excess water because in every month of that year (2004), Thornton had excess effluent available at the RHWTF. However, FRICO did not fill Barr Lake historically in the spring of 2004; therefore, its excess water would be released from United Reservoir to meet an irrigation demand (Scenario 1) or from Barr Lake to recharge (Scenario 2).

7.3.4. MODEL RESULTS FOR SCENARIO 1

An annual summary of the results for Scenario 1 is provided in Table 7-4. Figures 7-2 and 7-3 show the amounts of excess water diverted to United Reservoir and released from storage for Thornton (M&I) and FRICO. Figure 7-4 shows the end-of-month contents in each account in United Reservoir. As shown in Table 7-4, there was a total of 15,109 AF of excess water available during the period from 2001 through 2004, of which a total of 2,087 AF was diverted to United Reservoir, split evenly between FRICO and Thornton. The amount diverted to storage in 2003 exceeds the space available for Thornton and FRICO because additional water was diverted to replace evaporation losses. There was no excess water diverted to storage in 2002 because none was available. Of the water stored in United Reservoir for Thornton, 415 AF was released in 2002 to supplement its other supplies due to the severity of the drought that year. Thornton's storage space in United Reservoir was refilled in 2003 because excess water was available that year. Releases were not made in 2004 because Thornton had excess water available throughout that year, in which case they did not need the additional water stored in United Reservoir. As a result, the only excess water diverted to storage in 2004 would be to replace evaporative losses. This scenario would not benefit Thornton in a sequence of years like 2003 and 2004 when Thornton already has sufficient supplies to meet its demands. Releases from FRICO's account in United Reservoir of 412 AF and 457 AF would be made in both 2002 and 2004, respectively, as Barr Lake did not fill in the spring of either of those years. Additional water would be beneficial in those years to increase the allocation for the shareholders.

Table 7-4. Annual Summary of Results for Scenario 1

Water Year	Annual Summary							
	Total Excess Water Available (AF)	Total Excess Water Diverted to United Reservoir for FRICO (AF)	Total Excess Water Diverted to United Reservoir for M&I (AF)	Total Excess Water Diverted to United Reservoir (AF)	Total Excess Water Lost to Reservoir Evaporation (AF)	Total Excess Water Released from United Reservoir for FRICO (AF)	Total Excess Water Released from United Reservoir for M&I (AF)	Total Excess Water Released from United Reservoir (AF)
2001	6,333	487	487	975	89	0	0	0
2002	0	0	0	0	59	412	415	827
2003	6,529	503	503	1,007	81	0	0	0
2004	2,247	53	53	105	81	457	0	457
Total	**15,109**	**1,043**	**1,043**	**2,087**	**310**	**869**	**415**	**1,285**

Barr Lake Dam

Figure 7-2. Excess Water Diverted to United Reservoir Scenario 1

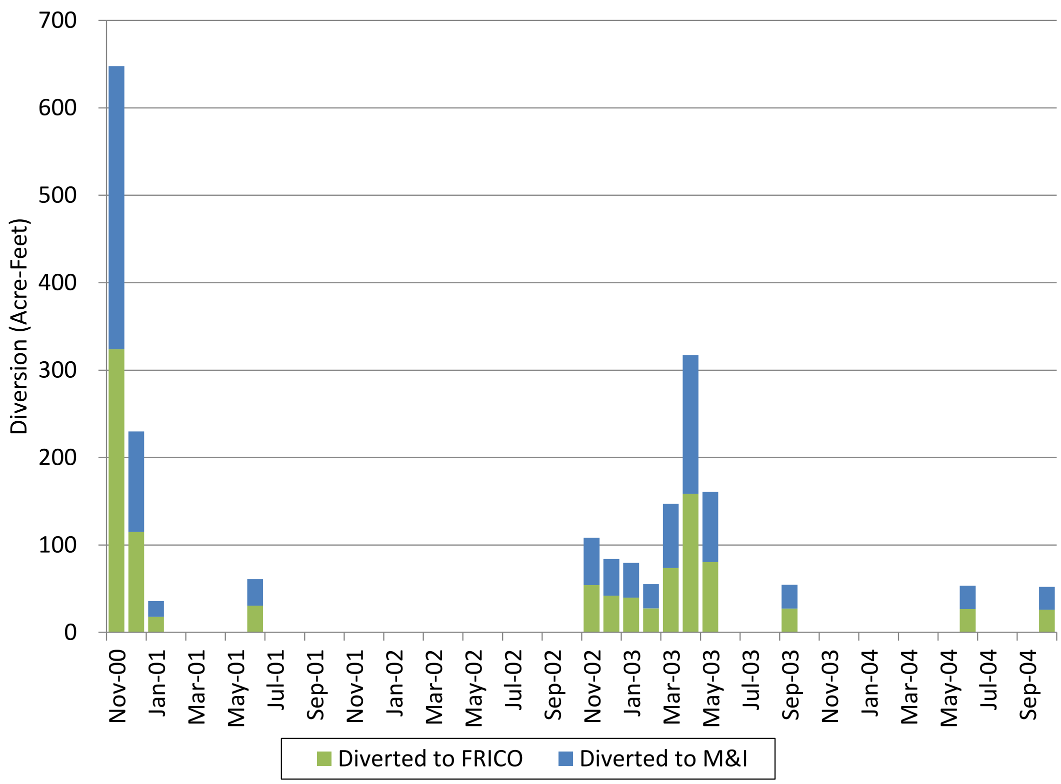


Figure 7-3. Excess Water Released from United Reservoir Scenario 1

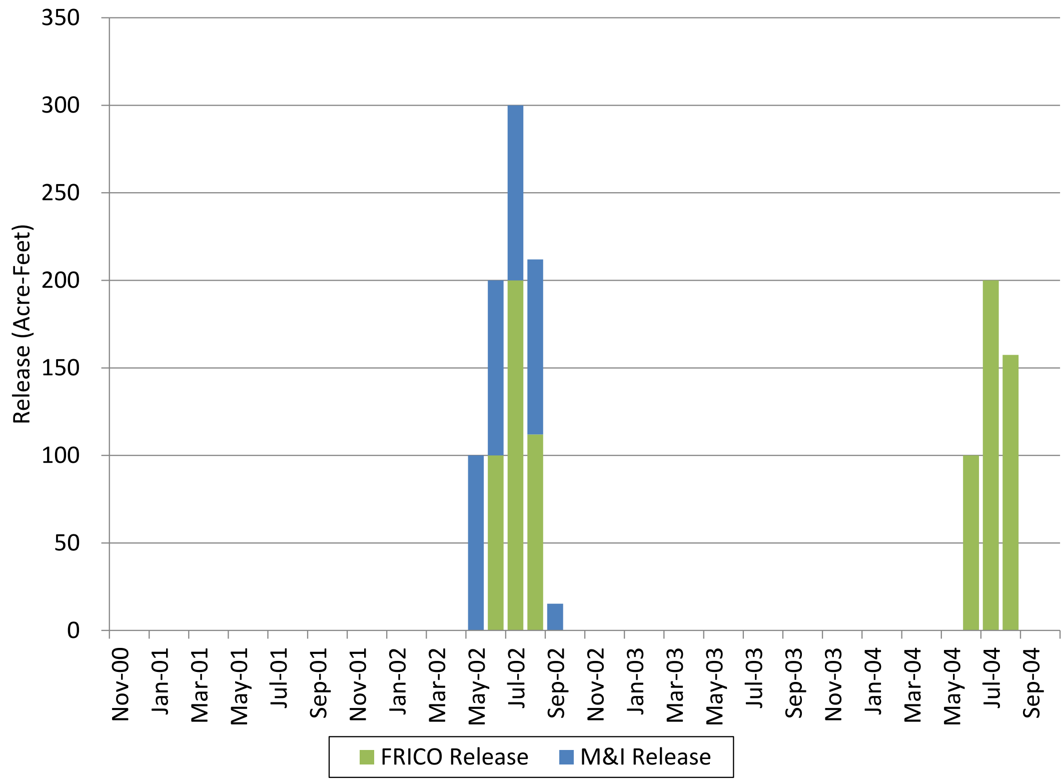
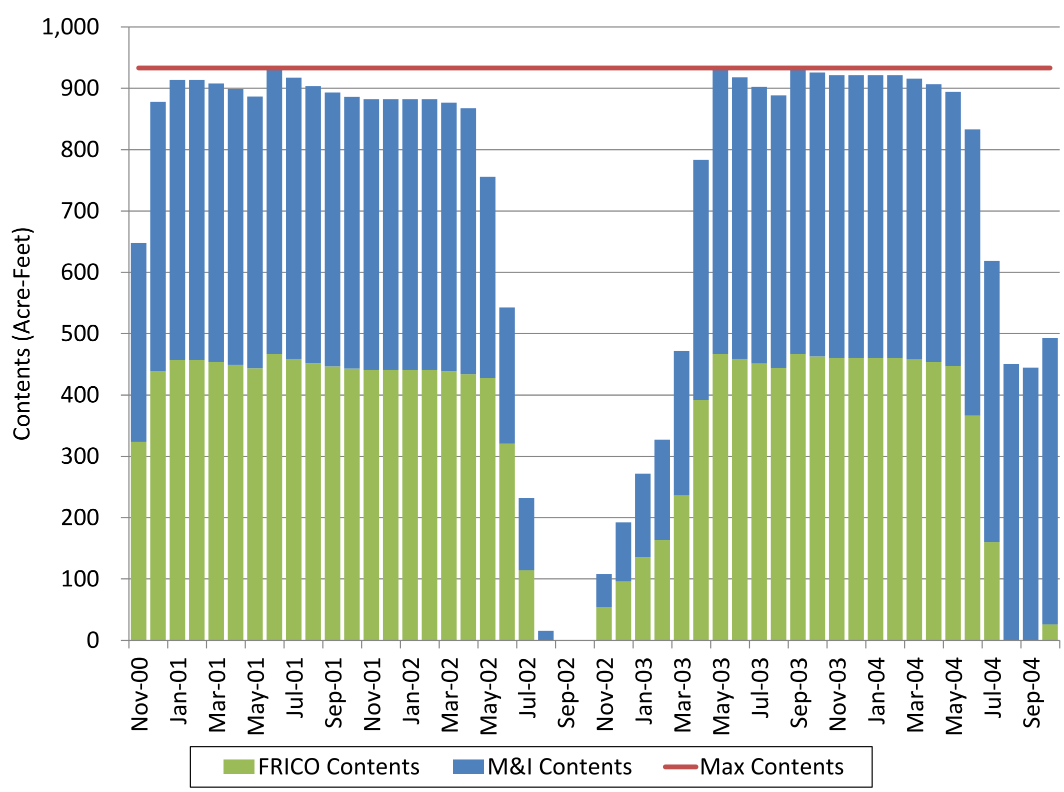


Figure 7-4. End-of-Month Contents in United Reservoir Scenario 1



7.3.5. MODEL RESULTS FOR SCENARIO 2

An annual summary of the results for Scenario 2 is provided in Table 7-5. Figures 7-5 and 7-6 show the amounts of excess water diverted to United Reservoir and Barr Lake. As shown in Table 7-5, there was a total of 15,109 AF of excess water available during the period from 2001 through 2004, of which a total of 1,988 AF was diverted to United Reservoir and Barr Lake. This is slightly less than the total amount delivered to United Reservoir under Scenario 1 due primarily to the additional canal losses along the Burlington Canal that would be incurred when delivering excess water to Barr Lake. There was no excess water diverted to storage in 2002 because none was available. Of the water stored in United Reservoir for Thornton, 392 AF was released in 2002 to supplement its other supplies due to the severity of the drought that year (Figure 7-7). Thornton's storage space in United Reservoir was refilled in 2003 because excess water was available that year. Releases were not made in 2004 because Thornton had excess water available throughout that year, in which case Thornton did not need the additional water stored in United Reservoir. As a result, the only excess water diverted to storage in 2004 would be to replace evaporative losses. Similar to Scenario 1, this scenario would not benefit Thornton in a sequence of years like 2003 and 2004 when Thornton already has sufficient supplies to meet its demands. Figure 7-8 shows the end-of-month contents in Thornton's account in United Reservoir.

Releases from FRICO's excess water account in Barr Lake of 439 AF, 188 AF and 149 AF would be made in the spring of 2001, 2003 and 2004, respectively, as shown in Figure 7-9. This excess water would be delivered to the Moser recharge pond and Bowles Seep Canal for recharge. In 2003, the model shows excess water would be delivered to Barr Lake from March through May at the same time Thornton would divert excess water to

Table 7-5. Annual Summary of Results for Scenario 2

Water Year	Annual Summary								
	Total Excess Water Available (AF)	Total Excess Water Diverted to United Reservoir for M&I (AF)	Total Excess Water Delivered to Barr Lake for FRICO (AF)	Total Excess Water Diverted to United Reservoir and Barr Lake (AF)	Total Excess Water Lost to Evaporation and Seepage (AF)	Total Excess Water Released from United Reservoir for M&I (AF)	Total Excess Water Released from Barr Lake for Recharge (AF)	Total Lagged Recharge Accretions in Beebe Draw (AF)	Total Lagged Recharge Accretions Diverted at East Neres (AF)
2001	6,333	467	467	933	47	0	439	252	159
2002	0	0	0	0	27	392	0	71	28
2003	6,529	471	471	942	85	0	188	143	127
2004	2,247	57	57	113	60	0	149	154	86
Total	**15,109**	**994**	**994**	**1,988**	**218**	**392**	**777**	**619**	**400**

United Reservoir. Because Barr Lake essentially filled in May 2003, there would not be sufficient capacity in Barr Lake to store all the excess water allocated to FRICO. As a result, some of FRICO's excess water would need to be released for recharge at the Moser pond in May. Excess water that was not released for recharge in April and May of 2003 would be held in storage and released the following year in February and March of 2004 to maximize recharge accretions during the summer months when irrigation deliveries are made. Available capacity in the Bowles Seep Canal for recharge deliveries to the Moser pond could be limited in May if irrigation deliveries are being made at the same time. Figures 7-10 and 7-11 show the end-of-month historical contents and excess water contents in Barr Lake.

Accretions associated with excess water recharged in 2001, 2003 and 2004 would accrue to the Beebe Canal and could be available for delivery to the East Neres Canal for irrigation. Figure 7-12 shows the timing of recharge accretions to the Beebe Canal and the amount available for diversion at the East Neres Canal. Model results show that a total of 400 AF would accrue to the Beebe Canal at the same time that irrigation deliveries were made to the East Neres Canal. This water could be diverted at the East Neres Canal, which would reduce the release out of Barr Lake by a commensurate amount plus the ditch loss from Barr Lake to the East Neres Canal. The increased supply available in Barr Lake would be available to increase the allocation or increase deliveries to other shareholders along the remaining

Figure 7-5. Excess Water Diverted to United Reservoir for M&I Scenario 2

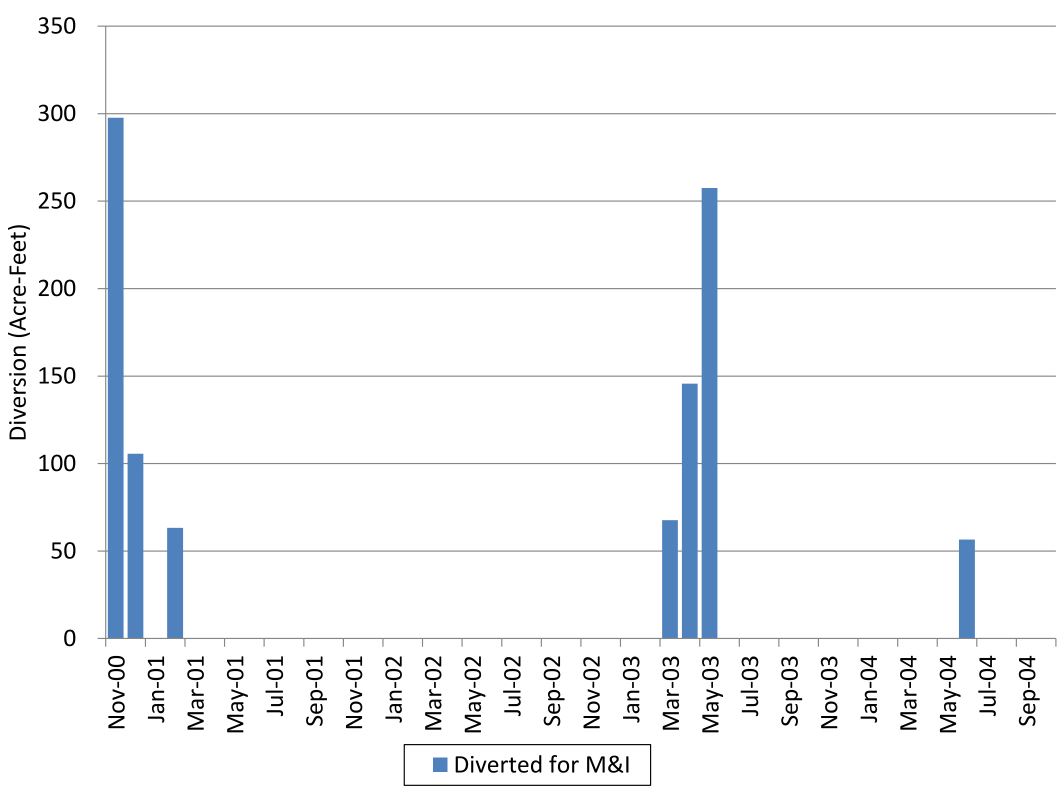


Figure 7-6. Excess Water Delivered to Barr Lake for FRICO Scenario 2

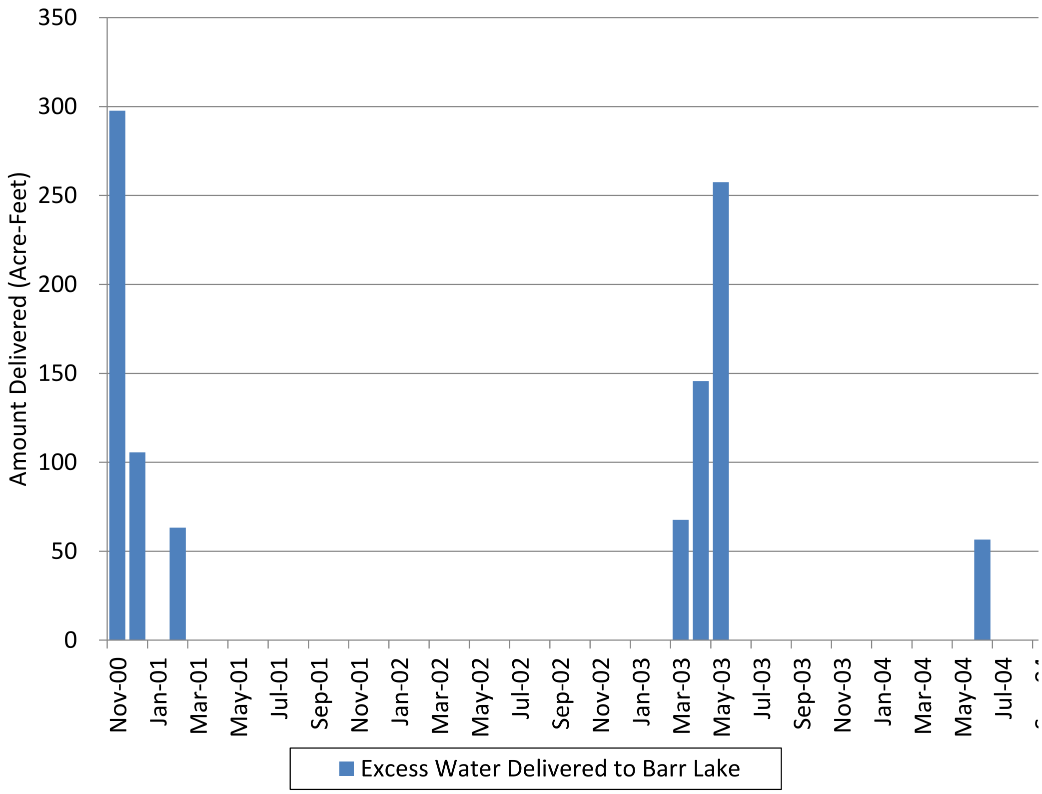


Figure 7-7. Excess Water Released from United Reservoir Scenario 2

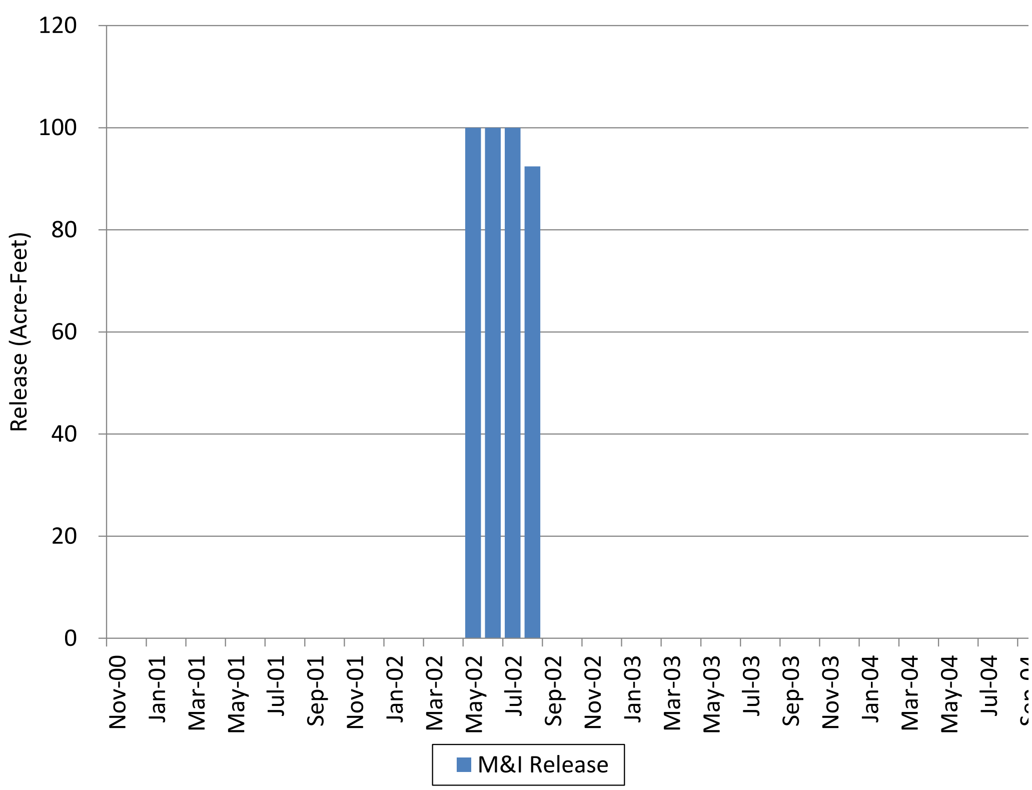


Figure 7-8. End-of-Month M&I Contents in United Reservoir Scenario 2

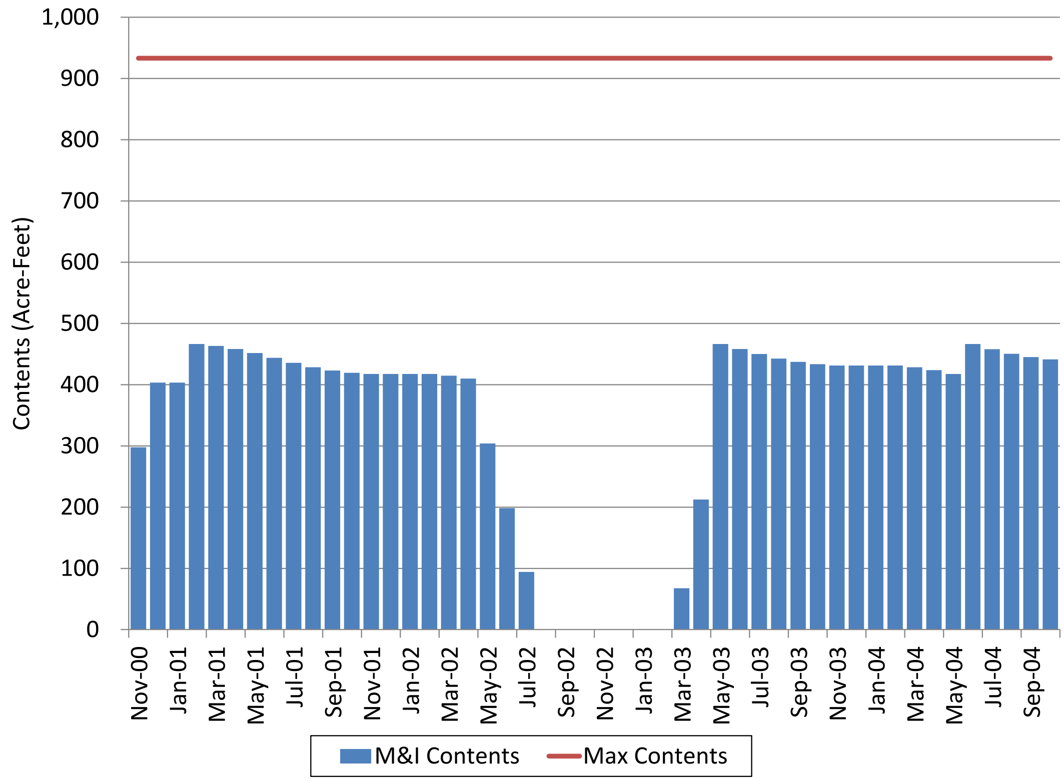


Figure 7-9. Excess Water Released from Barr Lake for Recharge Scenario 2

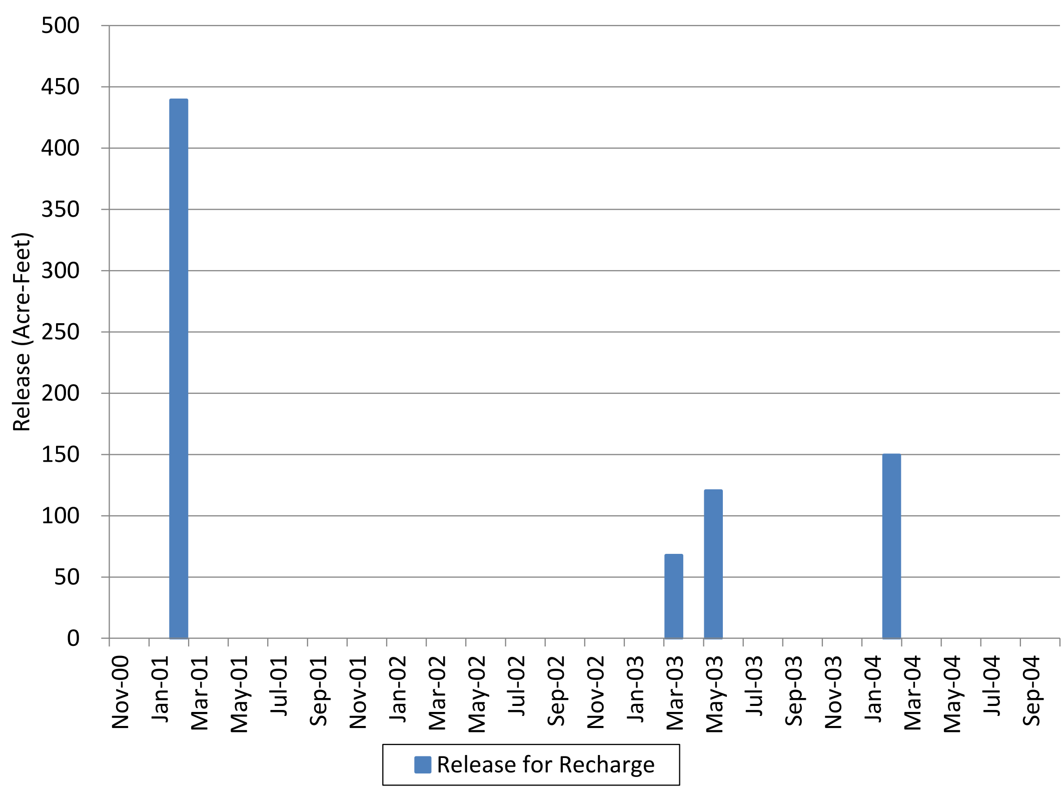


Figure 7-10. End-of-Month Historical Contents in Barr Lake Scenario 2

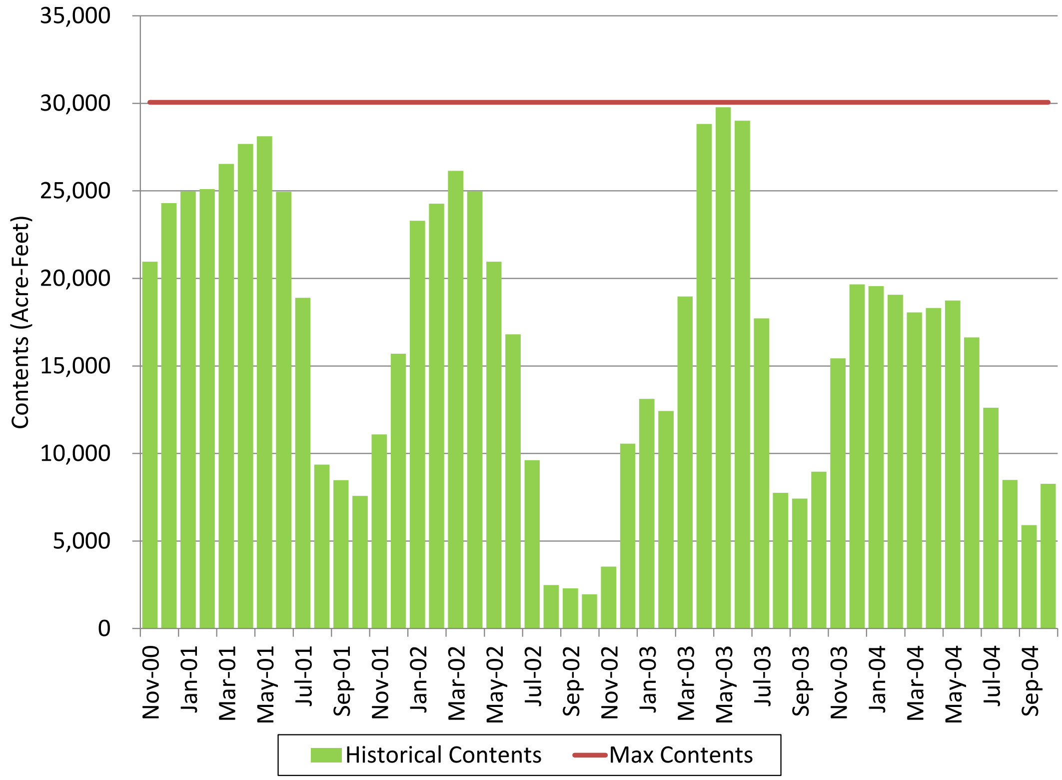


Figure 7-11. End-of-Month Excess Water Contents in Barr Lake Scenario 2

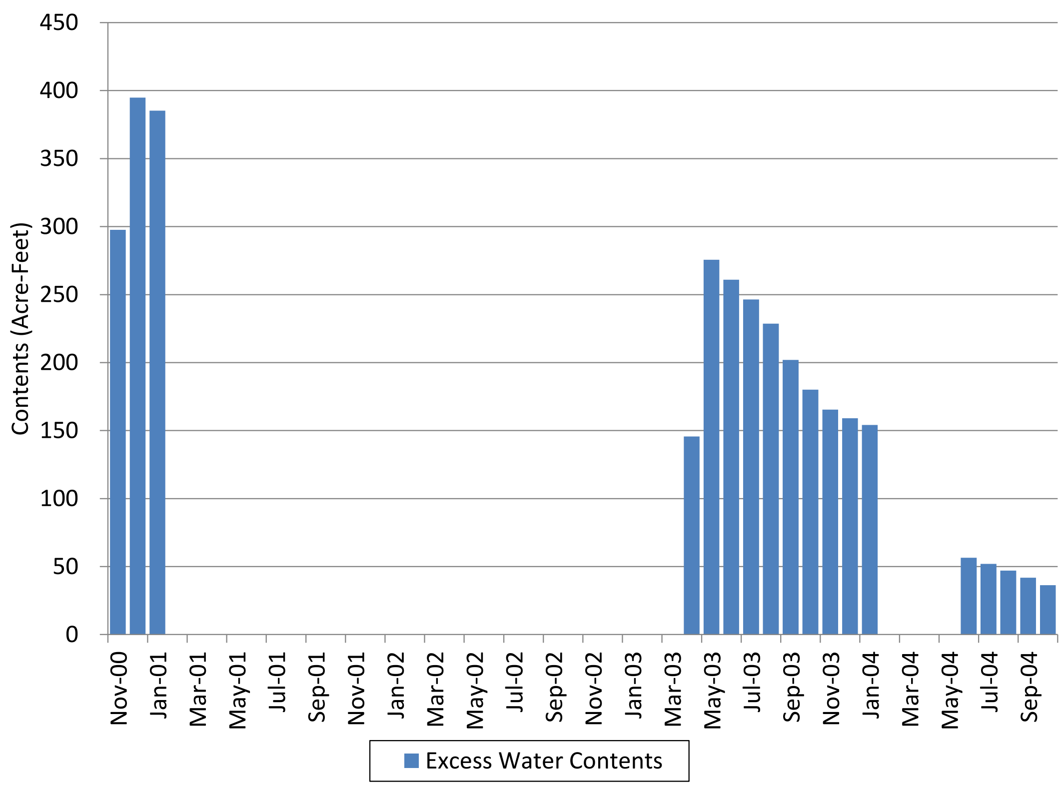
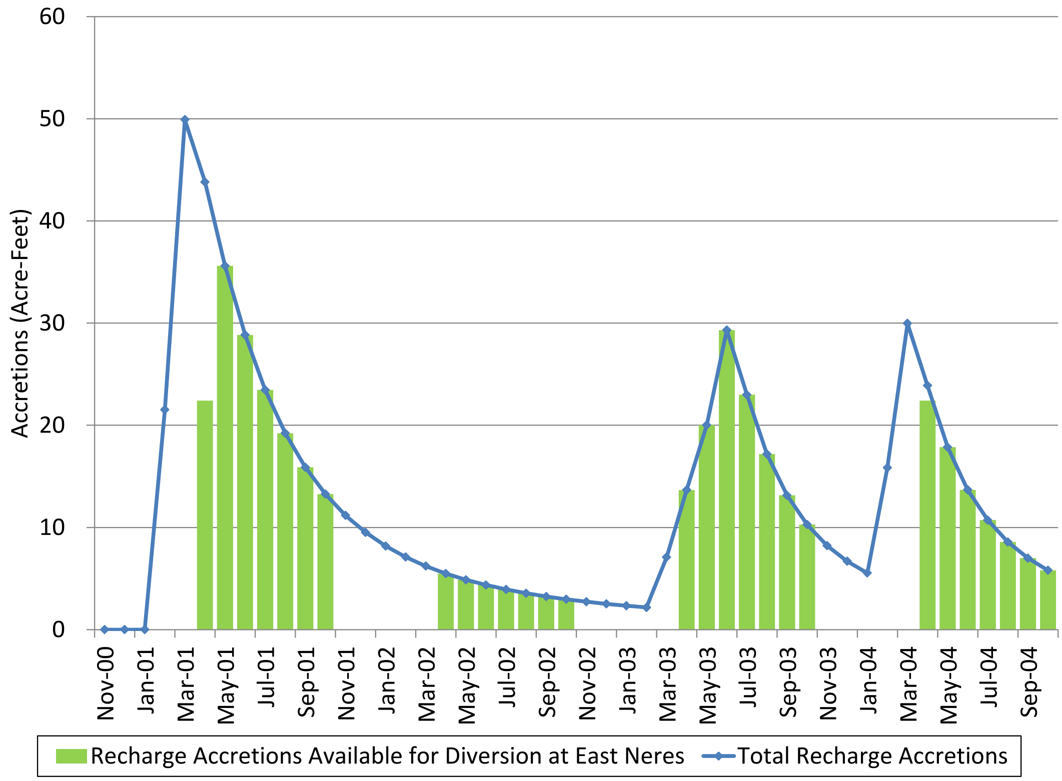


Figure 7-12. Recharge Accretions Associated with Excess Water Scenario 2



canals. The recharge accretions that FRICO is unable to capture and divert down the East Neres Canal would likely flow downstream and could potentially be stored in Milton Lake and be available to those shareholders. This would occur primarily during the winter months when the East Neres Canal is not diverting. Excess water stored in Milton Lake could be accounted for separately from other share water; however, it would be subject to spilling when Milton Lake fills. Since Milton Lake typically fills under its own senior storage decree, these additional supplies would most likely not benefit these shareholders.

Model results show that Scenario 1 would be more efficient for FRICO in terms of increasing their supplies and deliveries because they can maintain more control of excess water stored in United Reservoir as opposed to water that is recharged in the Beebe Draw. It would be difficult for FRICO to recapture recharge accretions that do not accrue to the Beebe Canal during summer months when water is delivered to the East Neres Canal. It would also be difficult for FRICO to store excess water during the months of March, April and May when Barr Lake is filling. This was demonstrated by model results for 2003, which showed that excess water delivered in May would need to be delivered through Barr Lake directly to recharge because the reservoir was full. If there was not sufficient capacity to recharge water at that time or the ditches/recharge ponds were not diverting due to maintenance, then there would need to be flexibility in the agreement that allows FRICO to take excess water when capacity exists in their system since that may not coincide with Thornton's diversions of excess water to United Reservoir.

7.4. Operational Challenges of the Shared Water Bank Concept

Under the assumptions in Scenarios 1 and 2, excess water hypothetically provided by Thornton may or may not increase FRICO's supply depending on where the water is diverted and the call on the South Platte River. If excess water is consumable effluent discharged at the RHWTF, then it would either need to be exchanged up to the Burlington Canal, pumped to the Burlington Canal or delivered downstream and pumped at United Diversion Facility No. 3. There would be a cost associated with pumping water to the Burlington Canal and the additional conveyance losses in the canal to Barr Lake, which may make that option prohibitive. Excess effluent could only be exchanged to the Burlington Canal if FRICO was bypassing water. If excess water is pumped at United Diversion Facility No. 3 into storage at United Reservoir, this would not increase FRICO's supply if FRICO could divert the same amount under its 2002 water right. If FRICO was willing to pay the cost to pump at United Diversion Facility No. 3, then FRICO would be foregoing storage space that could potentially be filled with its 2002 water right when in priority. In most above-average and wet years, the 2002 water right is in priority for sufficient periods to divert the full 933 AF. That amount could be diverted in 19 days assuming the pumps are operating at 25 cfs, which is half of the pumping capacity at the United Diversion Facility No. 3. Based on an analysis of call records during the period from 2000 through 2010, there were less than 20 days of no call in 2003, 2004, 2005 and 2006; therefore, excess supplies in those years would be beneficial to FRICO, as the periods when FRICO's 2002 water right was in priority were limited. The primary benefit to FRICO of this concept would be Thornton's payment of the pumping costs of FRICO's portion of the excess water delivered to United Reservoir and excess supplies in years that FRICO's 2002 water right is not in priority.

One of the main challenges with Scenario 2 would be coordinating recharge accretions with canal deliveries to minimize the amount of recharge accretions that FRICO is unable to capture and deliver. To the extent that recharge accretions accrue to the Beebe Canal at times the East Neres Canal is not diverting, this water would flow downstream and could potentially be stored in Milton Lake and be available to those shareholders. This would occur primarily during the winter months. Once in Milton Lake, this water could be accounted for separately from other share water; however, it would be subject to spilling when Milton Lake fills. Milton Lake typically fills under its own senior storage decree in most years; therefore, additional supplies during the winter provide minimal benefit.

8. WATER ADMINISTRATION CHALLENGES

In Case No. 02CW403, East Cherry Creek Valley Water and Sanitation District (ECCV) changed 140.702 Farmers Reservoir and Irrigation Company (FRICO) Barr and 64.083 Burlington Barr shares in the Barr Lake system. Other major components of that case include rights of exchange on the South Platte River for fully consumable water provided by Denver Water pursuant to the 1999 Agreement, alternate points of diversion and place of storage for FRICO, Burlington and Henrylyn senior direct and storage rights, a FRICO 2002 multipurpose water right and a plan for augmentation for ECCV. The applicants for the case were FRICO, Burlington, Henrylyn, United Water and Sanitation District and ECCV. The Colorado Supreme Court ruling on that case was entered in May 2011.

The decree in Case No. 02CW403 (403 Decree) imposed several limitations on the Barr Lake system, which are described below. The 403 Decree imposed volumetric limits on Barr Lake releases on all shares in that system, both changed and unchanged. While volumetric limits were imposed on all shares, only the shares owned by ECCV were changed. Maximum annual and 20-year running average and cumulative release limits were imposed on the 1885 and 1909 storage rights and the 1908 direct rights, as shown in Table 8-1.

Table 8-1. Barr Lake System 403 Decree Limitations

Right	Average Annual Release (AF)	Maximum Annual Release (AF)	20-yr Cumulative Total Release (AF)
Burlington 1885 storage right	5,546	8,450	109,120
FRICO 1909 storage right	11,616	21,982	232,320
FRICO 1908 direct flow right	4,621	17,818	92,240

Releases of the 1885 storage right were limited to the lands under the Hudson Laterals (Speer and Neres Canals) and the East and West Burlington Extension Laterals as they existed in 1909. The decree also limited use of the FRICO 1885 direct flow right to 200 cfs for use above Barr Lake. Seepage through the Barr Lake Dam that was historically recaptured in a drain system and discharged to FRICO canals and groundwater inflows into the Beebe Canal that were captured and used for shareholder deliveries was limited from being diverted and delivered to shareholders. As a result, dam seepage and gains in the Beebe Canal cannot be diverted at the Bowles Seep or East Neres Canals and delivered for irrigation use. The Division One Water Court determined that the Denver

Water Metro pumps, which are currently used to pump effluent water from the Metro Denver Wastewater Reclamation District's Robert Hite Wastewater Treatment Facility (RHWTF) to the Burlington Canal, were not previously decreed as an alternate point of diversion for the FRICO and Burlington decrees. As a result, future diversions at the Metro pumps as an alternate point of diversion cannot exceed the amount that is physically and legally available for diversion at the Burlington Canal headgate at the time the alternate diversion is exercised. This limitation prevents FRICO and Burlington from diverting additional water at the Metro pumps when diverting under their senior water rights.

The full impact of the terms and conditions of the 403 Decree on the operations and yield of the Barr Lake system is unknown. The release limits could limit the amount that FRICO and Burlington are able to release from Barr Lake to their shareholders under certain circumstances. The limitation of the 1885 direct flow right may result in reductions in direct flow deliveries below Barr Lake at times the call on the South Platte River is senior to FRICO's 1908 direct flow water right. As a result of the limitation on the Metro pumps, it will generally take longer for FRICO and Henrylyn to fill their senior storage rights during the storage season. The extension of the Barr Lake fill period will depend on Barr Lake contents at the end of the irrigation season and hydrologic conditions during the storage season. In some instances, the limitations imposed by the 403 Decree may affect operations but have little to no impact on yield.

A shared water bank alternative may be attractive to FRICO because it provides an opportunity to deliver water from non-FRICO sources to the Barr Lake shareholders without interfering with the release limits and other terms and conditions of the 403 Decree. Releases of water provided through a shared water bank alternative would not be subject to the limits imposed on FRICO's and Burlington's senior water rights.

9. SUMMARY OF FINDINGS AND RECOMMENDATIONS

9.1. Summary of Findings

1. The irrigators in the Farmers Reservoir and Irrigation company (FRICO) Barr Lake division were reluctant to work with municipal and industrial (M&I) providers on alternative agricultural transfer methods (ATM) arrangements. Reasons for this reluctance include:
    a. Concerns over the ability to sell their water rights in the long-run
    b. The political environment surrounding FRICO during the study period as a result of the Division One Water Court decree in Case No. 02CW403.
2. Many M&I water providers in the South Platte basin acquire and transfer agricultural water rights as a matter of normal water supply planning, development and acquisition.
3. M&I water providers in the South Platte basin, while generally unlikely to enter into alternative ATM arrangements, expressed interest and the possibility of considering these arrangements in the future if concerns over security can be addressed. These concerns can be summarized as:
    a. The need for a permanent supply.
    b. Ownership of water rights, or preference to own all agricultural water rights.
    c. Need for certainty and reliability in yield.
    d. Unwillingness to develop supplies that may not be permanent at the end of the agreement period.
4. Except for those instances when no other alternatives exist, water providers are going to insist on security before entering into alternative ATM arrangements.

9.2. Discussion of Findings

This study shows that while there may be some reluctance by both irrigators and M&I providers entering into alternative ATM arrangements in future water supply portfolios, the reasons for the reluctance have been identified. Irrigators do not want to be at a disadvantage when dealing with M&I providers and want to preserve the ability to sell their water rights in the future. M&I providers insist on security. Some sort of incentives to participate would be needed to make the alternative ATMs attractive to both irrigators and M&I providers. Possible incentives could come in the form of a guaranteed worst-case outcome or upfront payment from the State of Colorado.

The goal of the alternative ATM program is, in part, to minimize the impacts to rural communities (and agriculture as a whole) associated with the reallocation of water from agricultural to other uses. These impacts are "public" in nature, borne by entire communities and citizens of Colorado. Evidence presented here suggests that these alternatives are not likely to happen on a large scale at this time given the preferences of the parties surveyed. This is largely due to uncertainty surrounding the feasibility of the alternatives (e.g., can an M&I provider rely on a water market to firm supplies during a drought year 20 years from now?) and the potential impact of the alternatives (e.g., impact on the price of agricultural water rights), as well as distrust between the parties. Given the nature of the impacts (public) and the position of the parties, additional incentives may need to be provided to make the alternatives attractive.

A question for the Colorado Water Conservation Board (CWCB), the Intrastate Basin Compact Committee (IBCC) and the state administration is: are we trying to save agriculture, or are we trying to save the individual farmer? If the answer is the former, then perhaps individual irrigators or M&I providers should not have to bear the full cost and risk of doing so.

9.3. Recommendations

The following are suggestions for next steps in the process of building an alternative market:

Water rights ownership provides security, something the M&I provider respondents identified as a necessary condition for long-run planning. As such, it would seem to make sense to promote options for M&I providers that have already purchased rights to work with irrigators to develop flexible lease back arrangements to keep water supplies predictable and available for use by irrigators in years when the water is not needed for M&I purposes. Examples of such arrangements already exist. An alternative to water rights ownership by M&I providers is the development of ATMs that are perpetual such that the security concerns of M&I providers are fully addressed.

The following are recommended actions for consideration by the CWCB, IBCC and other parties interested in promoting alternative ATMs.

1. Conduct an anonymous survey of M&I providers, similar to the survey developed for this report, in other basins to evaluate if the concerns expressed by South Platte M&I providers are shared by providers in other basins.

2. Continue to refine and provide more education about lesser-known alternative agriculture transfer methods such as limited irrigation and shared water banking. Concepts that are not well understood by M&I providers may not be fully evaluated or considered as possible future supplies.

3. Work with M&I providers that will be acquiring and transferring agricultural water rights to discuss and address the most important factors M&I survey respondents listed that are preventing them from entering into alternative ATM arrangements: need for a permanent supply, preference to own agriculture water rights, and unwillingness to develop supplies that may not be permanent at the end of the agreement.

4. Work with M&I providers to develop revised ATM approaches that satisfy the security concerns (need for permanence and reliability) while providing the maximum opportunities to lease water to agriculture in a predictable manner to allow the water to be beneficially used on historically irrigated or other lands.

5. Conduct additional laboratory experiments that test features of alternative ATMs that have not been tested yet. In particular, the

effects of shared water banks, once understood by irrigators and M&I providers, can be examined cleanly with such experiments.

6. Develop operational and financial models that can be used to illustrate to irrigators and M&I providers the financial and water supply impacts and risks of various alternative ATMs vs. traditional agricultural water transfers that result in dry-up.

7. Develop potential incentives that may be needed so that the costs of preserving agriculture are not borne by individual irrigators or M&I providers.

8. Meet with and present the findings of this report and the results of the follow-up recommendations on improved ATMs to the IBCC ATM subcommittee, CWCB Board, agricultural users and M&I and other stakeholder groups to develop consensus on alternative ATMs that have an improved likelihood of implementation by M&I providers.

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11. APPENDICES

Appendices for this report can be found at **www.dinatalewater.com/waterpartnerships**.

The Potential for Alternatives to Permanent Water Transfers

This questionnaire consists of two parts: Part 1 asks you to make a series of choices regarding different alternatives to permanent transfers of water. Part 2 asks you about you and your farm. Together, this information will help us better understand how FRICO shareholders feel about various alternatives. Please do your best to answer all questions as accurately as you can. The information you provide will be kept strictly confidential and your responses cannot be personally associated with you.

If you have any questions or comments regarding this research, please don't hesitate to contact either of the following individuals:

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Thank you, your participation in this research is greatly appreciated!

PART I: Leasing and Water Bank Scenarios

Section 1: Leasing Scenarios

Instructions: *This section presents you with ten individual scenarios where you will be asked to choose between two hypothetical water lease contracts. Two different types of leases are considered here: Multi-Year Water Leases and Interruptible Water Supply Agreements. A detailed explanation of each type is presented on the next page. Specific contracts of both types can also vary in length of contract, payment amount, and other features.*

On each page in this section you will be asked to identify which of the two contracts presented that you prefer (whether or not you would actually use either) AND how many of your FRICO shares you would be willing to commit under each of the options. If you would not choose to lease ALL of your shares under either alternative described, you are asked to indicate at what price you would be willing to do so.

Please assume the following when responding to each scenario in Section 1:

- **You could enter into the agreement(s) at any point in the next five years**
- **You would be required to fallow the land you previously irrigated with any shares you agreed to commit**
- **There are no legal or physical impediments to entering into the agreements presented below**
- **Your property right would not be jeopardized in any way**
- **Prices would be adjusted annually to account for inflation**
- **You can choose to lease any portion of the shares you own**

(For your own reference, please write down the number of shares you own in each reservoir division. This is the maximum number of shares that you can allocate in each scenario presented.)

Number of Barr Shares ________ Number of Milton Shares ________

Multi-year Water Lease

In a multi-year lease, you would agree to lease a specified number of shares to a city, every year for the duration of the contract. You would be compensated annually per share of water leased. Note: you would retain ownership of any shares you agreed to lease. Multi- year Leases are characterized by the following:

- ***Contract Length***: Refers to the length of the contract. For example, a ten-year lease would require you to lease the agreed upon amount of water **every** year for ten years.
- ***Price per Share:*** The dollar amount per share per year you would be paid over the course of the lease. Note: The price listed represents the amount that you would be paid in year one. This amount would be adjusted for inflation in subsequent years.
- ***First Right to Lease Back:*** Indicates whether or not, in years when the city has excess supply, you would have priority in terms of renting back any excess water supplies that the city decided to rent. In the questions below, "yes" indicates that you would have the first right to rent back any water from the shares you leased the city. Note: The city would still have to pay you the per share price agreed upon in the contract. If this option is included, a price per share will also be listed. This price is the per share price that **you** could choose to pay if you wanted to rent back water. If you chose not to exercise this right, the city could rent the water to anyone else.

Interruptible Water Supply Agreement

Interruptible Water Supply Agreements are similar to standard multi-year water leases, except that you would agree to lease shares on an as-needed basis to the city. Over the length of the contract, the city has the option to lease the shares from you in years when they need the water. In years that they do not exercise this option (because they do not need the water), you would be allowed to use the shares any way they wish. In an IWSA, the city would notify you by a particular date whether or not they intend to exercise their option. IWSA are described as follows:

- ***Contract Length:*** Refers to the length of the contract.
- ***Payment Amount per Share:*** Annual payment amount per share
  - ***When exercised:*** the price per share that you would receive in years that the city chose to exercise its option.
  - ***When not exercised:*** the price per share that you would receive in years that the city chose NOT to exercise its option.
- ***Exercise Announcement Date:*** The date at which the city must notify you that they intend to exercise the option. If the city does not notify you by the specified date, you would be allowed to use the shares in any way you choose.
- ***Maximum Exercise Frequency:*** The maximum number of years over the course of the contract that the city may exercise the option. For example, an IWSA with a maximum exercise frequency of three would indicate that the city could not exercise the option more than three times during the 10 year period.

SCENARIO 1

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A		Option B		
Type of Contract	***Multi-year Lease***	**Type of Contract**		***Interruptible***
Contract Length	5 years	Contract Length		5 years
Price per Share	$450	**Price per Share**	Exercised	$450
			Not Exercised	**$25**
First Right to Lease Back	**Yes, $25 per Share**	**Announcement Date**		**March 1**
		Maximum Exercise Frequency		**3**

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

↳ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in order for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

↳ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 2

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A			Option B	
Type of Contract		***Interruptible***	**Type of Contract**	***Multi-year Lease***
Contract Length		10 years	Contract Length	10 years
Price per Share	**Exercised**	**$750**	**Price per Share**	**$250**
	Not Exercised	**$25**		
Announcement Date		**March 1**	**First Right to Lease Back**	**NO**
Maximum Exercise Frequency		**5**		

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

⮡ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

⮡ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in order for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 3

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A		Option B	
Type of Contract	*Multi-year Lease*	Type of Contract	*Multi-year Lease*
Contract Length	10 years	Contract Length	10 years
Price per Share	**$450**	**Price per Share**	**$750**
First Right to Lease Back	**Yes, $25 per Share**	**First Right to Lease Back**	**NO**

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

⇨ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in order for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

⇨ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in order for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 4

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A		Option B		
Type of Contract	***Multi-year Lease***	**Type of Contract**		***Interruptible***
Contract Length	**10 years**	**Contract Length**		**20 years**
			Exercised	**$750**
Price per Share	**$450**	**Price per Share**		
			Not Exercised	**$25**
First Right to Lease Back	**NO**	**Announcement Date**		**May 1**
		Maximum Exercise Frequency		**3**

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in order for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 5

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A		Option B	
Type of Contract	*Multi-year Lease*	Type of Contract	*Multi-year Lease*
Contract Length	10 years	Contract Length	10 years
Price per Share	**$750**	**Price per Share**	**$450**
First Right to Lease Back	Yes, $25 per Share	First Right to Lease Back	Yes, $25 per Share

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in order for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in order for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 6

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A			Option B		
Type of Contract		*Interruptible*	Type of Contract		*Interruptible*
Contract Length		10 years	Contract Length		10 years
Price per Share	**Exercised**	**$750**	**Price per Share**	**Exercised**	**$450**
	Not Exercised	$25		Not Exercised	$25
Announcement Date		May 1	Announcement Date		May 1
Maximum Exercise Frequency		3	Maximum Exercise Frequency		3

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 7

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A			Option B		
Type of Contract		*Interruptible*	Type of Contract		*Interruptible*
Contract Length		**10 years**	**Contract Length**		**20 years**
Price per Share	Exercised	$450	Price per Share	Exercised	$450
	Not Exercised	$25		Not Exercised	$25
Announcement Date		**May 1**	**Announcement Date**		**Jan 1**
Maximum Exercise Frequency		5	Maximum Exercise Frequency		5

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

↳ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

↳ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 8

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A			Option B		
Type of Contract		*Interruptible*	Type of Contract		*Interruptible*
Contract Length		10 years	Contract Length		10 years
Price per Share	**Exercised**	**$250**	**Price per Share**	**Exercised**	**$450**
	Not Exercised	$25		Not Exercised	$25
Announcement Date		Jan 1	Announcement Date		Jan 1
Maximum Exercise Frequency		**1**	**Maximum Exercise Frequency**		**3**

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

⮡ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

⮡ If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 9

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A			Option B		
Type of Contract		*Interruptible*	Type of Contract		*Interruptible*
Contract Length		**5 years**	**Contract Length**		**10 years**
Price per Share	Exercised	$450	Price per Share	Exercised	$450
	Not Exercised	$25		Not Exercised	$25
Announcement Date		Jan 1	Announcement Date		Jan 1
Maximum Exercise Frequency		**1**	**Maximum Exercise Frequency**		**3**

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

SCENARIO 10

Please consider Option A and Option B as offers to you. Items in **bold** differ across the options.

Option A			Option B		
Type of Contract		*Interruptible*	Type of Contract		*Interruptible*
Contract Length		**10 years**	**Contract Length**		**20 years**
Price per Share	**Exercised**	**$250**	**Price per Share**	**Exercised**	**$750**
	Not Exercised	$25		Not Exercised	$25
Announcement Date		May 1	Announcement Date		May 1
Maximum Exercise Frequency		3	Maximum Exercise Frequency		3

1. Which of the two options presented above would you prefer? (check only one)

☐ Option A ☐ Option B

Consider OPTION A Only

2. If you were ONLY offered **OPTION A**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION A**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Consider OPTION B Only

3. Assuming that you were ONLY offered **OPTION B**, please indicate the number of FRICO shares of each type you would be willing to lease.

Number of Barr Shares ________ Number of Milton Shares ________

If you would not be willing to lease 100% of your shares at the price indicated in **OPTION B**, please list the price per share you would need to receive in years the option was exercised for you to be willing to lease 100% of your shares in each division.

$_______ per Barr Share $________ per Milton Share

Section 2: Your thoughts on Multi-year Leases and Interruptible Agreements

We are interested in learning more about your general feelings towards Multi-year Leases and Interruptible Water Supply Agreements (IWSA). This information will be useful in identifying potential changes you would like to see made.

How would your decision to enter into a Multi-year Lease change, if:	Less likely to agree	No change	More likely to agree
you were allowed to dryland, deficit irrigate or change to a lower consumptive use crop mix instead of fallowing?	☐	☐	☐
you received one upfront lease payment (equivalent to inflation-adjusted annual payments)?	☐	☐	☐
if you were required to verify water with a flow meter or other device required by a lease?	☐	☐	☐
as part of the contract, the city would have the option to purchase your shares outright at the end of the contract?	☐	☐	☐

What is the maximum number of years for which you would consider entering into a multi-year lease? _______________Years

What are your biggest concerns regarding entering into a multi-year lease?

____

____

How would your decision to enter into an IWSA change, if:	Less likely to agree	No change	More likely to agree
you were allowed to dryland, deficit irrigate or change to a lower consumptive use crop mix instead of fallowing?	☐	☐	☐
if you were required to verify water with a flow meter or other device required by a lease?	☐	☐	☐
as part of the contract, the city would have the option to purchase your shares outright at the end of the contract?	☐	☐	☐

What is the maximum number of years for which you would consider entering into a multi-year lease? _______________Years

What are your biggest concerns regarding entering into a multi-year lease?

____

____

Section 3: Shared Water Banking

Instructions: We would now like to explore your willingness to participate in what we are calling a "Shared Water Bank". Unlike a traditional water bank, you would not be required to contribute any water. Your involvement would be tied to your willingness to utilize a portion of your land as a recharge site to recharge excess city water. If you chose to participate, a 1 to 5 acre recharge site would be built on your property (if one does not already exist). Cities would receive augmentation credits depending on the amount of water recharged. These augmentation credits would accrue over a period of 1 to 10 years following recharge. The shared water bank would provide cities with the opportunity to store excess water in wet years without having to build additional storage. In exchange for your participation, during the years in which the city was granted augmentation credits, you would receive either additional water from the city or cash payment.

Below are a series of questions pertaining to how much money or water you would need to receive to participate in the Shared Water Bank. *Please assume the following when answering these questions:*

- Assume that the city would pay for ALL costs associated with the construction and maintenance of the recharge site.
- Assume that FRICO would be responsible for all monitoring and accounting tasks associated with any agreement.

Shared Water Bank Scenario

Assume that a city had 100 acre feet of water it wished to recharge on your site. If you agreed, the city would receive 10 acre feet of augmentation credits each year for the next ten years. In exchange for the use of your recharge site the city would pay you in water. Please fill in the following:

1. I would be willing to participate if I received **at least** _____ acre feet of water per year.

   ⇨ If you would not be willing to participate for any amount of water, please list the primary reasons why you would not want to participate

   ____

   ____

Now, assume that instead of giving you water, the city would make an annual payment to you. Please fill in the following:

2. I would be willing to participate if I received at least _____ dollars every year.

Section 4: Your thoughts on the Shared Water Bank concept

In general, how interested would you be in participating in a Shared Water Bank if this were to be realized? (check one)

Very Interested	Somewhat Interested	Neutral	Probably not Interested	Not at all Interested
☐	☐	☐	☐	☐

What are your biggest concerns regarding entering into a Shared Water Bank?

____

____

____

Please list additional information **NOT** described above that would be important for you to know before entering into a Shared Water Bank:

____

____

____

PART II: You and Your Farm:
SECTION 1: Your Farm and Farming Practices

The following questions are designed to give us a better understanding of your current farming practices. This information will be helpful in determining how farms of different size, production practices, etc. view the various alternatives to permanent transfers we are studying.

1. Please indicate the total number of *cropland* acres you farm in a typical year, including land that you own and rent from others:

   _____________ acres, irrigated   _____________ acres, dryland

2. What portion of your irrigated acres are rented or leased **FROM** someone else?   ___________% or ___________acres

3. What portion, if any, of the land that you own do you rent or lease **TO** someone else?   ___________% or ___________acres

If you lease 100% of the land that you own ***to*** *someone else, please skip to the next section (Section 2)*

4. Using the table below, please list your major farm enterprises:

Crop	Number of Acres	If irrigated, please indicate the *percentage* of acreage that is irrigated with:			
		FRICO Barr Shares	FRICO Milton Shares	Other surface water	Other Groundwater

5. Approximately what percent of the irrigated acres on your farm is serviced by each of the following types of irrigation systems? (note: total should add up to 100%)

Gravity:

gated pipe: __________%

siphon tubes: __________%

flood: __________%

other gravity: __________%

Sprinkler:

center pivot: __________%

other sprinkler: __________%

other system: __________%

6. Which of the following irrigation components do you use on your farm? (check all that apply)

☐ Surge Valves
☐ Drop Nozzles
☐ LEPA
☐ Flow meters
☐ Low pressure sprinklers
☐ Flume or weir for measurement
☐ None of these are used

7. In a typical year, what *percent* of your annual gross farm and ranch sales come from irrigated farming? ____________%

8. Which of the following best describes how your production activities change during drought periods when you receive less water? (check all that apply)

☐ Fallow a portion of the land typically irrigated ☐ Change crop mix to crops requiring less water

☐ Plant dryland crops on a portion of the land typically irrigated ☐ Deficit irrigate

☐ Other: (please explain) ____

____

____

9. Is dryland farming feasible on your land?
☐ Yes ☐ No

SECTION 2: Your Views on the Future of Agriculture in the South Platte

The questions up to this point have been focused on your current farming practices. As part of this project we are hoping to getter a better understanding of your thoughts on the future of agriculture in the South Platte River Basin. As such, we would now like you to think about what your land will look like once you are no longer actively managing your land.

10. Which of the following best describes what you envision the land you currently irrigate will be used for once you are no longer actively managing the land? (whether due to change of careers, retirement, etc.)

☐ Farming activities will likely continue similar to the past. ☐ The land will still be used for farming, but will likely switch to dryland.

☐ The land will no longer be used for farming. It will likely be used for: (please explain)____________

____

11. When do you think it is most likely that this (your answer to question 10) will happen?
___________years

12. In the future, what do you think will be the single biggest factor that impacts agriculture in the South Platte River basin?

____

____

____

13. What factors will be most important in determining what happens to your land?

____

____

SECTION 3: Your Water

The following questions pertain to your current water portfolio. This information will help us understand how you currently use your water and the extent to which shareholders with different sources of water view the alternatives to permanent transfers differently.

14. Please indicate the total number of shares you own in each of the following **FRICO** divisions:

    # of shares Barr: ______________ # of shares Milton: ______________

15. Using the table below, describe the remainder of your water "portfolio". List any additional sources of water you own. If possible, identify the typical average and dry year yields associated with each source.

Source/Name	Total number of shares (if applicable)	Total Acre Feet	
		Average Year	Dry Year

16. Have you ever leased or rented water **FROM** another farmer or city? (check all that apply)

    ☐ City ☐ Farmer/Rancher

    If yes, please estimate the total quantity of water you have leased or rented **FROM** cities or other farmers *over the past five years,* and the type of water:

Quantity of Water	Type of Water	
______Acre Feet from City	☐ FRICO Water	☐ Other
______Acre Feet from Farmer	☐ FRICO Water	☐ Other

17. Have you ever leased or rented water **TO** another farmer or city? (check all that apply)

☐ City ☐ Farmer/Rancher

If yes, please estimate the total quantity of water you have leased or rented TO cities or other farmers *over the past five years,* and the type of water:

Quantity of Water	Type of Water	
______Acre Feet from City	☐ FRICO Water	☐ Other
______Acre Feet from Farmer	☐ FRICO Water	☐ Other

18. During the last five years, have you **BOUGHT** water shares or rights **FROM** another farmer or city? (check all that apply)

☐ City ☐ Farmer

19. During the last five years, have you **SOLD** water shares or rights **TO** another farmer or city? (check all that apply)

☐ City ☐ Farmer

If yes, please explain why you chose to sell at the time you did:______________________

____

____

____

SECTION 4: About You

This information is important for several reasons. It will not only help us better understand you and your background, but it will also help us in our efforts to generalize the results of this research to other areas of Colorado.

20. In what year were you born? ______________________

21. Including your generation, for how many generations has your family been in farming? ________

22. Please check your ***total*** estimated annual household income.

☐ Less than $50,000
☐ $50,001 - $100,000
☐ $100,001-$150,000
☐ $150,001-$200,000
☐ More than $200,000

23. Do you or anyone else in your household have another job off the farm?

☐ No

☐ Yes If yes, what percent of your total household income comes from farming? ______________%

Thank you very much for taking the time to complete this questionnaire. Feel free to use the space below to share with us any additional comments you may have. Again, all information you have provided will be treated confidently and anonymously. Please do NOT sign the questionnaire.

Instructions

You are about to participate in an experiment on decision-making. If you follow these instructions carefully and make good decisions you can earn a considerable amount of money, which will be paid to you in cash at the end of the session.

Your earnings in this experiment will be in "Lab Dollars." At the end of the experiment, Lab Dollars (£) will be converted into US dollars and paid to you in cash. For the entire experiment, the exchange rate will be:

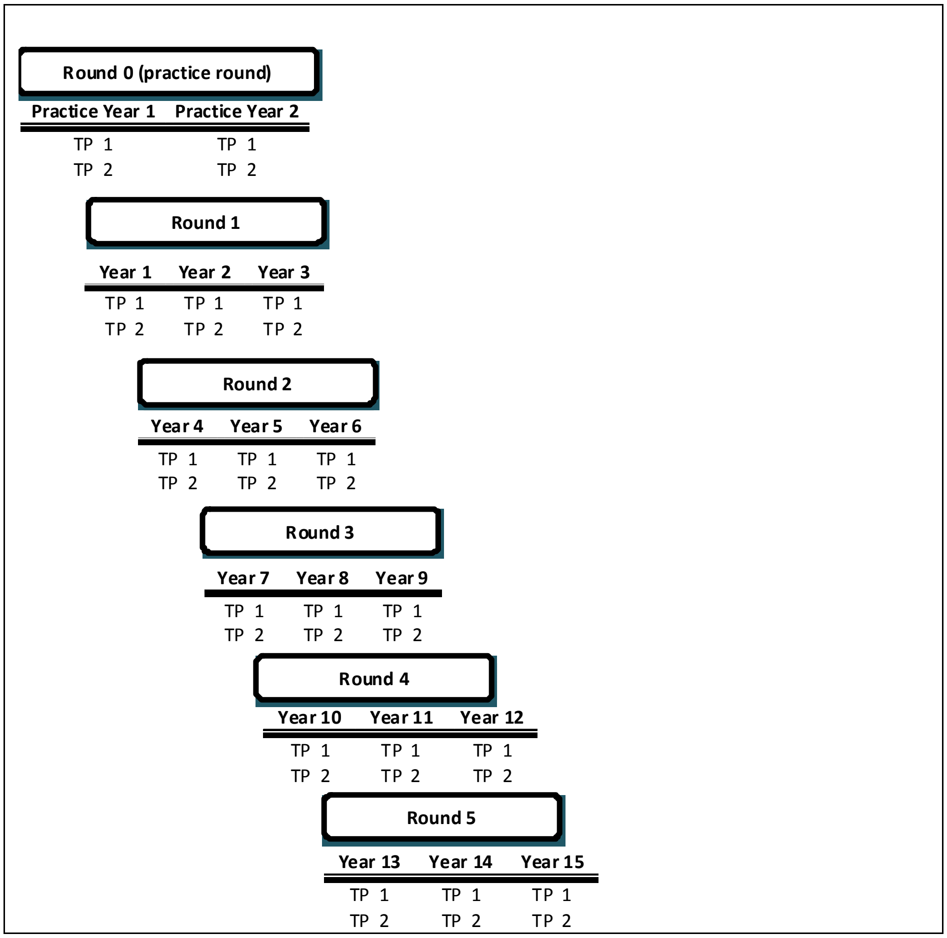
£120 = $1.00

Important: *During the entire experiment, communication of any kind is strictly prohibited. Communication between participants will lead to your exclusion from the experiment and the forfeit of all monetary earnings. Please raise your hand if you have any questions; a member of the research team will come to you and answer your question privately.*

1. Overview of the Experiment

In this experiment you will sell ***water rights*** AND buy and sell ***water***. Water rights and water are two different goods, each with a separate market. The entire experiment consists of five independent "rounds," and each round consists of three "years." Each year consists of two trading periods: ***Trading Period 1 for water rights*** and ***Trading Period 2 for water***. Each trading period will last 90 seconds. Figure 1 displays an overview of the experiment:

Figure 1



Note that the five rounds are independent from each other: in Years 1, 4, 7, 10, and 13 you start out "fresh." However, the years within a round and the trading periods within a year are not independent from each other: whatever happens in, for example, Year 1 has an impact on Years 2 and 3, and whatever happens in Trading Period 1 has an impact on Trading Period 2 in the same year and on future trading periods in subsequent years within the same round.

You will start off each round with an endowment of 5 ***water rights.*** In Trading Period 1 in each year, you can sell ***water rights*** to a subset of the other participants. At the end of Trading Period 1, there will be an Announcement Period, which tells you how much water you get for each water right that you own at that point. The number of water rights that you own will depend on how many of the 5 water rights you were initially given you sold in this and previous years (in the same round). Following this announcement you will have the opportunity to buy and sell ***water*** from and to a subset of the other participants. ***Water*** that you own *at the end* of Trading Period 2 will be used to produce another good.

Purchases of water will be subtracted from your earnings. Sales of water rights, water, and the good produced will be added to your earnings. Earnings from a given year carry over to subsequent years within the same round. At the end of each round you will have cumulative three-year earnings. At the end of the experiment, we will choose randomly one of the five three-year earnings to determine how much money you receive today.

1.1Definitions

Understanding the following definitions are important to understand how to participate in this market.

1.1 Water right:
This is a property right that entails the owner to receive a variable amount of water each year they retain ownership of the right. Participants are either sellers or buyers of water rights. Once a seller has sold a water right in a year, it is gone for this and the following years in the same round, and once a buyer has bought a water right in a year, it is his/hers for this and the following years in the same round.

1.2 Water:
The actual water in your possession. Water is used in the production of another good. You will be paid for the production of this good, the details of which are described below.

Each year you will be given a variable amount of water per water right that you own. The amount of water you receive per water right will differ depending on the *type of* year. Everybody can buy and sell water. How much water you buy and sell within a year has only an impact on that year; the amount of water you have next year depends only on the amount of your water rights you have next year and the type of year, not on your sales and purchases of water in the previous year.

1.3 Type of Year: How much water you get from each water right you own at the beginning of Trading Period 2 depends on the climate conditions, which will vary from year to year. The probability of each type of year and the amount of water you will be given per water right you own are presented below:

	*Water per water right**	*Probability***
Dry	1	0.2
Normal	2	0.6
Wet	3	0.2

*The water per right indicates the amount of water you will get, per water right. This varies from year to year depending on climate conditions. For example, if you own 5 water rights at the end of Trading Period 1, then you will receive 5 units of water in a dry year, 10 units if it is a normal year, and 15 units if it is a wet year.

The probabilities listed above mean that, ***on average*, 2 out of 10 years will be a dry year, 2 out of 10 years will be a wet year and 6 out of every 10 years will be normal years. However, the computer chooses randomly, so it is possible to have several dry years (or wet years) in a row, and probabilities are the same in each year, independent of happened in previous years.

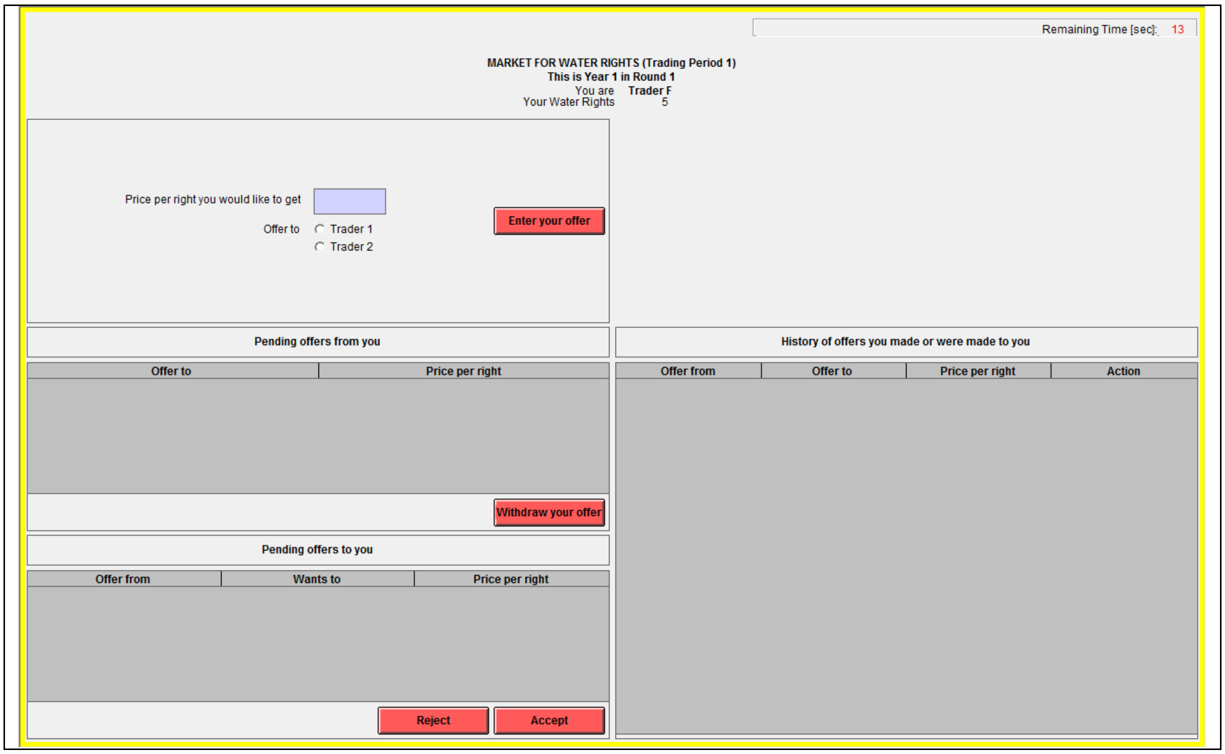
2. The Market

2.1 Trading Period 1: The Market for *Water Rights*

In trading period 1, you will sell ***water rights*** only. You may start with more or less water rights than other participants. The trading environment will allow you to simultaneously make offers to other participants, as well as accept offers from others. When deciding whether or not to make or accept offers, you should consider your current water rights, and how much profit you can make in the entire round if you sell additional rights. You can always sell only one unit at a time (but you can have more than one outstanding offer to others).

The following screenshot is an example of the screen you will see during this period.

Figure 2



How to make an offer

1. Decide what minimum price per right you want to receive. Fill in 'Price per right you would like to get' field.
2. Decide to whom you would like to make the offer. Check the corresponding box.
3. Wait for your offer to be accepted or rejected.

How to respond to offers

1. Decide whether the offer will increase your profits, and accept or reject accordingly. *Remember that the amount of water rights impacts not only your amount of water in this year but also in the following years in the same round.*
2. If you reject, but would like to continue negotiating with the same trader, make an offer as described above.

Rules

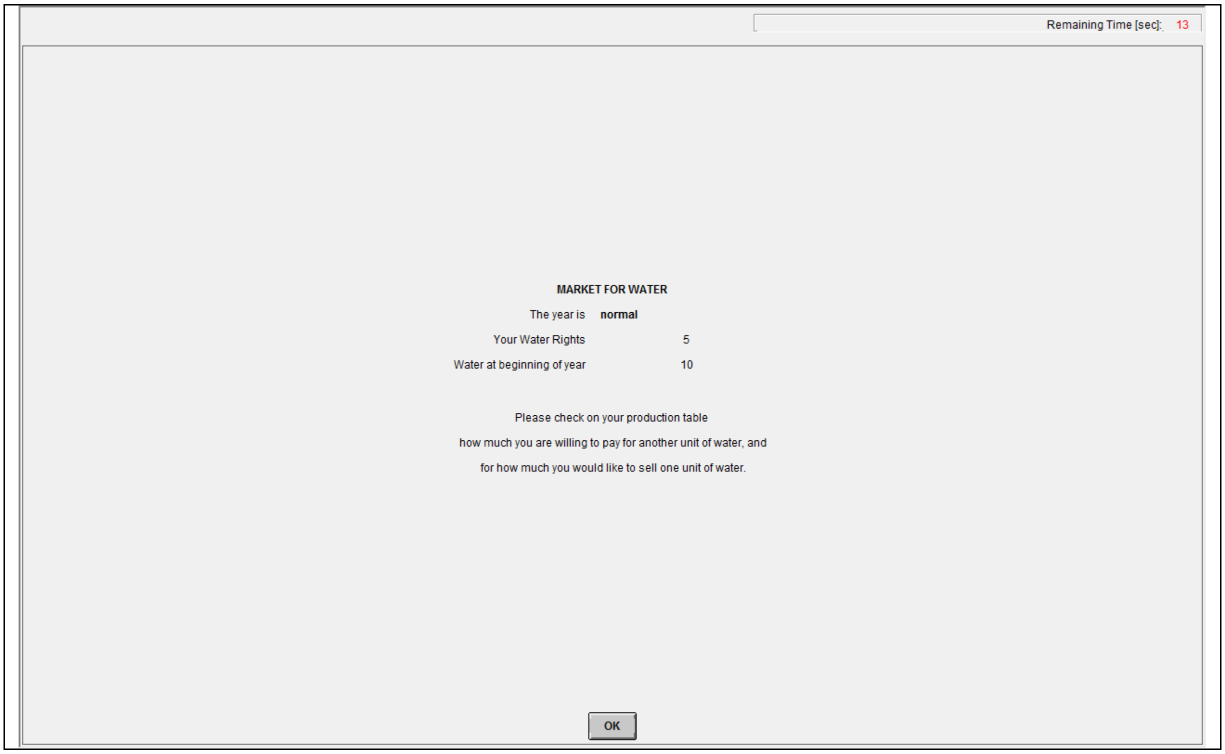
- You cannot offer any water rights (or accept a buyer's offer to buy from you) if you do not have any water rights available anymore.
- You can make more offers of water rights than you have available, but if somebody accepts one of your offers, then the computer automatically checks whether your remaining outstanding offers can still be fulfilled.
- You will have 90 seconds to make all transactions.
- You do not have to trade if you do not want to.

The number of water rights you hold at the end of Trading Period 1 will determine the amount of water you are given that year.

2.2 Announcement Period

In this period, you learn the type of year. The type of year lets you know how much water each water right you own at the end of Trading Period 1 will yield in this year, according to the table presented in Section 1.3. The following screenshot is an example of the screen you will see during this period for 15 seconds unless you hit the OK-button before 15 seconds are over.

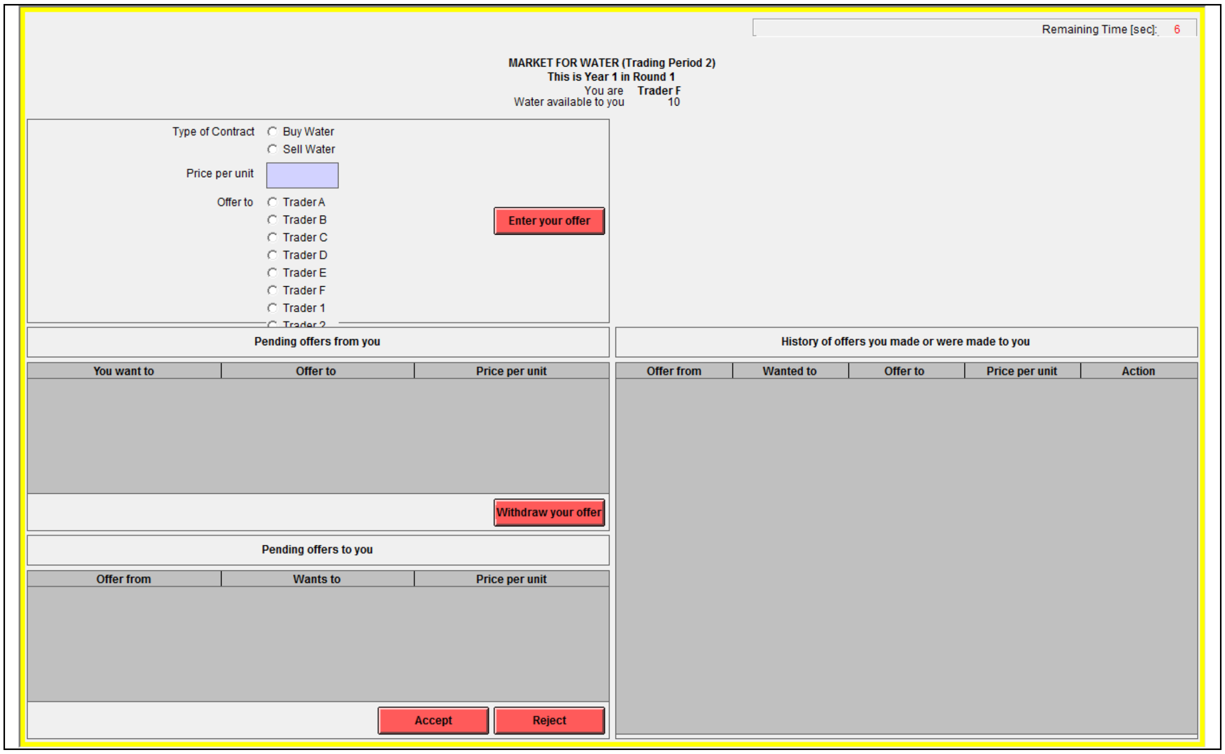
Figure 3



2.3 Trading Period 2: The Market for *Water*

In this period, you will be allowed to buy *and* sell only ***water.*** The same trading procedure and rules as Trading Period 1 apply, except everybody can now be a buyer or a seller. The following screenshot is an example of the screen you will see during this period.

Figure 4



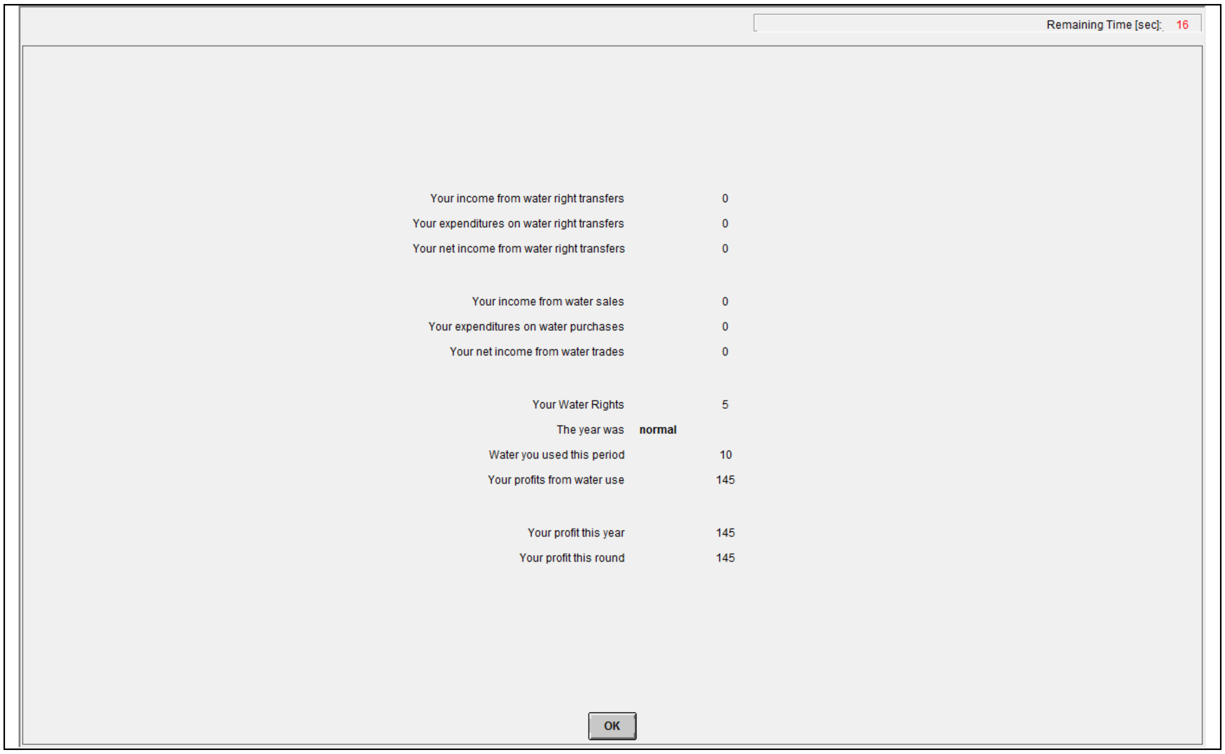
The amount of water you have at the *end* of Trading Period 2 in each year will depend on (a) the quantity of water rights you own at the end of Trading Period 1, (b) the climate in that year, and (c) the net amount of water that you buy and sell during Trading Period 2.

2.4 Calculation of Profit

Profits are generated from the sale of water rights, water, and a good. Total profits in each year are equal to the sum of the net revenues you receive in the ***water rights market***; the net revenues from the ***water market***, and your profits from the production of the other good.

Water that you own at the conclusion of Trading Period 2 will be used to produce another good. Each unit of water will produce 1 unit of the other good. For example, if you have 10 units of water at the end of Trading Period 2 you will produce 10 units of the other good. Your profit will vary according to (a) the quantity of water you have and (b) the year. You will receive two tables that indicate how much profit you make, per unit and in total, for the goods you produce in each year. The following screenshot (next page) is an example of the screen you will see at the end of each year, following the conclusion of Trading Period 2.

Figure 5



3. Example

The following is an example for a player who can *sell* ***water rights***. In your instruction packet, there is a single sheet of paper labeled, "Example Production Profit Tables". This sheet contains two tables. These tables are examples of the type of Production Profit information you will have during the experiment to help you make your trading decisions. The table on the left identifies the amount **per unit** you will be paid for the production of the other good. The table on the right identifies the **TOTAL** amount you will be paid for the production of the other good.

Trading Period 1: Market for permanent water rights

Trader Y starts with 4 Water Rights

Trader Y's decision: Trader Y can sell ***water rights***. In Trading Period 1, Trader Y decides whether to sell water rights to other participants. After looking at the Production Profit Table, Trader Y offers to sell 1 water right to Trader X for $300, which Trader X accepted. At the end of Trading Period 1, Trader Y has now 3 water rights:

Announcement Period

Trader Y learns it is a normal year. Everybody receives 2 unit of water per water right, thus 3 water rights will yield 6 units of water. Trader Y would have received 8 units of water had she not sold one ***water right*** in Trading Period 1.

Now assume that Trader Y decides not to buy or sell any water in Trading Period 2. If this is the case, then all of her water would go to the production of the other good. The example production table on the right shows Trader Y would be paid $390 for the goods produced with 6 units of water. Note: had she not sold the additional ***water right***, Trader Y would have earned $440 from the production of the other good. Not having the additional water right, which yielded an additional 2 units of water, allowed her to produce 2 less units of the other good. As a result, she earned $50 less; $20 dollars for the 8th unit and $30 for the 7th unit.

The table on the left indicates if Trader Y had an additional unit of ***water*** (a 7th unit), she could earn an additional $30 by using it to produce an additional unit of output.

Period 2: Market for water
Trader Y has 6 units of water.

Trader Y's decision: Trader Y can purchase water from other participants and/or can sell water to other participants. Looking at the Production Payment per Good Table (left table), Trader Y would not want to pay more than $30 for another unit of water, because she will earn only additional $30 for the production of the 7th unit of the other good.

Alternatively, Trader Y would like to have at least $40 to sell a unit of water (the 6th unit), because she will earn $40 for the production of the 6th unit of the other good.

Assume Trader Y decides not to buy, but accepts an offer to sell 1 unit of water to Trader X for $80. At the end of Period 2, Trader Y's screen will look as follows:

Your income from water right transfers	300
Your expenditures on water right transfers	0
Your net income from water right transfers	300
Your income from water sales	80
Your expenditures on water purchases	0
Your income from water sales	80
Your Water Rights	3
The year was **normal**	
Water you used this period	5
Your profits from water use	350
Your profit this year	730
Your profit this round	730

Trader Y will end this year with a profit of $300 + $80 + $350 = $730. She will start the next year with 3 water rights, and will repeat the above process for 2 more years.

4. Test Questions

We have attached an additional sheet that contains a series of "test questions". Please pull this sheet out now. Please follow the directions and, using your Example Production Profit Tables answer these questions. You can refer back to the Example in Section 3 to help you answer these questions. If you have any questions about how to interpret the table or if you have any difficulty answering the questions, raise your hand and one of us will come help you.

We will continue once everyone has correctly answered the questions.

5. Trial Period

We will now conduct a trial period to help you understand how to use your production profit table to make good trading decisions that will earn you money. After I am finished reading the instructions, you will participate in the market for one practice round containing only two years. Remember, in the real experiment each round will consist of three years.

Make some offers to buy and sell, and accept offers to buy and sell made by other players. This is just practice to make sure you understand mechanically how to trade and for what prices you would like to buy and sell; what you do in this round will not affect your earnings from the experiment.

Example

Table 1

Payment per ADDITIONAL Unit of Good Produced

	Year		
Quantity	1	2	3
1	90	140	170
2	80	130	160
3	70	120	150
4	60	110	140
5	50	100	130
6	40	90	120
7	30	80	110
8	20	70	100
9	10	60	90
10	0	50	80
11	0	40	70
12	0	30	60
13	0	20	50
14	0	10	40
15	0	0	30
16	0	0	20
17	0	0	10
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0

Table 2

TOTAL Payment for Goods Produced

	Year		
Quantity	1	2	3
1	90	140	170
2	170	270	330
3	240	390	480
4	300	500	620
5	350	600	750
6	390	690	870
7	420	770	980
8	440	840	1080
9	450	900	1170
10	450	950	1250
11	450	990	1320
12	450	1020	1380
13	450	1040	1430
14	450	1050	1470
15	450	1050	1500
16	450	1050	1520
17	450	1050	1530
18	450	1050	1530
19	450	1050	1530
20	450	1050	1530
21	450	1050	1530

Alternative Agricultural Transfer Methods Survey for M&I Providers

Section 1: Provider Information

This survey is intended to collect information on attitudes of municipal and industrial water providers regarding agricultural transfers and alternatives to traditional water rights transfers that typically result in the permanent dry-up of irrigated land.

This effort is partially funded by a grant from the Colorado Water Conservation Board under the Alternative Agricultural Transfer Methods Grant Program.

Although the information gathered in the survey may be made available to the IBCC and its subcommittees, this survey is not a document prepared by or for the IBCC.

Individual water provider's responses will not be reported. Results will be aggregated by category, such as service area population, total raw water demand or geographic area.

We appreciate your participation in this survey.

1. Name of Water Provider

____

2. Name of primary person completing this survey

____

3. Title of primary person completing survey

____

4. Phone number of person completing survey

____

5. Email of primary person completing survey

____

6. Type of water utility/water provider

- ○ Water utility within municipal government
- ○ Title 32 water or water and sanitation district
- ○ Water Authority
- ○ Public Water Company
- ○ Independent Industrial Water System
- ○ Other (please specify)

____

7. Current service area population. Service area is the total area served by your utility including area that may be outside of your corporate boundaries.

- <10,000
- 10,000 to < 25,000
- 25,000 to <75,000
- 75,000 to <125,000
- >125,000
- N/A - industrial user

Comments on service area population, such as includes partial supply to another provider, wholesale contract, etc.

8. Projected buildout service area population.

- <10,000
- 10,000 to < 25,000
- 25,000 to <75,000
- 75,000 to <125,000
- >125,000
- N/A - industrial user

Comments on service area population, such as includes partial supply to another provider, wholesale contract, etc.

9. Current total raw water demand in acre-feet per year

- ◯ <5,000
- ◯ 5,000 to <10,000
- ◯ 10,000 to <20,000
- ◯ 20,000 to <40,000
- ◯ >40,0000

Comments on total raw water demand such as amounts provided under wholesale contracts, etc.

10. Projected total raw water demand at buildout in acre-feet per year

- ◯ <5,000
- ◯ 5,000 to <10,000
- ◯ 10,000 to <20,000
- ◯ 20,000 to <40,000
- ◯ >40,0000

Comments on total raw water demand such as amounts projected to be provided under wholesale contracts, etc.

Section 2: Current Water Supply Planning Efforts

11. Are additional agricultural water rights transfers a part of your current plans to meet future demands?

- ◯ Yes
- ◯ No

12. Do you typically require dry-up covenants when acquiring agricultural water rights?

- ◯ Yes
- ◯ No
- ◯ Don't acquire agricultural water rights

13. Do the challenges and uncertainty in permitting a future water supply project affect your decision to acquire and transfer agricultural water rights?

- ◯ Yes, will acquire agricultural rights rather than face the costs and uncertainties in environmental permitting
- ◯ No
- ◯ Do not plan to acquire additional agricultural rights
- ◯ We purchase agricultural water rights as a matter of normal planning

14. The following are factors that you may consider when evaluating water supply development and acquisitions. Please rank the following in terms of importance on a scale of 1 to 5 with 5 being very important

	1 (Least Important)	2	3	4	5 (Very Important)
Low cost	◯	◯	◯	◯	◯
Certainty and reliability in yield	◯	◯	◯	◯	◯
Permanency of supply	◯	◯	◯	◯	◯
Competition for limited supplies	◯	◯	◯	◯	◯
Deliver water within a defined period of time	◯	◯	◯	◯	◯
Avoidance of environmental permitting	◯	◯	◯	◯	◯
Difficulty of environmental permitting	◯	◯	◯	◯	◯
Local permits (1041)	◯	◯	◯	◯	◯
Water quality	◯	◯	◯	◯	◯
Ownership of water rights	◯	◯	◯	◯	◯
Ownership of infrastructure	◯	◯	◯	◯	◯
Water Court approval process	◯	◯	◯	◯	◯
Availability of administrative approval (similar to SWSP)	◯	◯	◯	◯	◯
Other (specify below)	◯	◯	◯	◯	◯

List other

Section 3: Current Practices on Agricultural Leases

The following questions relate to your utility's practices in leasing or renting water from your supplies to agricultural users. For the purposes of these questions, use the following definitions:

LEASE BACK AGREEMENTS - Agricultural water rights that are purchased by your utility may be leased-back to the original seller for a period of years as part of the initial water rights acquisition agreement

SURPLUS LEASES - Water supplies that have been determined to be surplus until development and demand reaches a certain level, allowing the utility to enter into multi-year contracts to lease these surplus supplies to agricultural users

ANNUAL RENTALS OF SURPLUS SUPPLIES - Rentals of C-BT or native water that is not needed in that one year and rented on a first come first served basis

15. Do you LEASE BACK agricultural water rights that are purchased by your utility to the original seller for a period of years as part of the water rights acquisition agreement?

- ◯ Often, as a normal practice
- ◯ Often, but only to our local basin
- ◯ Occasionally
- ◯ No

16. If you enter into LEASE BACK AGREEMENTS to agricultural users as part of a water rights purchase, what is the typical length of your leases?

	<5 years	5 to 10 years	> 10 years	Varies
Typical length of LEASE BACK AGREEMENTS	☐	☐	☐	☐

Additional comments

17. Do you enter into SURPLUS LEASES for water supplies that have been determined to be surplus until development reaches a certain level, allowing the utility to enter into multi-year contracts to lease these surplus supplies to agricultural users?

- ◯ Yes, as a normal activity except during droughts
- ◯ Occasionally
- ◯ No

18. If you enter into SURPLUS LEASES to agricultural users, what is the typical length of your leases?

	<5 years	5 to 10 years	> 10 years	Varies
Typical length of leases	☐	☐	☐	☐

Additional comments

19. If you enter into SURPLUS LEASES to agricultural users, what is the typical per AF lease charge?

	Annual ditch assessment	<$20/AF	$20 to $39/AF	$40 to $60/AF	>60/AF
Typical lease charge	☐	☐	☐	☐	☐

20. Do you enter into ANNUAL RENTALS OF SURPLUS SUPPLIES for Rentals of C-BT or native water that is not needed in that one year and rented on a first come first served basis?

- ◯ Yes, as a normal activity except during droughts
- ◯ Occasionally
- ◯ No

21. If you enter into ANNUAL RENTALS to agricultural users, what is the typical per AF lease charge?

	Annual ditch assessment	<$20/AF	$20 to $39/AF	$40 to $60/AF	>60/AF
Typical ANNUAL RENTAL charge	☐	☐	☐	☐	☐

22. Have you ever leased agricultural water supplies FROM agricultural users to supplement your supply?

	Yes	No
Prior to 2002	☐	☐
During 2002 drought	☐	☐
Post 2002 drought	☐	☐

23. If you have leased agricultural water supplies FROM agricultural users, what was the typical per AF lease charge?

	N/A	Annual ditch assessment	<$100/AF	$100 to $200/AF	>$200 to $300/AF	>300/AF
Typical charge per AF charged to you to lease agricultural supplies	☐	☐	☐	☐	☐	☐

Section 4: Alternatives to Traditional Agricultural Water Transfers

The following is a list of alternatives to permanent transfers for reallocating agricultural water to municipal and industrial (M&I) users:

Extended Period Water Leases
Interruptible Water Supply Agreements
Rotational Fallowing
Limited Irrigation
Shared Water Banks

In the subsequent pages, you will presented with an explanation of each of these alternatives followed by a series of questions designed to give us a better understanding of your current understanding and preferences towards each of the various alternatives presented above.

Long-Term Water Leases

EXTENDED PERIOD WATER LEASES
As discussed here, extended period water leases refer to an agreement between a water provider and an agricultural user where the water provider enters into a lease with the agricultural user to lease all or a portion of the irrigators water rights annually for a defined period of time. The resulting yield to the M&I provider each year would depend on the yield of the specific water rights that were leased. Under this form of agreement, the irrigator retains ownership of the leased water right. Extended period water leases are typically characterized by the following:

Lessee and Lessor: The agricultural water rights user (Lessor) leases water to the M&I water provider (Lessee)

Contract Length: Refers to the length of the lease. Extended period leases are typically a minimum of 10 years and may be as long as 40 years. The lease would require you to lease the agreed upon amount of water every year for the length of the lease agreement.

Price per Share: The per year dollar amount paid to the irrigator over the course of the lease.

Lease Extension Option: An extended period lease agreement may include a provision for the lessee to extend the lease by an agreed upon additional term.

Assignment of Lease: The lease agreement is typically binding on heirs and assigns if the water is sold or inherited.

Permanent Purchase Option: Provides the lessee the option to purchase the water rights at the end of the lease. An extended period lease may or may not include this provision.

Nature of Payment: Payment for the lease are typically paid annually but may also include an upfront payment in addition to annual payments during the lease term. Less common is a one-time payment that covers the entire lease term.

Water Rights Administration Approval: For the purposes of the following questions, assume that the water rights in question have been through a ditch-wide change of use and authorized for municipal use.

24. How familiar are you with the concept of "Extended Period Water Leases" as described above?

- ◯ Very familiar
- ◯ Somewhat familiar
- ◯ not very familiar

25. How likely is it that extended period water leases will be a part of your utility's future water supply portfolio?

- ◯ Likely
- ◯ Possibly
- ◯ Unlikely

26. If you answered 'possibly' or unlikely' please rank the following from least to most likely in terms of factors you currently see as preventing you from signing an extended period lease.

	1 (Least Likely)	2	3	4	5 (Most Likely)
Anticipated cost likely to be greater than benefit	○	○	○	○	○
Concerns over the sale of the water rights that are leased if the price of water increases significantly, even if protected under the contract	○	○	○	○	○
Concerns that leased water will not provide yields when needed	○	○	○	○	○
Concerns with Water Court process	○	○	○	○	○
Do not have a need for extended period leases from agriculture	○	○	○	○	○
Need a permanent water supply	○	○	○	○	○
Unwilling to develop supplies that may not be permanent at end of lease	○	○	○	○	○
Would be more willing if administrative approval is available (similar to SWSP)	○	○	○	○	○
Would prefer to own all agricultural water rights	○	○	○	○	○

Other (please describe

27. The following are factors that you may consider when evaluating deciding whether or not to enter into an extended period lease. Please rank the following items in terms of importance on a scale of 1 to 5 with 5 being very important.

	1 (Not Important)	2	3	4	5 (Very Important)
Contract Length	○	○	○	○	○
Price per Acre Foot	○	○	○	○	○
Lease Extension Option	○	○	○	○	○
Option to purchase at end of lease, or right of first refusal to purchase if sold	○	○	○	○	○
Nature of Payment (Upfront or Annual)	○	○	○	○	○

Other (please indicate relative importance)

28. What is the MINIMUM number of years needed for you to consider entering into an extended period water lease?

- ☐ < 10 years
- ☐ 10 to 20 years
- ☐ 21 to 40 years
- ☐ > 40 years
- ☐ Would not enter into an extended period lease
- ☐ Must have option to purchase at end of lease or right of first refusal

Interruptible Water Supply Agreement (IWSA)

INTERRUPTIBLE WATER SUPPLY AGREEMENTS
Interruptible water supply agreements (ISAs) may consist of temporary, long-term or permanent arrangements in which agricultural water is transferred for other purposes in other locations while irrigation is temporarily suspended. Exercising an ISA is typically triggered on an as-needed basis and could include dry-year needs, drought recovery needs, and even wet-year needs. An ISA would include limitations as to the frequency in which the supply could be exercised throughout the term of the agreement. Current law (Section 37-75-309 CRS) allows the State Engineer to administratively approve temporary ISAs as long as they are not triggered more than three times in a 10-year period. A longer term ISA that could involve more frequent interruption of the agricultural use would require water court approval. The terms of such an ISA are within the parties' discretion, as is the schedule of payments that might reflect frequency or repetition of exercise of the option.

Interruptible Water Supply Agreements are typically characterized by the following:

Ownership of Water Rights: Ownership of water rights remain with the irrigator

Contract Length: An ISA typically would be for a minimum of 10 years and could extend as long as 40 years or in perpetuity

Frequency of Interruption: An ISA would typically be a maximum of 3 years out of 10 in order to comply with state statutes and can be administratively approved by the State Engineer. A Water Court approval process would not be required.

Nature of Payment: An ISA may involve an upfront payment to the irrigator, annual payments, payment in the year of interruption or a combination of these payments

Administration of the Agreement: An Interruptible Supply Agreement would typically be administered by the irrigation company if involving multiple shareholders or may be an agreement between an individual shareholder and the end user

Water Rights Administration Approval: For the purposes of the following questions, assume that the water rights in question can be administratively approved for use under Section 37-75-309 CRS.

29. How familiar are you with the concept of "Interruptible Water Supply Agreements" described above?

- ◯ Very familiar
- ◯ Somewhat familiar
- ◯ Not very familiar

30. How likely is it that interruptible water supply agreements will be a part of your utility's future water supply portfolio?

- ◯ Likely
- ◯ Possibly
- ◯ Unlikely

31. If you answered 'possibly' or unlikely' please rank the following from least to most likely in terms of factors you currently see as preventing you from entering into an interruptible water supply agreement.

	1 (Not Important)	2	3	4	5 (Very Important)
Anticipated cost likely to be greater than benefit	○	○	○	○	○
Concerns with Water Court process	○	○	○	○	○
Do not have a need for interruptible supply leases from agriculture	○	○	○	○	○
Need a permanent supply	○	○	○	○	○
Unwilling to develop supplies that may not be permanent at end of agreement period	○	○	○	○	○
Would be more willing if longer administrative approval available	○	○	○	○	○
Would prefer to own all agricultural water rights	○	○	○	○	○

Other (please describe

32. The following are factors that you may consider when evaluating deciding whether or not to enter into an interruptible supply agreement. Please rank the following items in terms of importance on a scale of 1 to 5 with 5 being very important.

	Not Important				Very Important
Contract Length	○	○	○	○	○
Price per Acre Foot	○	○	○	○	○
Lease Extension Option	○	○	○	○	○
Option to purchase at end of agreement, or right of first refusal to purchase if sold	○	○	○	○	○
Nature of Payment (Upfront or Annual)	○	○	○	○	○

33. What is the MINIMUM number of years needed for you to consider entering into an interruptible supply agreement?

- < 10 years
- 10 to 20 years
- 21 to 40 years
- > 40 years
- Would not enter into a long-term lease
- Must have option to purchase at end of agreement or right of first refusal

Rotational Fallowing

ROTATIONAL FOLLOWING
Rotational fallowing corresponds to an alternative means of freeing-up agricultural water. A rotational fallowing agreement between a water provider and a group of agricultural users would require each member of the group of agricultural users to agree not to irrigate for a period of time over the course of the agreement. Each member of the irrigator group would fallow on a rotating basis. Water would be made available to the water provider on a negotiated schedule.

For example, if 5 agricultural users signed a 5 year rotational fallowing agreement, each irrigator would take a turn not irrigating in 1 year out of 5. The M&I user would obtain an annual yield, with this yield coming from a different agricultural user each year.

Rotational Fallowing Agreements are typically characterized by the following:

Ownership of Water Rights: Ownership of water rights remain with the irrigator

Contract Length: An ISA typically would be for a minimum of 10 years and could extend as long as 40 years or in perpetuity

Frequency of Supply: A Rotational Fallowing Agreement could provide a minimum yield every year or to provide supply as needed in drought years or for drought recovery in years following a drought

Nature of Payment: A Rotational Fallowing Agreement may involve an upfront payment to the irrigator, annual payments, payment in the years of supply delivery or a combination of these payments

Administration of the Agreement: A Rotational Fallowing Agreement would typically be administered by the irrigation company or a coordination agency combined of multiple ditch companies

Water Rights Administration Approval: For the purposes of the following questions, assume that the water rights in question have been through a ditch-wide change of use and authorized for municipal use.

34. How familiar are you with the concept of "Rotational Fallowing" described above?

- Very familiar
- Somewhat familiar
- Not very familiar

35. How likely is it that Rotational Fallowing Agreements will be a part of your utility's future water supply portfolio?

- ◯ Likely
- ◯ Possibly
- ◯ Unlikely for various reasons

36. If you answered 'possibly' or unlikely' please rank the following from least to most likely in terms of factors you currently see as preventing you from entering into a rotational fallowing agreement.

	Not Important				Very Important
Anticipated cost likely to be greater than benefit	◯	◯	◯	◯	◯
Concerned with Water Court process	◯	◯	◯	◯	◯
Concerns over long-term costs	◯	◯	◯	◯	◯
Do not have a need for rotational fallowing leases from agriculture	◯	◯	◯	◯	◯
Need a permanent supply	◯	◯	◯	◯	◯
Unwilling to develop supplies that may not be permanent at end of agreement period	◯	◯	◯	◯	◯
Would be more willing if administrative approval is available (similar to SWSP)	◯	◯	◯	◯	◯
Would prefer to own all agricultural water rights	◯	◯	◯	◯	◯

Other (please describe

37. The following are factors that you may consider when evaluating deciding whether or not to enter into a rotational fallowing agreement. Please rank the following items in terms of importance on a scale of 1 to 5 with 5 being very important.

	Not Important				Very Important
Contract Length	○	○	○	○	○
Price per Acre Foot	○	○	○	○	○
Lease Extension Option	○	○	○	○	○
Option to purchase at end of agreement, or right of first refusal to purchase if sold	○	○	○	○	○
Nature of Payment (Upfront or Annual)	○	○	○	○	○

38. What is the MINIMUM number of years needed for you to consider entering into a rotational fallowing agreement?

- ☐ < 10 years
- ☐ 10 to 20 years
- ☐ 21 to 40 years
- ☐ > 40 years
- ☐ Would not enter into a long-term lease
- ☐ Must have option to purchase at end of agreement or right of first refusal

Limited Irrigation

LIMITED IRRIGATION
A different concept that has been proposed to meet M&I needs via agricultural transfers while minimizing impacts to local agricultural production is a concept called "Limited Irrigation." Limited irrigation would involve an agreement between a water provider and an agricultural user where only a portion of the historical consumptive use associated with a parcel would be transferred to the water provider. A portion of the historical water supply would be left on the historically irrigated land to provide for a limited irrigation supply for a dryland crop such as grain or allow one cutting of hay of alfalfa. This could potentially result in the avoidance of the need to revegetate the land.

Limited Irrigation is typically characterized by the following:

Ownership of Water Rights: Ownership of the water rights used for limited irrigation may remain with the irrigator or owned by the end user with a lease back arrangement with the original irrigator. The ownership of the majority of the historical consumptive use would be transferred to the end user.

Contract Length: A Limited Irrigation Agreement could be for 5 to 10 years or longer or be perpetual

Frequency of Supply: A Limited Irrigation Agreement would provide for a defined volume of water that could be used annually for limited irrigation

Nature of Payment: A Limited Irrigation Agreement would typically be negotiated at time of purchase of the water rights by the end user and may not involve any additional payments, depending upon the terms of the agreement

Administration of the Agreement: A Limited Irrigation Agreement would typically be an arrangement with an irrigator and the end user and not require any additional administration except for delivery by the ditch company

Water Rights Administration Approval: For the purposes of the following questions, assume that the water rights in question have been changed to M&I and continued irrigation use by the end user (water utility.)

39. How familiar are you with the concept of "Limited Irrigation" described above?

- ○ Very familiar
- ○ Somewhat familiar
- ○ Not very familiar

40. How likely are limited irrigation strategies to be a part of your future water supply portfolio?

- ○ Likely
- ○ Possibly
- ○ Unlikely for various reasons

41. If you answered 'possibly' or unlikely' please rank the following from least to most likely in terms of factors you currently see as preventing you from entering into limited irrigation arrangements as part of your water agricultural transfers.

	Not Important				Very Important
Anticipated cost likely to be greater than benefit	○	○	○	○	○
Concerned about the Water Court process	○	○	○	○	○
Needs to be the responsibility of the seller with no ongoing obligation of the provider	○	○	○	○	○
Prefer to transfer all of the water and lease back a portion of the transferred water for a defined period of time	○	○	○	○	○
Seller must discount the price to account for any water left on the land for limited irrigation	○	○	○	○	○
Would be more willing if administrative approval is available (similar to SWSP)	○	○	○	○	○
Would not consider this concept as part of future acquisitions and transfers	○	○	○	○	○

42. The following are factors that you may consider when evaluating deciding whether or not to enter into a limited irrigation arrangement. Please rank the following items in terms of importance on a scale of 1 to 5 with 5 being very important.

	Not Important				Very Important
Contract Length	○	○	○	○	○
Price per Acre Foot	○	○	○	○	○
Lease Extension Option	○	○	○	○	○
Option to purchase at end of agreement, or right of first refusal to purchase if sold	○	○	○	○	○
Nature of Payment (Upfront or Annual)	○	○	○	○	○

43. What is the MAXIMUM number of years you would consider for a a limited irrigation arrangement?

- < 10 years
- 10 to 20 years
- 21 to 40 years
- > 40 years
- Would not enter into a long-term arrangement
- Willing to leave a portion of water permanently

Shared Water Bank

SHARED WATER BANK
A "Shared Water Bank" is a different concept where a water provider would provide surplus supplies to a ditch company for storage and re-operations. In return the water provider would have the right, for a defined period of time, to reclaim a portion of the surplus water that was previously provided to the ditch company. In effect, the ditch company would be providing storage for the water provider's surplus supplies in return for a portion of the supplies.

A Shared Water Bank is typically characterized by the following:

Ownership of Water Rights: Ownership of the water rights remain with the water provider. Surplus rights are deposited by the water provider into the shared water bank on a lease basis

Contract Length: A Shared Water Bank Agreement could be for 5 to 10 years or longer or be perpetual

Frequency of Supply: A Shared Water Bank would provide that deposits would be made only when surplus supplies are available for deposit. The water deposited into a shared bank would be distributed annually based on negotiated terms.

Nature of Payment: A Shared Water Agreement could involve cash payments or a sharing of the water managed in the water bank

Administration of the Agreement: A Shared Water Bank would typically be administered by the irrigation company that is providing the storage and re-operations of the deposited water

Water Rights Administration Approval: For the purposes of the following questions, assume that the water rights in question have already been decreed for consumptive use as part of previous changes and it is the responsibility of the agricultural users to ensure that the M&I water deposited into the shared bank can be stored and used in the agricultural system.

44. How familiar are you with the concept of a "Shared Water Bank" as described above?

- Very familiar
- Somewhat familiar
- Not very familiar

45. How likely are shared water banks to be a part of your future water supply portfolio?

- Likely
- Possibly
- Unlikely

46. If you answered 'possibly' or unlikely' please rank the following from least to most likely in terms of factors you currently see as preventing you from entering into a shared water bank arrangement.

	Least Important				Very Important
Anticipated cost likely to be greater than benefit	○	○	○	○	○
Concerned about the water court process	○	○	○	○	○
Concerned that the ag users may develop a dependence on my surplus supplies	○	○	○	○	○
Don't project any surplus supplies that could be made available for a shared water bank	○	○	○	○	○
Needs to result in a substantially lower cost than developing or acquiring additional storage	○	○	○	○	○
Would be more willing if administrative approval is available (similar to SWSP)	○	○	○	○	○
Would not consider for a number of reasons	○	○	○	○	○
Would prefer a long-term arrangement >30 years	○	○	○	○	○
Would prefer a perpetual agreement	○	○	○	○	○

47. The following are factors that you may consider when evaluating deciding whether or not to enter into a shared water bank arrangement. Please rank the following items in terms of importance on a scale of 1 to 5 with 5 being very important.

	Not Important				Very Important
Contract Length	◯	◯	◯	◯	◯
Price per Acre Foot	◯	◯	◯	◯	◯
Lease Extension Option	◯	◯	◯	◯	◯
Option to be paid with water or cash	◯	◯	◯	◯	◯
Nature of Payment (Upfront or Annual)	◯	◯	◯	◯	◯

48. What is the MAXIMUM number of years you would consider for a shared water bank arrangement?

- ◯ < 10 years
- ◯ 10 to 20 years
- ◯ 21 to 40 years
- ◯ > 40 years
- ◯ Would not enter into a long-term arrangement
- ◯ Willing to loan a portion of surplus water permanently

Final Questions

49. Please list any of the following that were consulted in preparing your survey responses

- ☐ Upper Management (City Manager, District Manager, Industrial VP)
- ☐ City Council or District/Industrial Board of Directors
- ☐ In-house Attorney
- ☐ Outside Water Attorney
- ☐ Utilities or Water Resources Department Manager
- ☐ In-house Water Resources staff
- ☐ Water Resources consultants

Other (please specify)

50. Overall, how easy or difficult did you find it to understand the questions? On a scale of 1 to 5 where 1 means the survey was 'difficult to understand' and 5 means the survey was 'easy to understand'

	Difficult to Understand Most of the Questions				All of the Questions Were Easy to Understand
How easy was it to understand the questions?	○	○	○	○	○

51. Overall, how biased or unbiased did you find the questions? On a scale of 1 to 5 where 1 means 'all of the questions were biased' and 5 means 'all of the questions were unbiased'.

	All of the questions were biased				All of the questions were unbiased
Did you feel the questions were biased or unbiased?	○	○	○	○	○

52. If you felt that the questions were biased, please note if they were biased toward promoting or discouraging Alternative Agricultural Transfer Methods

- ○ Biased toward promoting Alternative Agricultural Transfers
- ○ No bias
- ○ Biased toward discouraging Alternative Agricultural Transfers

53. Please rate this survey overall. On a scale of 1 to 5 where 1 means the survey was 'Poor' and 5 means the questionnaire was 'Excellent.'

	Poor				Excellent
Please rate the survey overall	○	○	○	○	○

54. Do you have any general comments on this survey, the topic of Alternative Agricultural Transfers or comments on your experience of taking this survey (optional)?

Municipal and Industrial Water Provider Survey on Attitudes Regarding Alternative Agricultural Transfer Methods

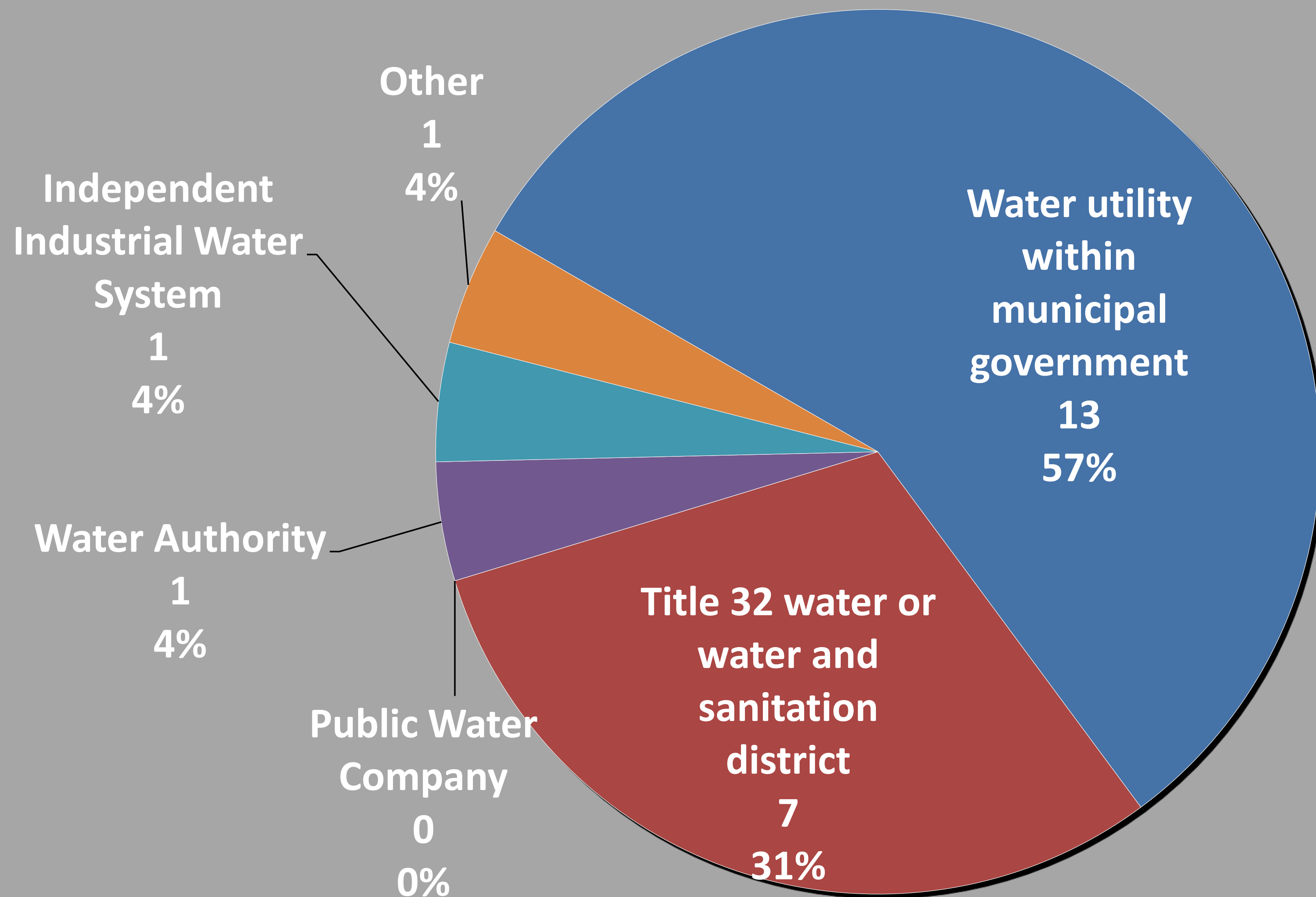
M&I Providers Survey Questions

- Survey Responses
  - General Information
  - Current and projected service area and water needs
  - Current alternative agriculture transfer practices
  - Identification of important factors
  - Alternative Agriculture Transfer Methods
    - Lease Back Agreements
    - Surplus Leases
    - Annual Rentals of Surplus Supplies
    - Leased from Agriculture Water Supplies
    - Extended Period Water Leases
    - Interruptible Water Supply Agreements
    - Rotational Fallowing
    - Limited Irrigation
    - Shared Water Bank
  - Survey Evaluation

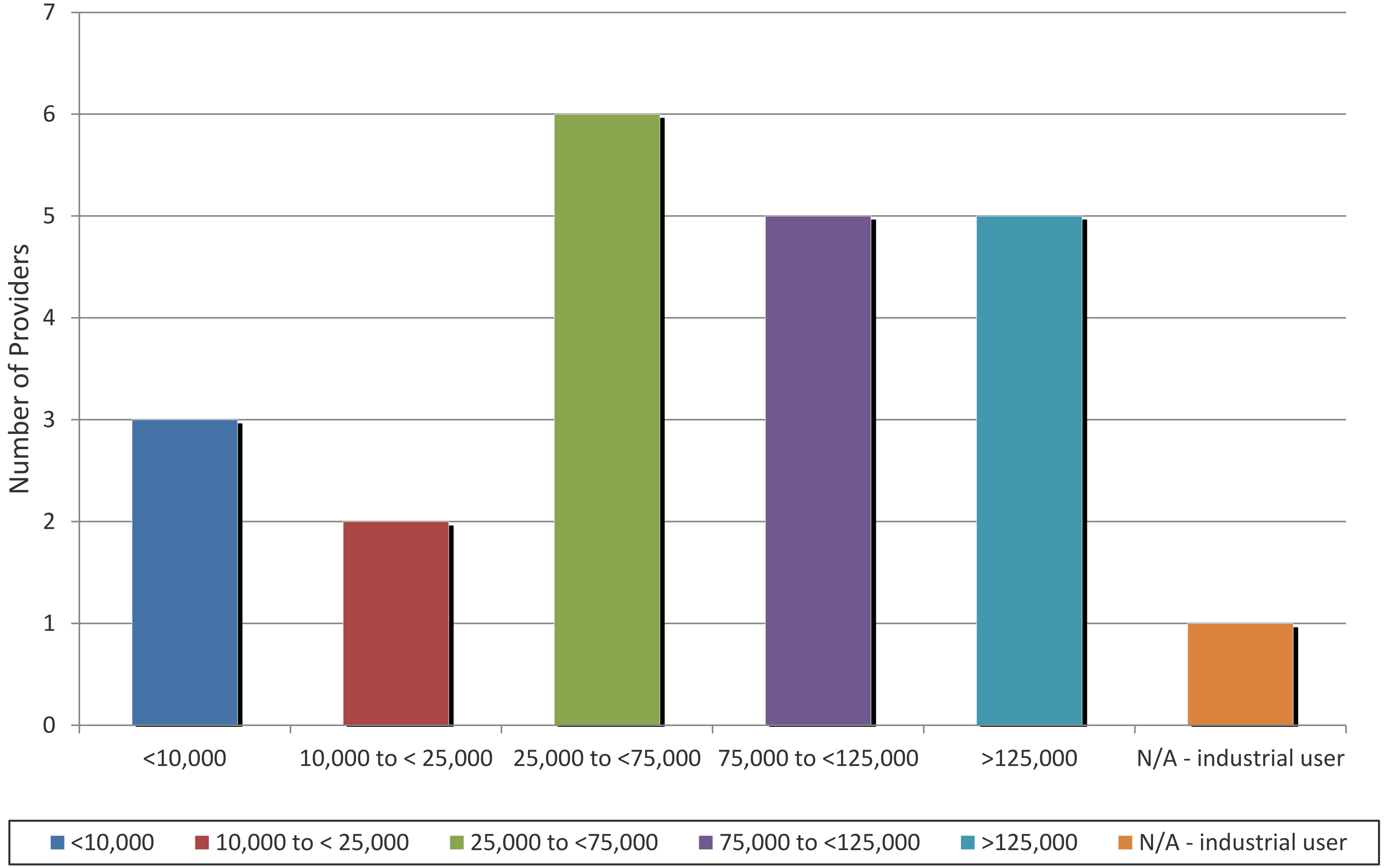
Providers Responding

Provider	
Arapahoe County Water and Wastewater Authority	City of Longmont
City of Arvada	City of Louisville
City of Aurora	City of Loveland
City of Boulder	Parker Water and Sanitation District
Centennial WSD	Public Service Company
Denver Water	South Adams County Water and Sanitation District
East Cherry Creek Valley Water and Sanitation District	St. Vrain and Left Hand Water Conservancy District
City of Fort Collins	City of Thornton
City of Greeley	Tri-Districts (East Larimer County, Fort Collins-Loveland and North Weld County Water Districts)
Town of Johnstown	United Water and Sanitation District
City of Lafayette	City of Westminster
Lefthand Water District	

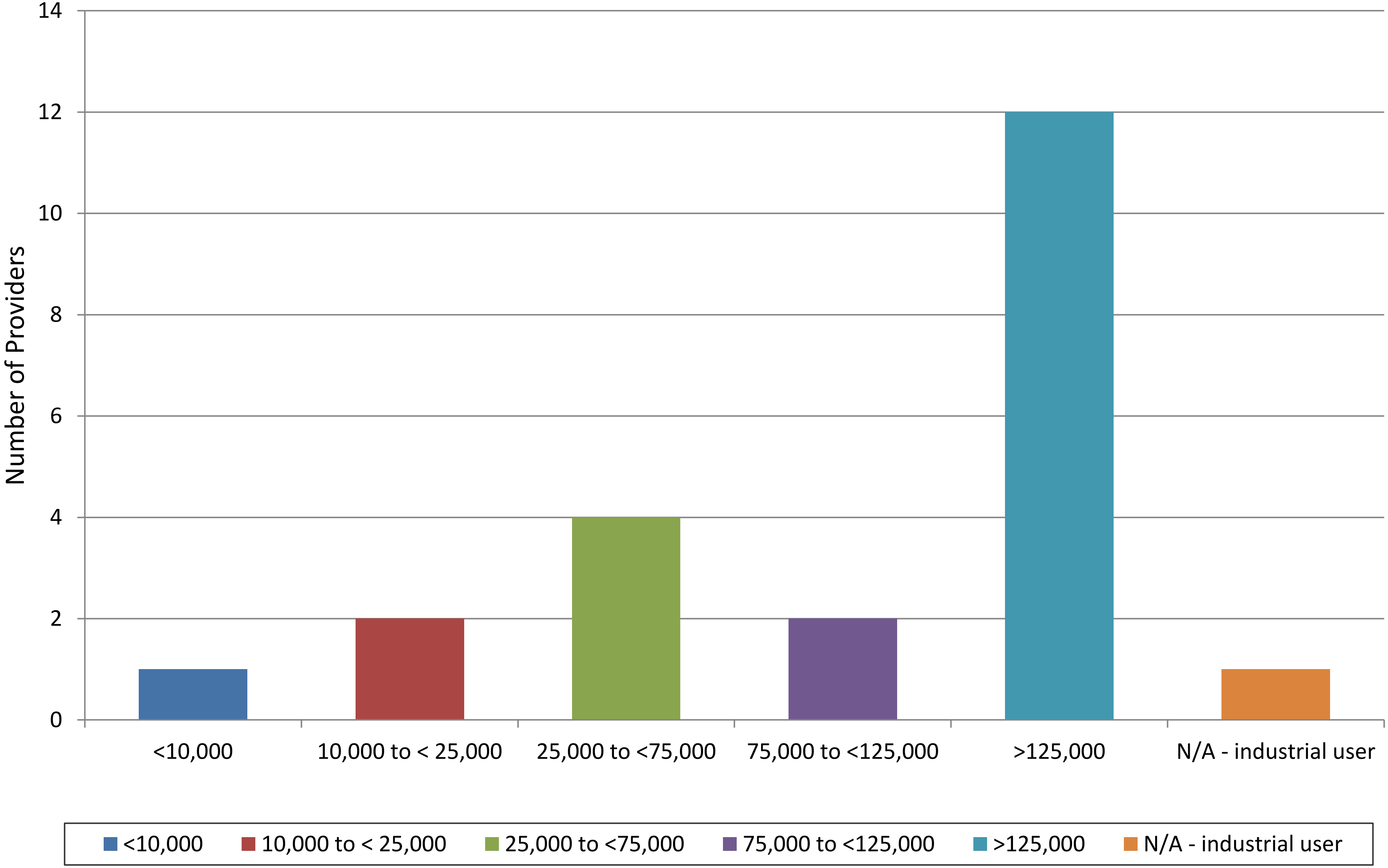
Type of Water Utility/Water Provider

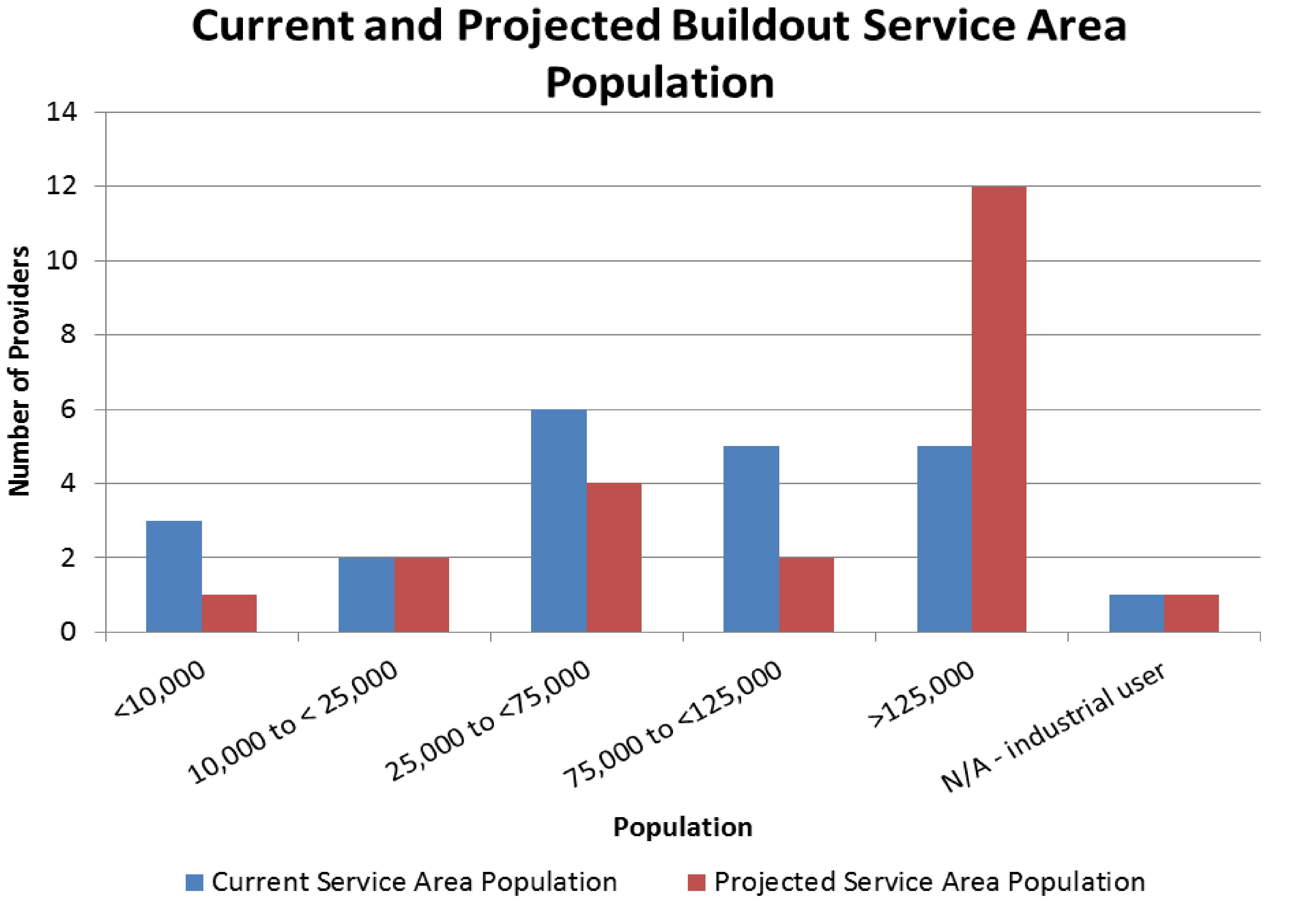


Current service area population. Service area is the total area served by your utility including area that may be outside of your corporate boundaries.

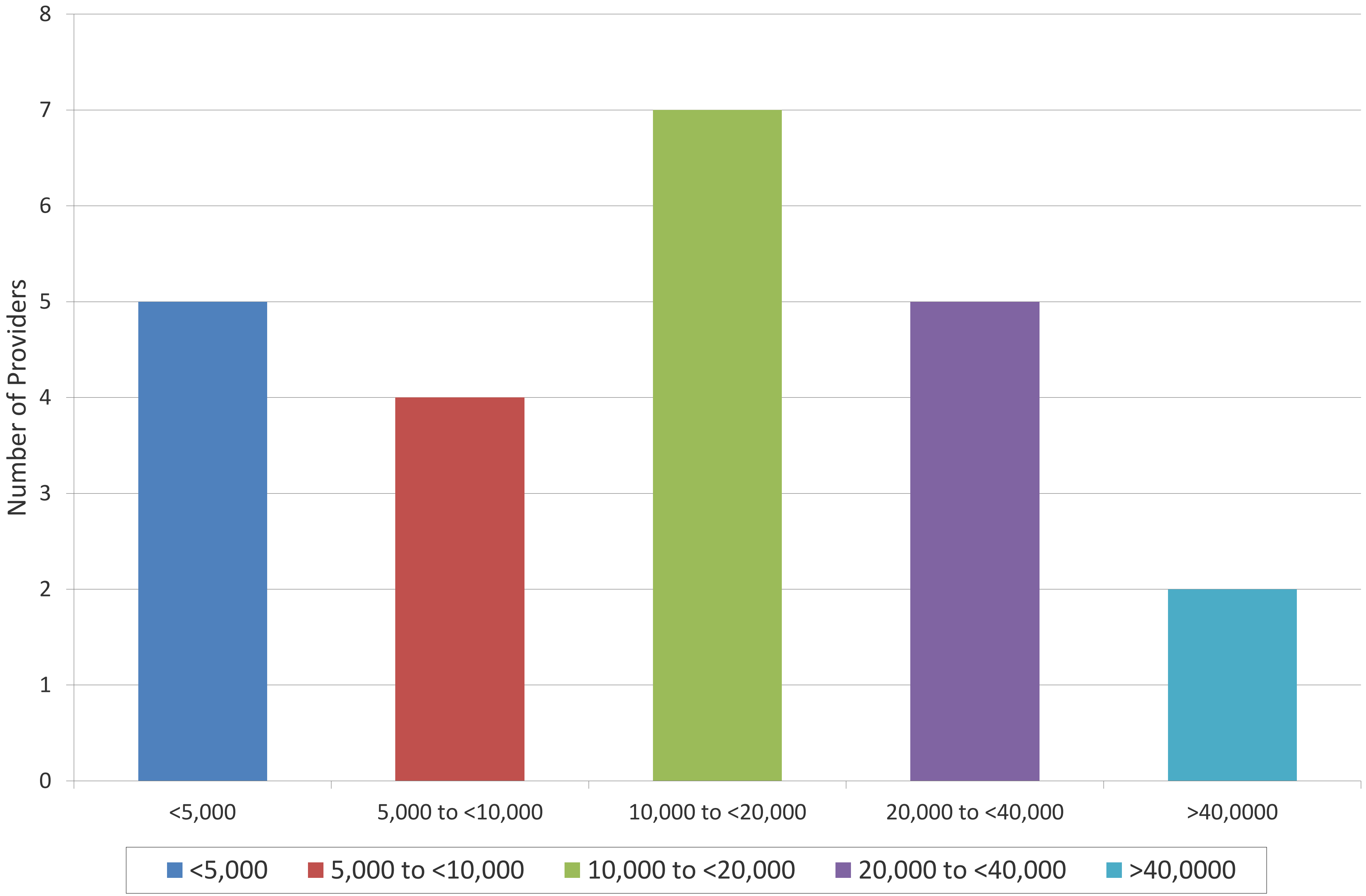


Projected Buildout Service Area Population

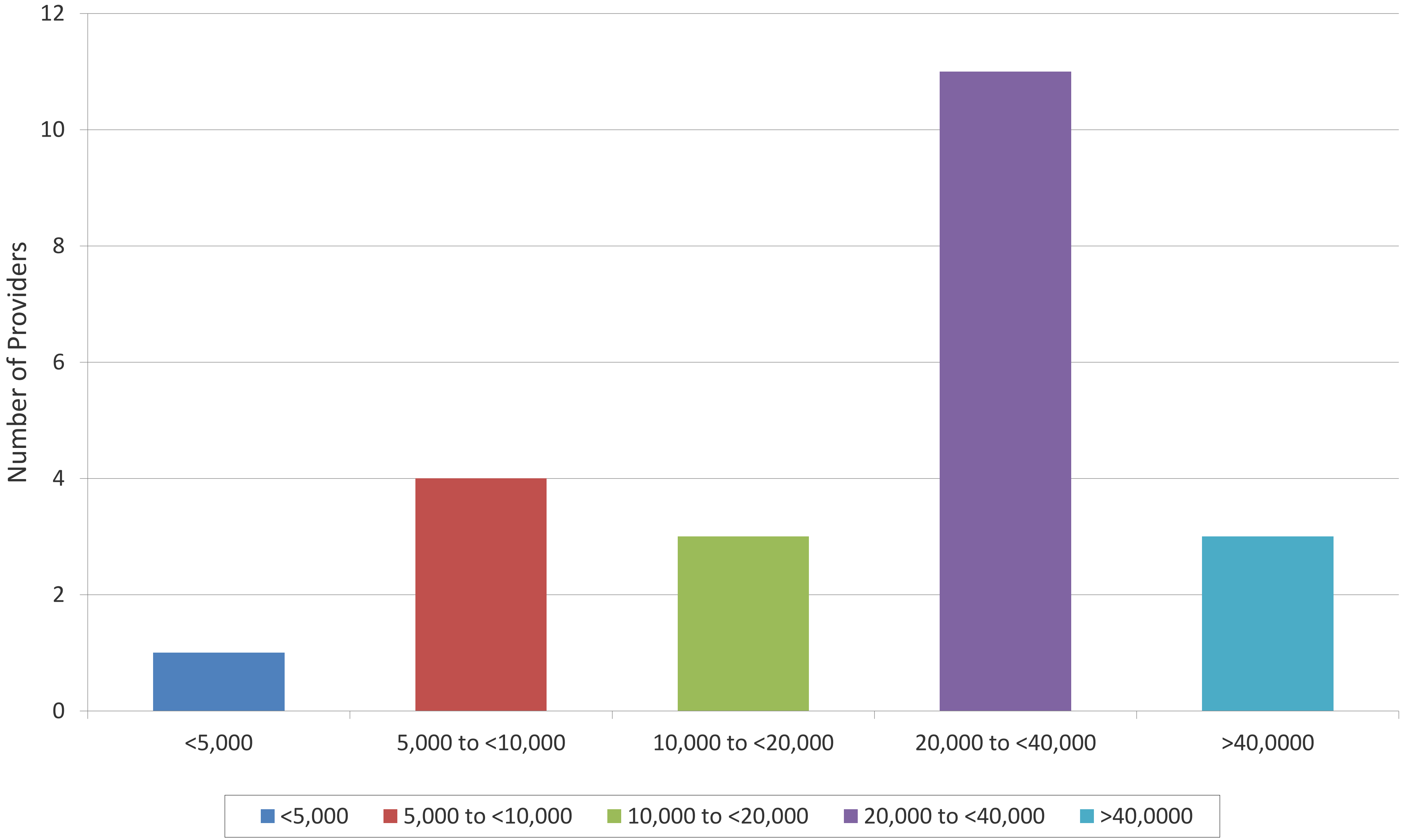



Current and Projected Buildout Service Area Population
Number of Providers
0
2
4
6
8
10
12
14
<10,000
10,000 to < 25,000
25,000 to <75,000
75,000 to <125,000
>125,000
N/A - industrial user
Population
Current Service Area Population
Projected Service Area Population

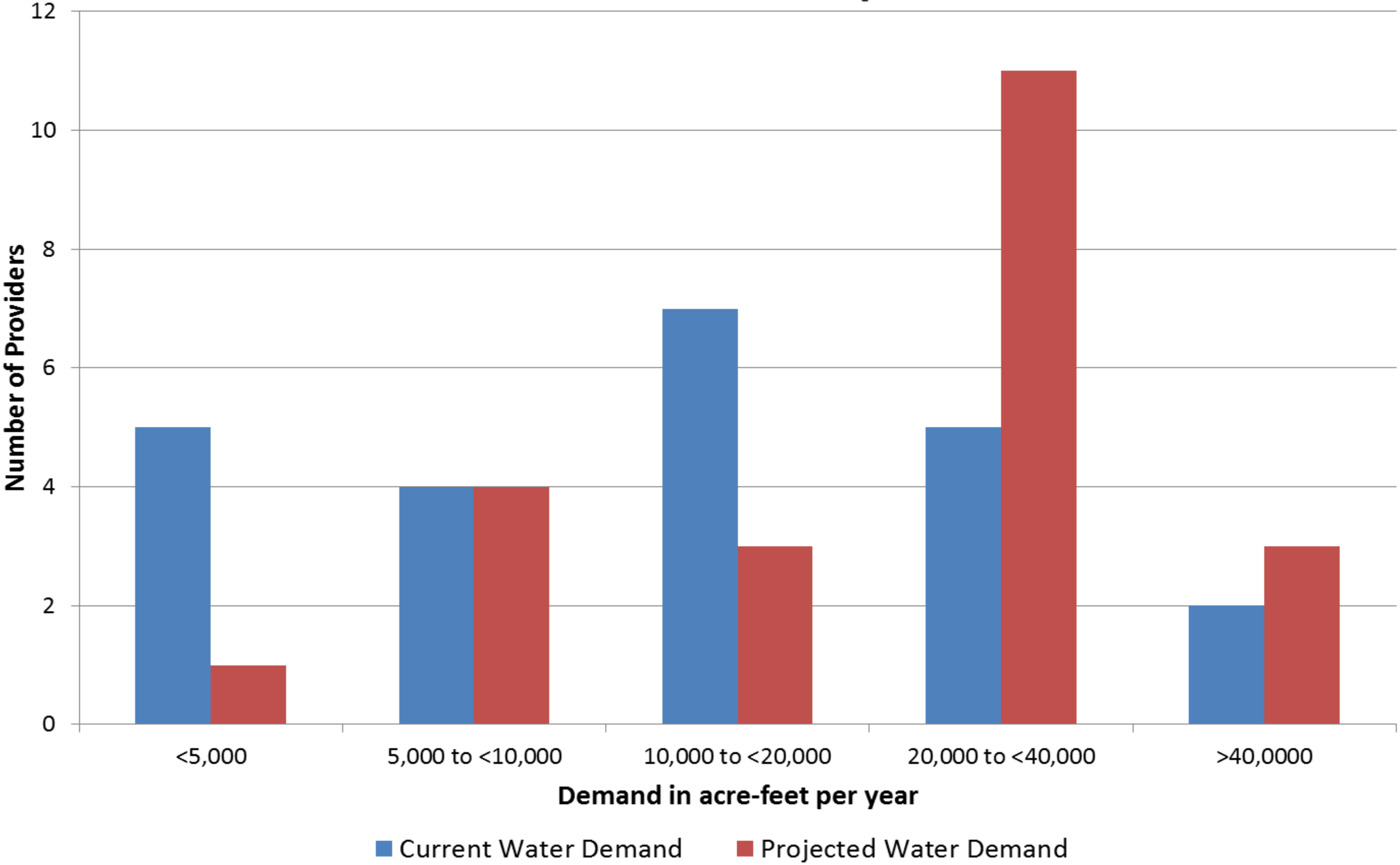
Current Total Raw Water Demand in Acre-Feet per Year



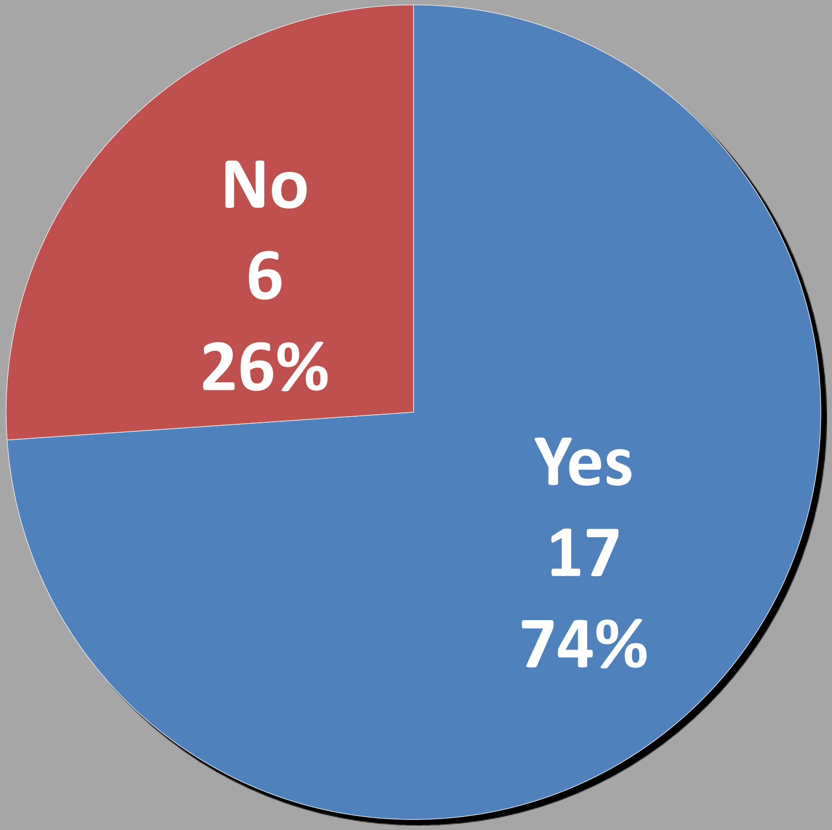
Projected Total Raw Water Demand at Buildout in Acre-Feet per Year



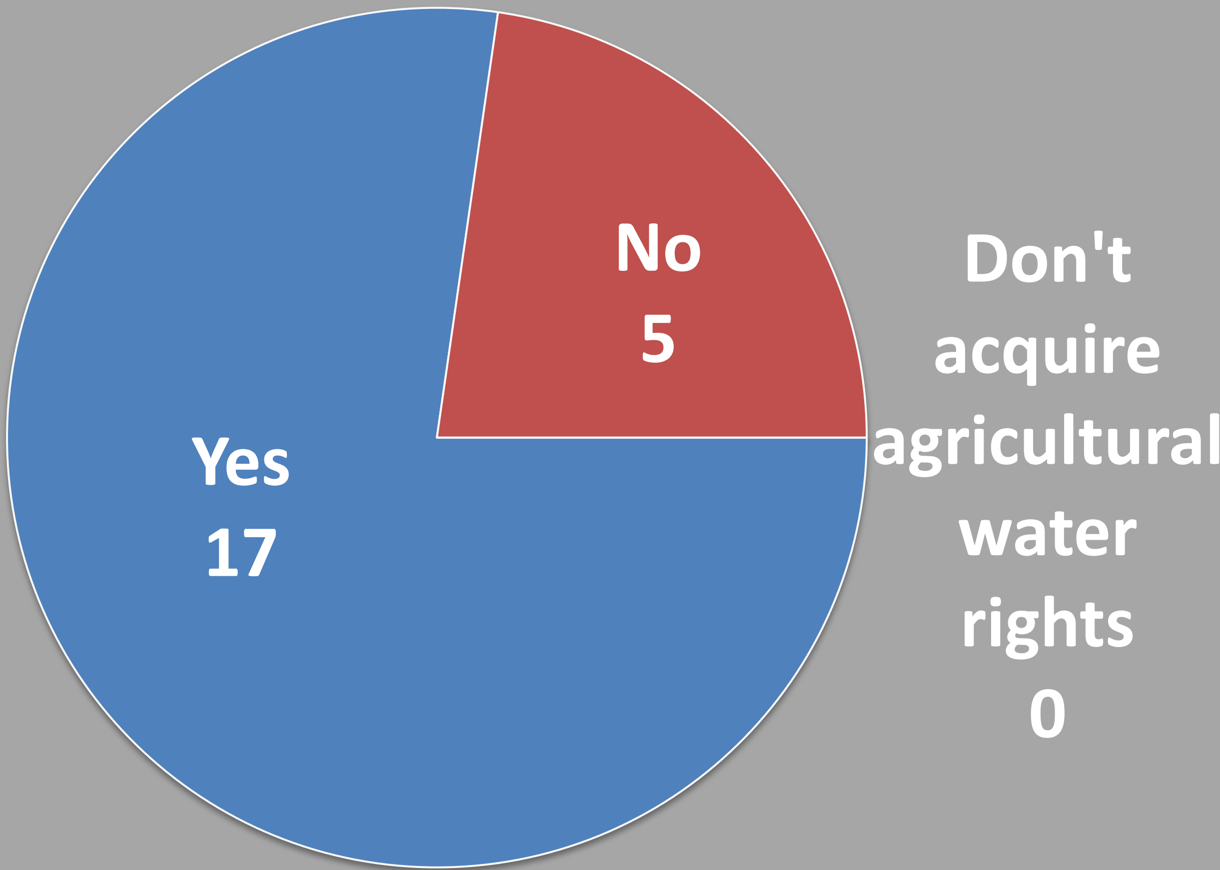
Current and Projected Total Raw Water Demand at Buildout in Acre-Feet per Year



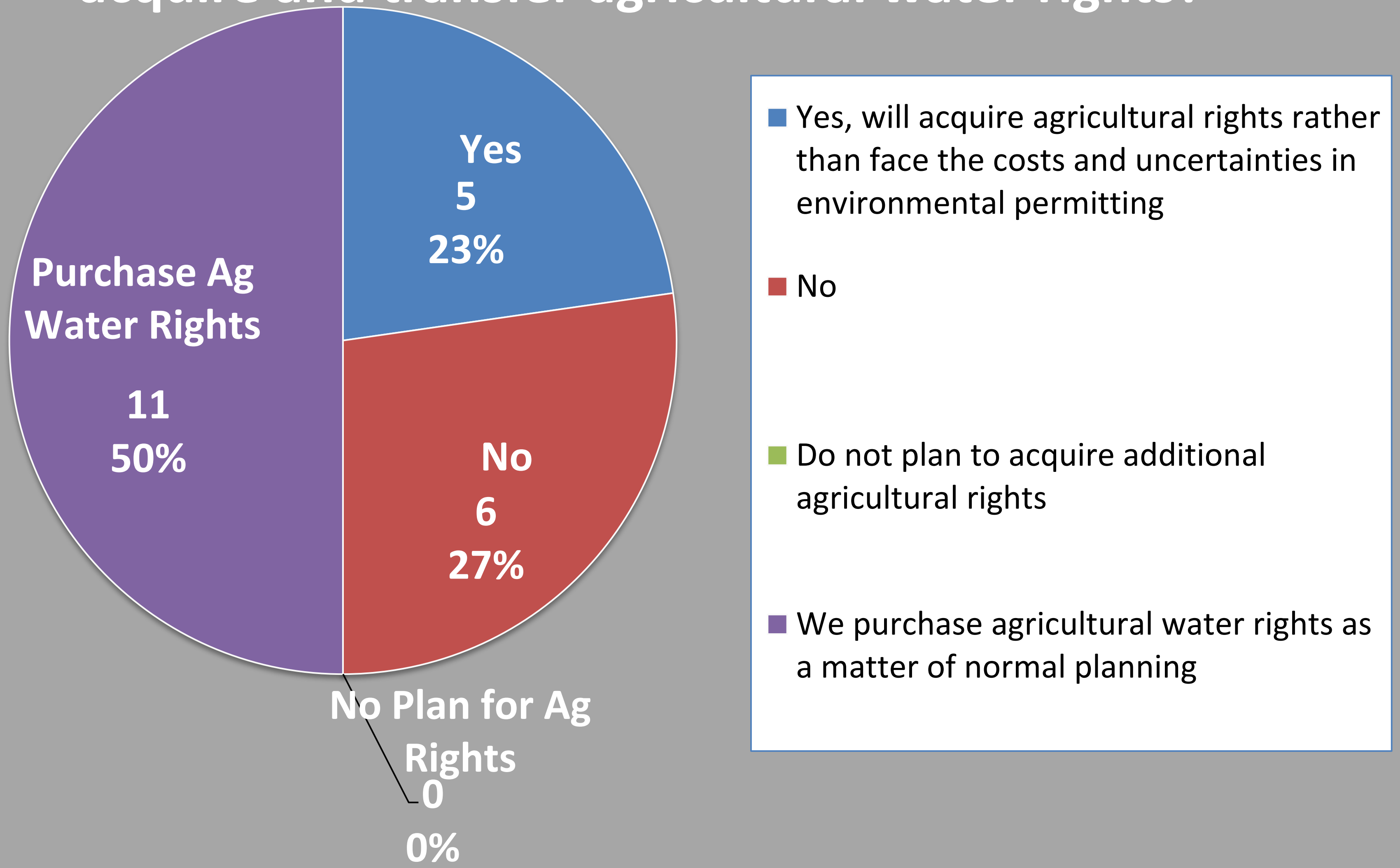
Are additional agricultural water rights transfers a part of your current plans to meet future demands?



Do you typically require dry-up covenants when acquiring agricultural water rights?

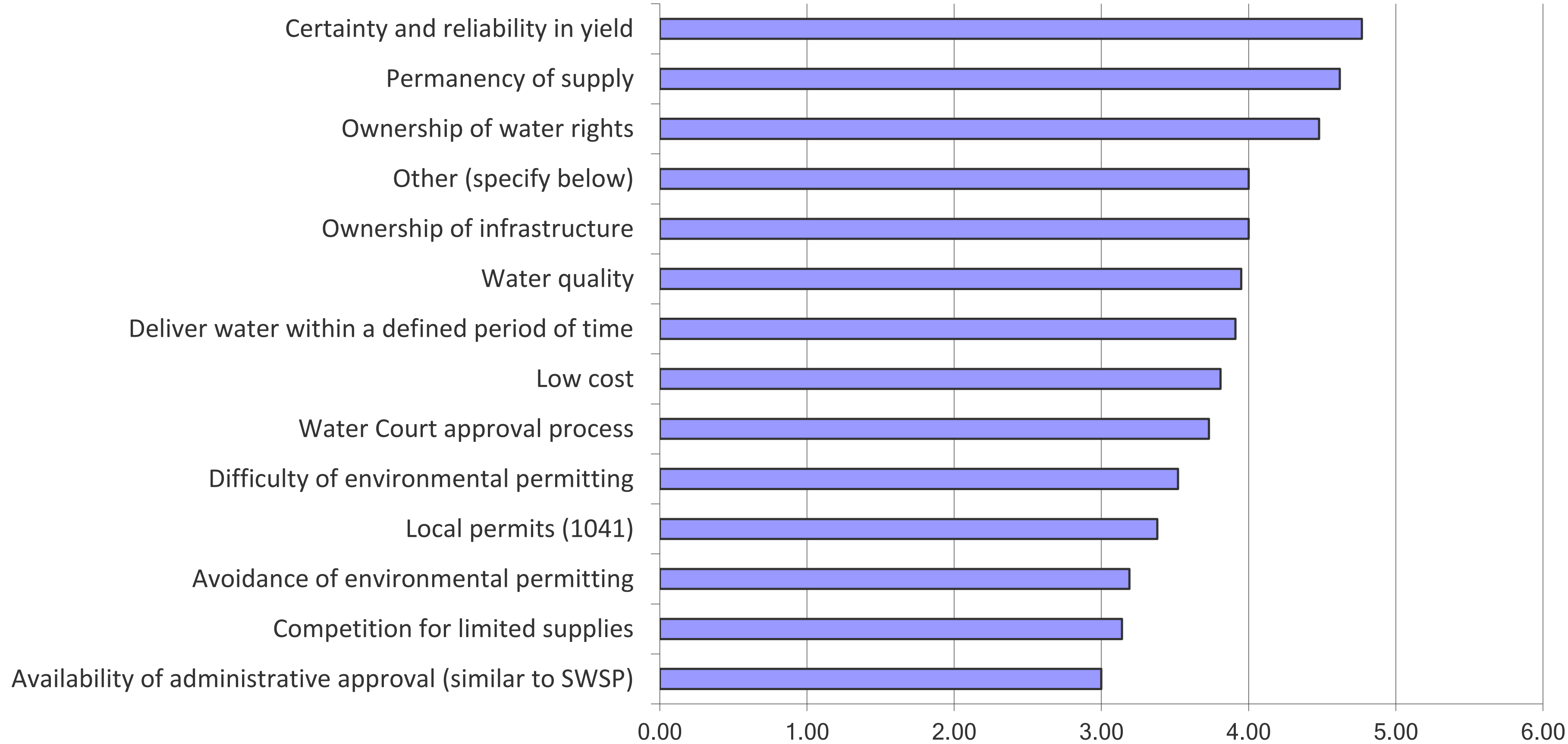


Do the challenges and uncertainty in permitting a future water supply project affect your decision to acquire and transfer agricultural water rights?



Factors Considered When Evaluating Water Supply Development

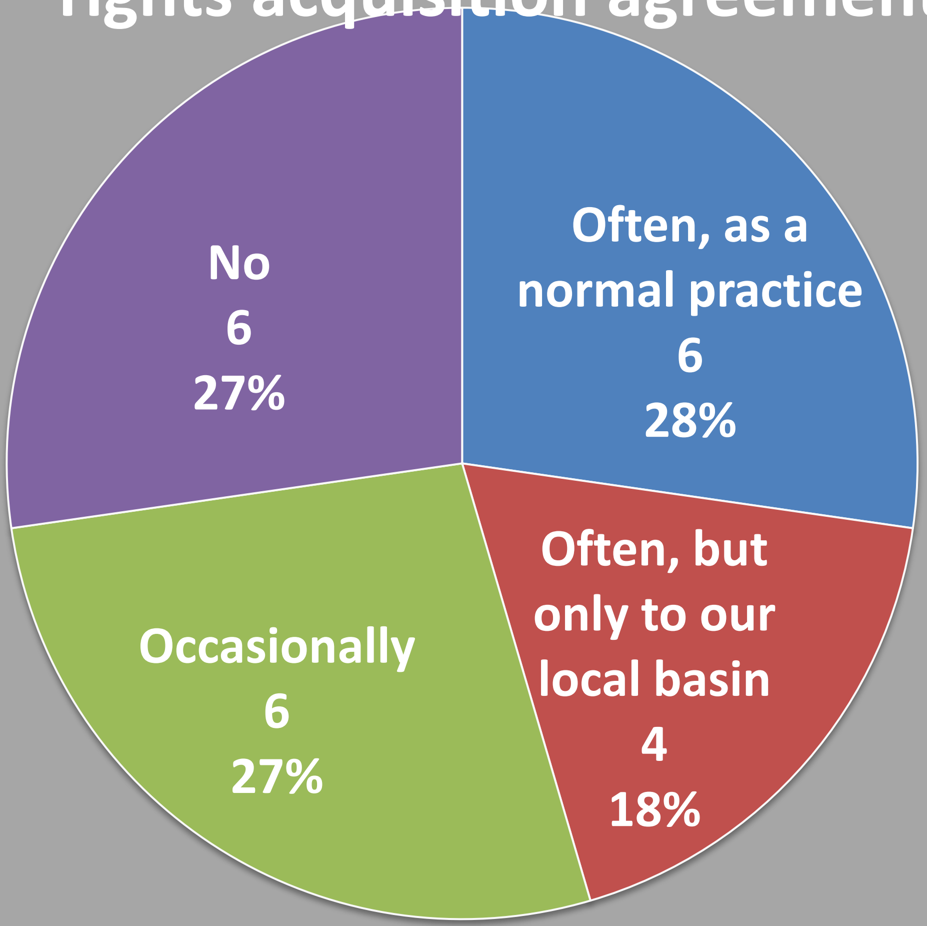
The following are factors that you may consider when evaluating water supply development and acquisitions.



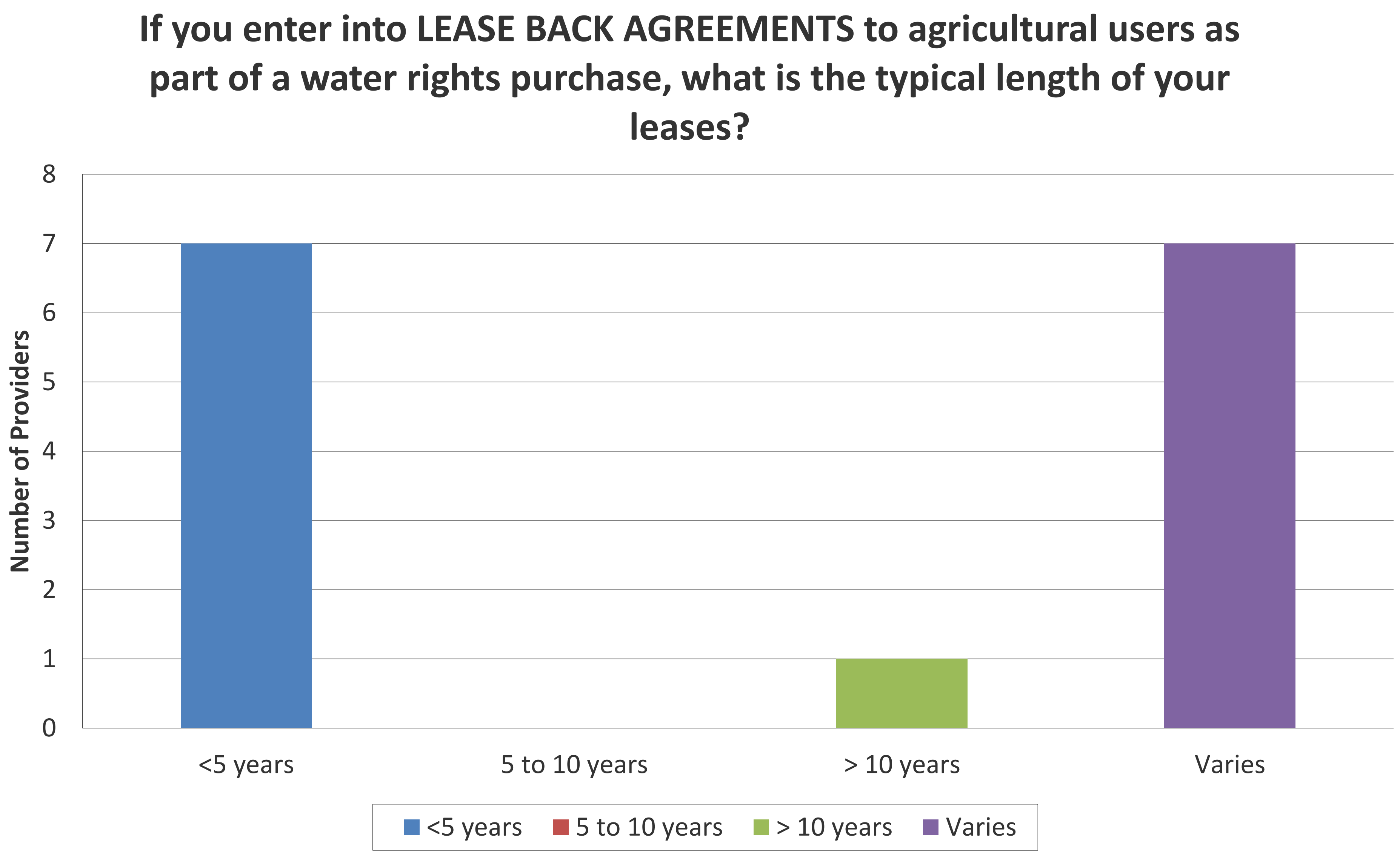
Comments on Factors Considered When Evaluating Water Supply Development

- Expansion of use issues are important
- Feasibility of Constructing Infrastructure
- Cost of Infrastructure Location of water rights and effects on surrounding areas

Do you LEASE BACK agricultural water rights that are purchased by your utility to the original seller for a period of years as part of the water rights acquisition agreement?



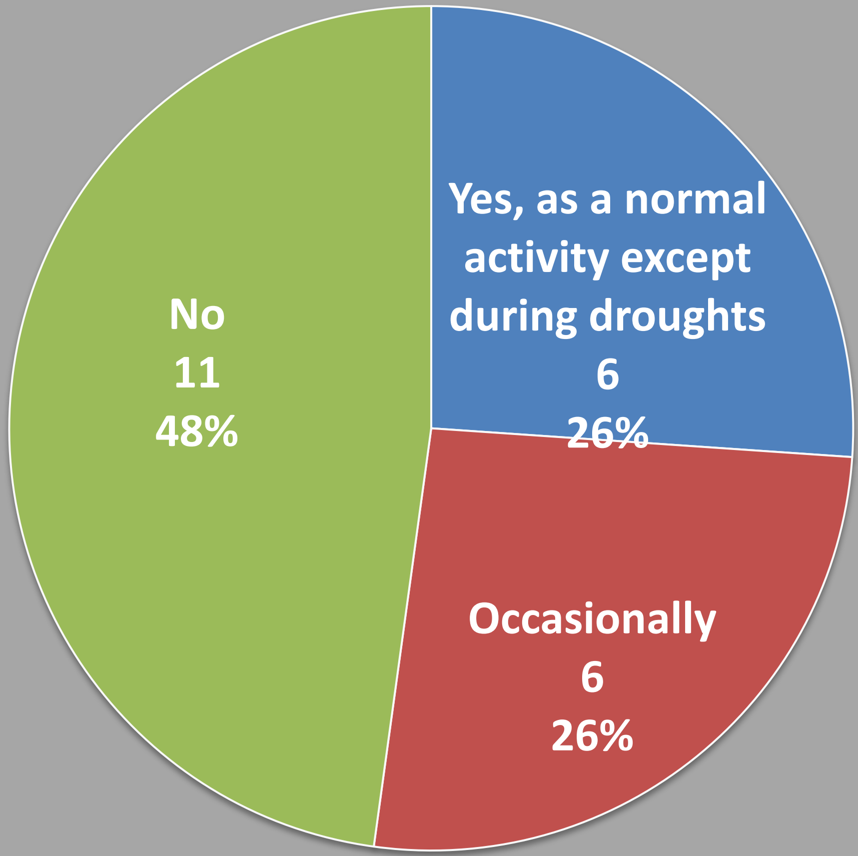
Typical Length of Lease Back Agreements



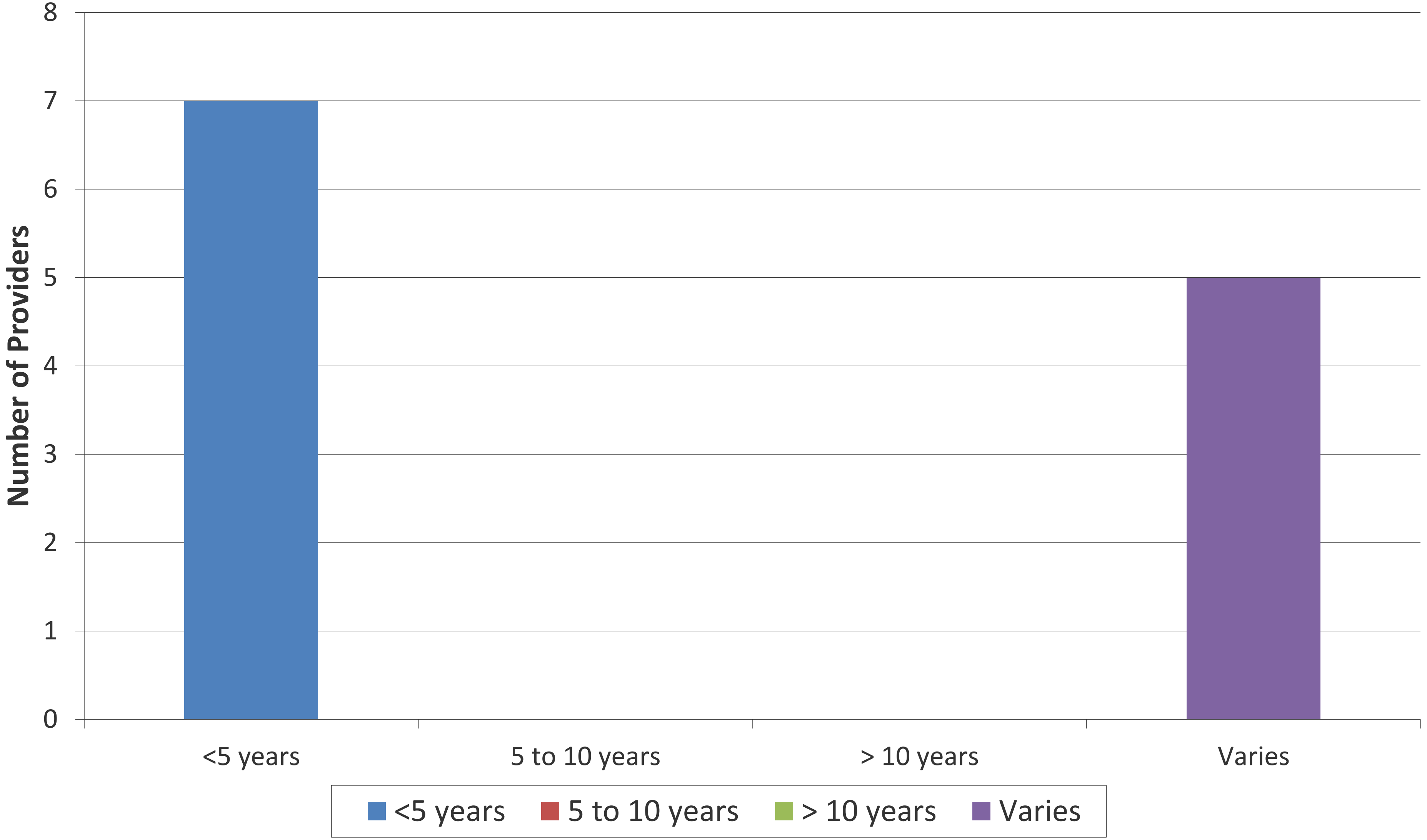
Comments on Lease Backs

- XXX has not purchased native basin rights in many decades. It requires raw water as a condition of development from developers. If a developer has acceptable native rights, those may be, and often are, used to meet portions of the requirement, but those rights usually come from the land that is developing.
- XXX is currently leasing its agricultural water rights on its farms to local farmers to keep the farms in production. That practice will continue until XXX decides to use these water rights for other uses… it varies and usually would include renewal clauses to the extent that the supply is still surplus.
- As needed, interruptible supply
- Lease back allowed for dedicated water rights until development occurs.
- Leases are year to year.

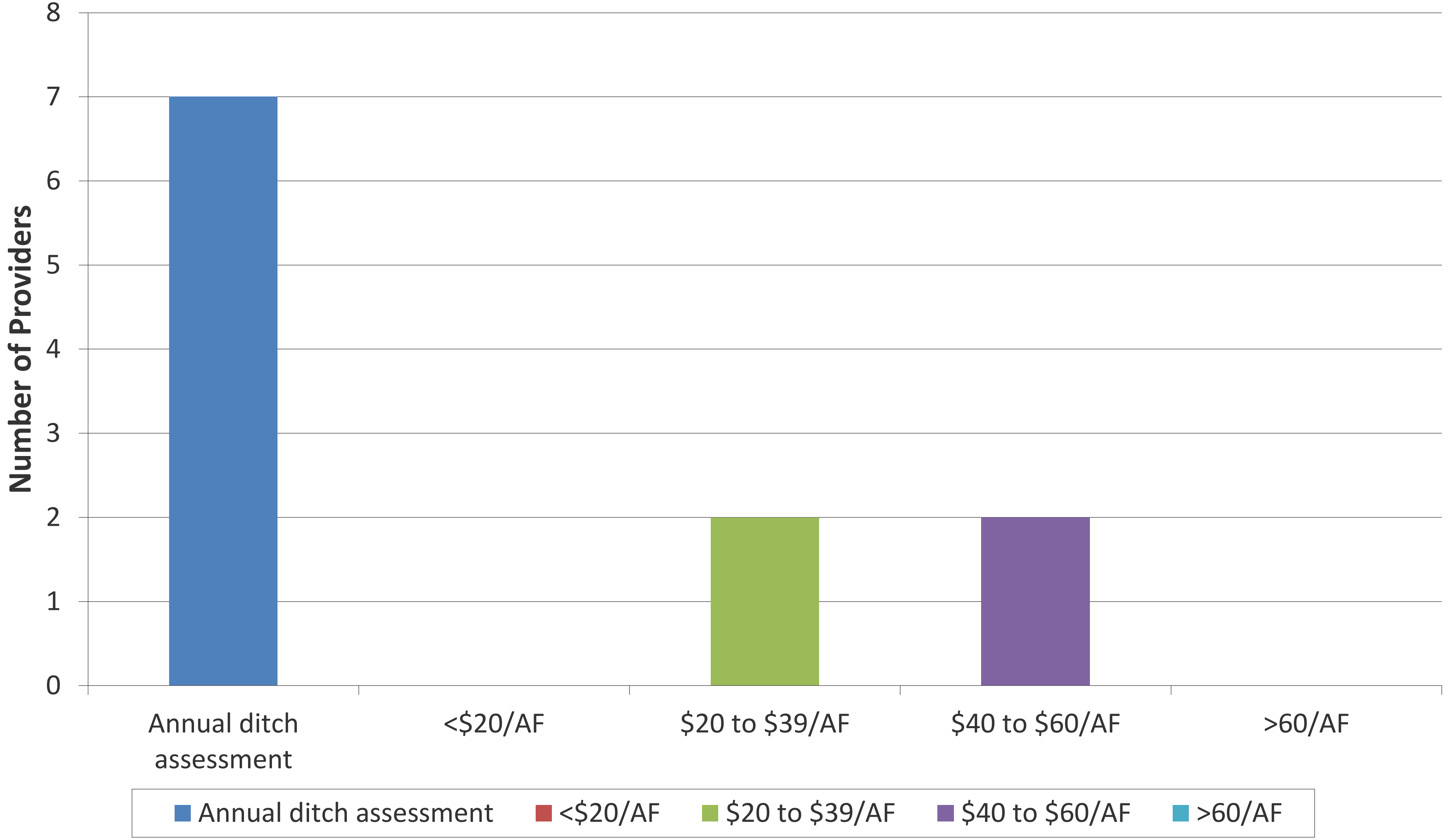
Do you enter into SURPLUS LEASES for water supplies that have been determined to be surplus until development reaches a certain level, allowing the utility to enter into multi-year contracts to lease these surplus supplies to agricultural users?



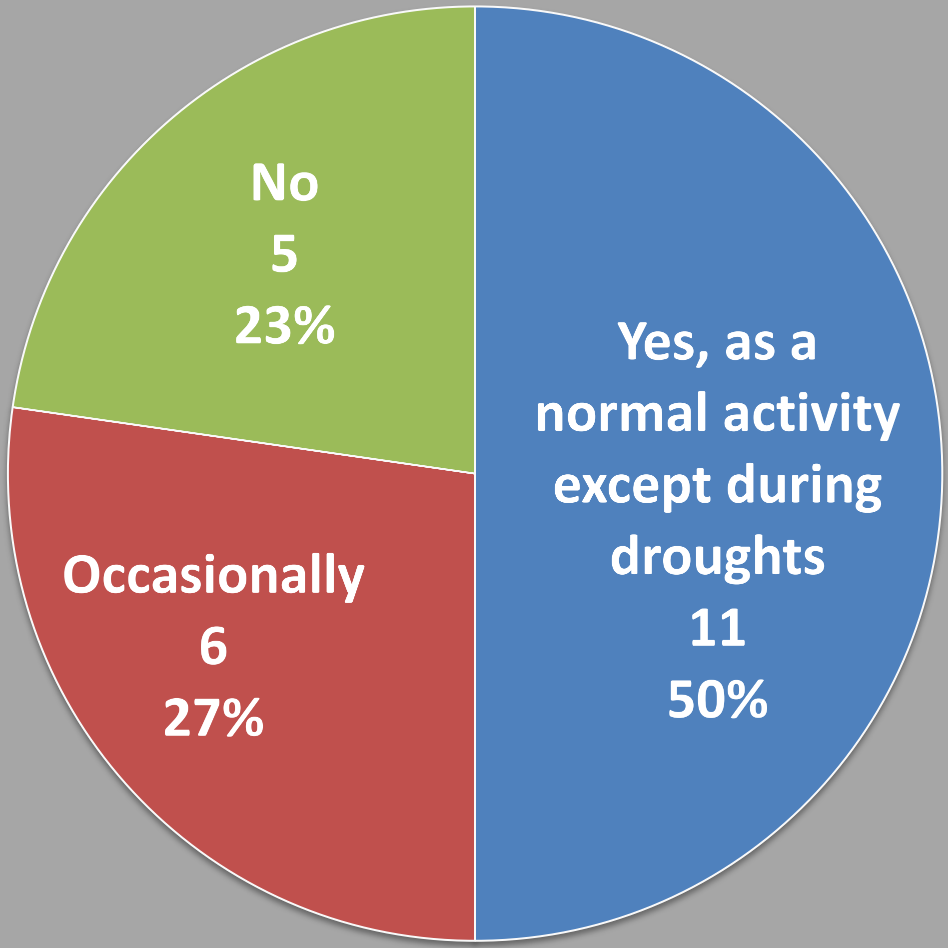
If you enter into SURPLUS LEASES to agricultural users, what is the typical length of your leases?



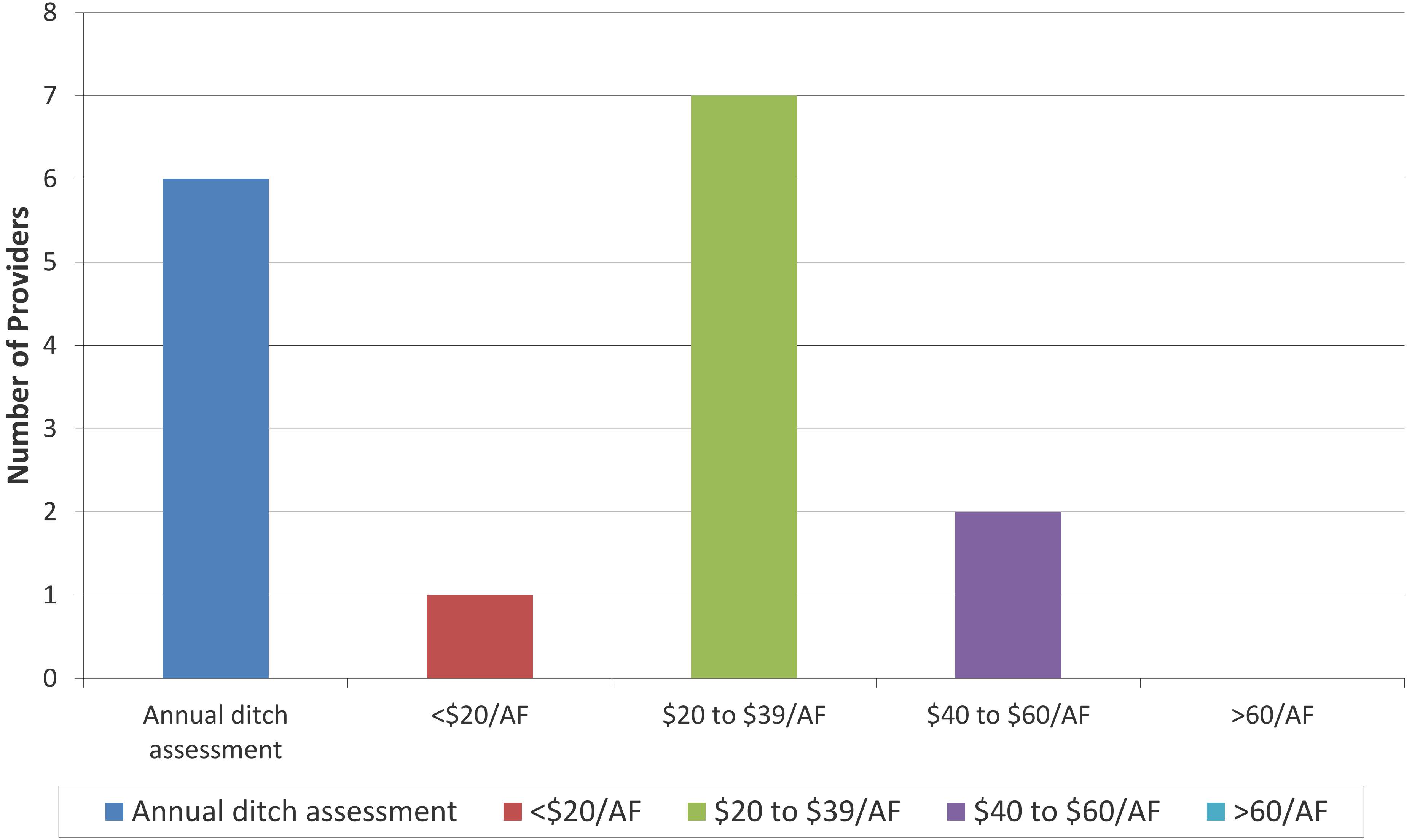
If you enter into SURPLUS LEASES to agricultural users, what is the typical per AF lease charge?



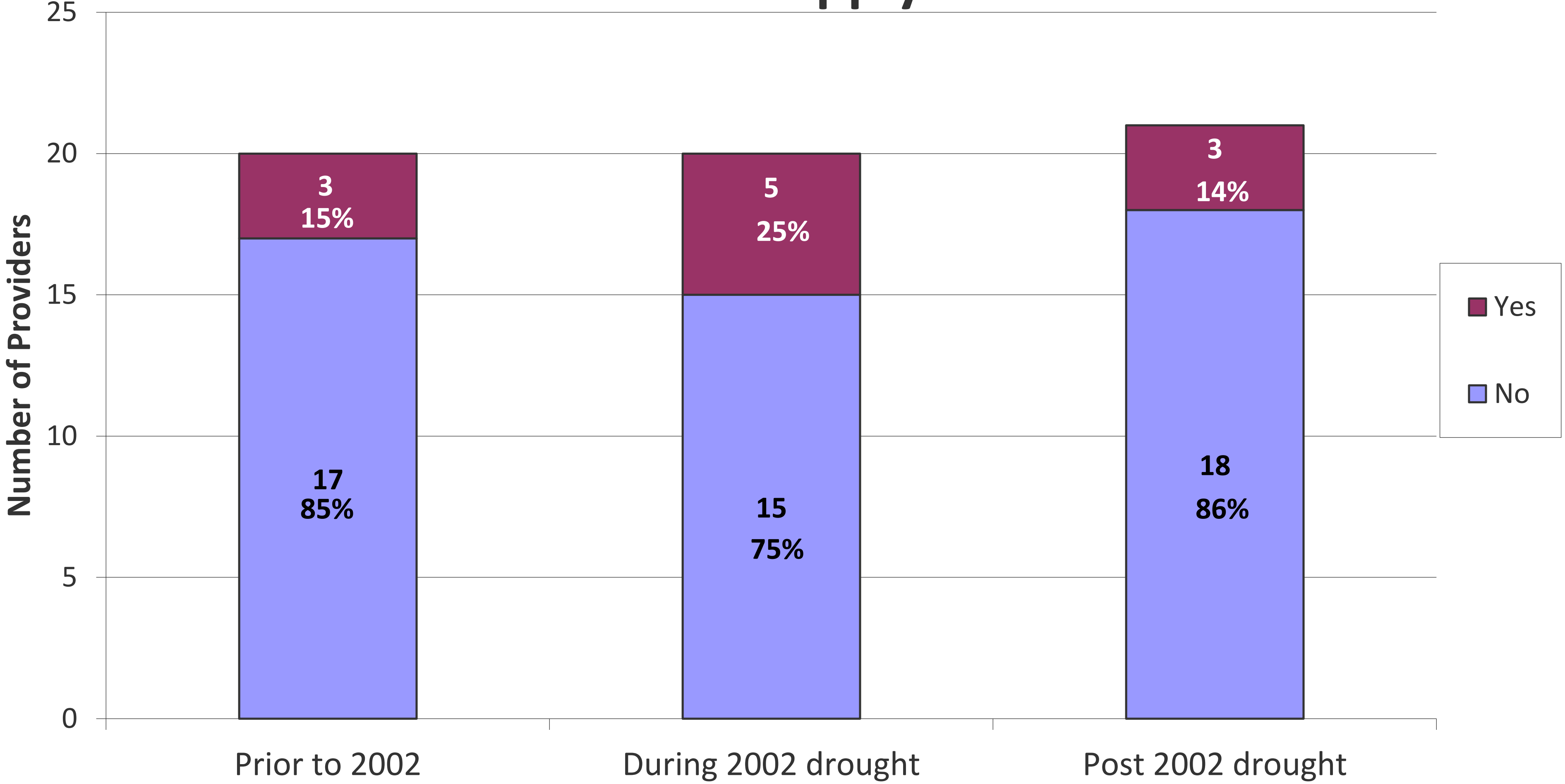
Do you enter into ANNUAL RENTALS OF SURPLUS SUPPLIES for Rentals of C-BT or native water that is not needed in that one year and rented on a first come first served basis?



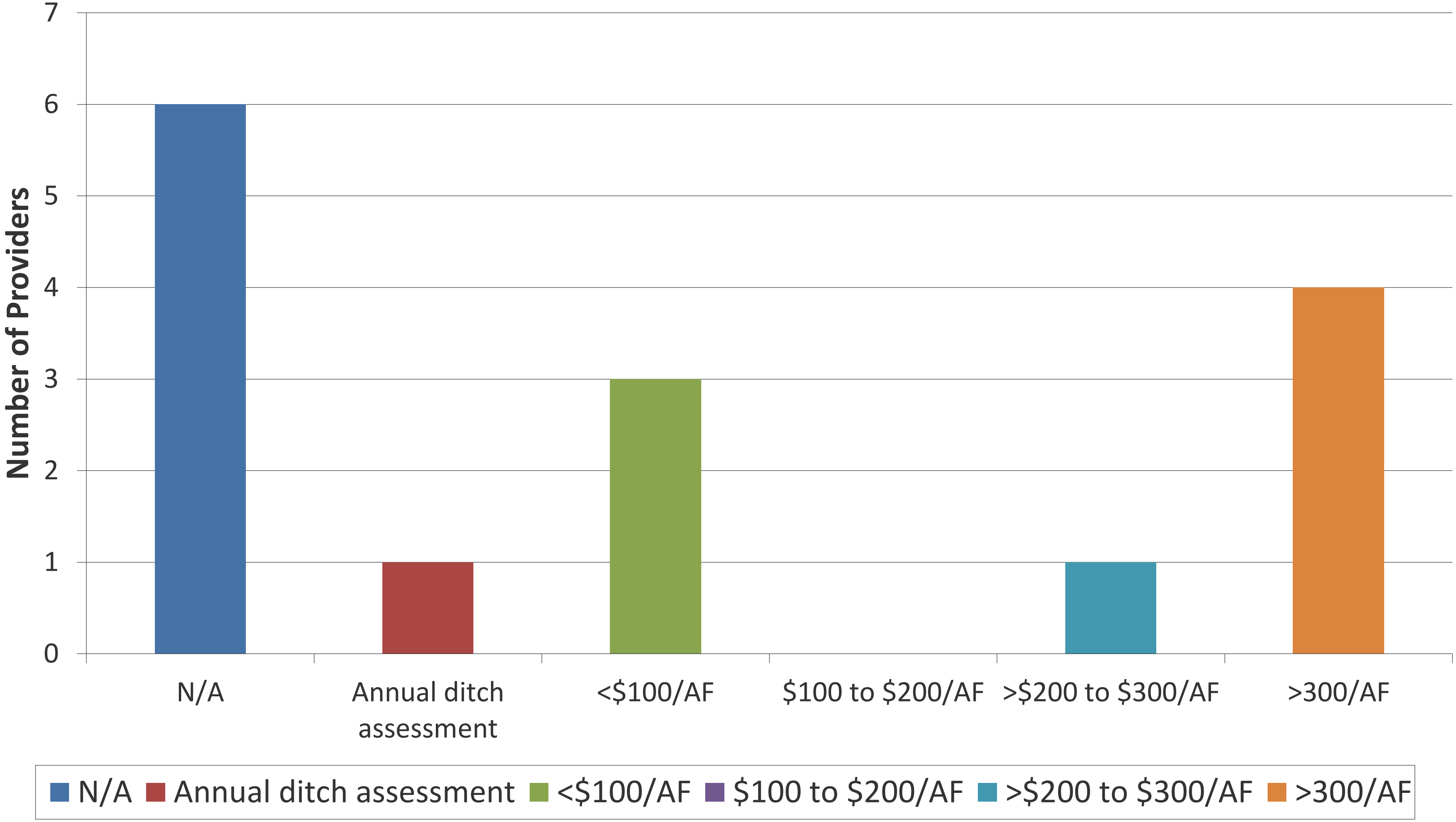
If you enter into ANNUAL RENTALS to agricultural users, what is the typical per AF lease charge?



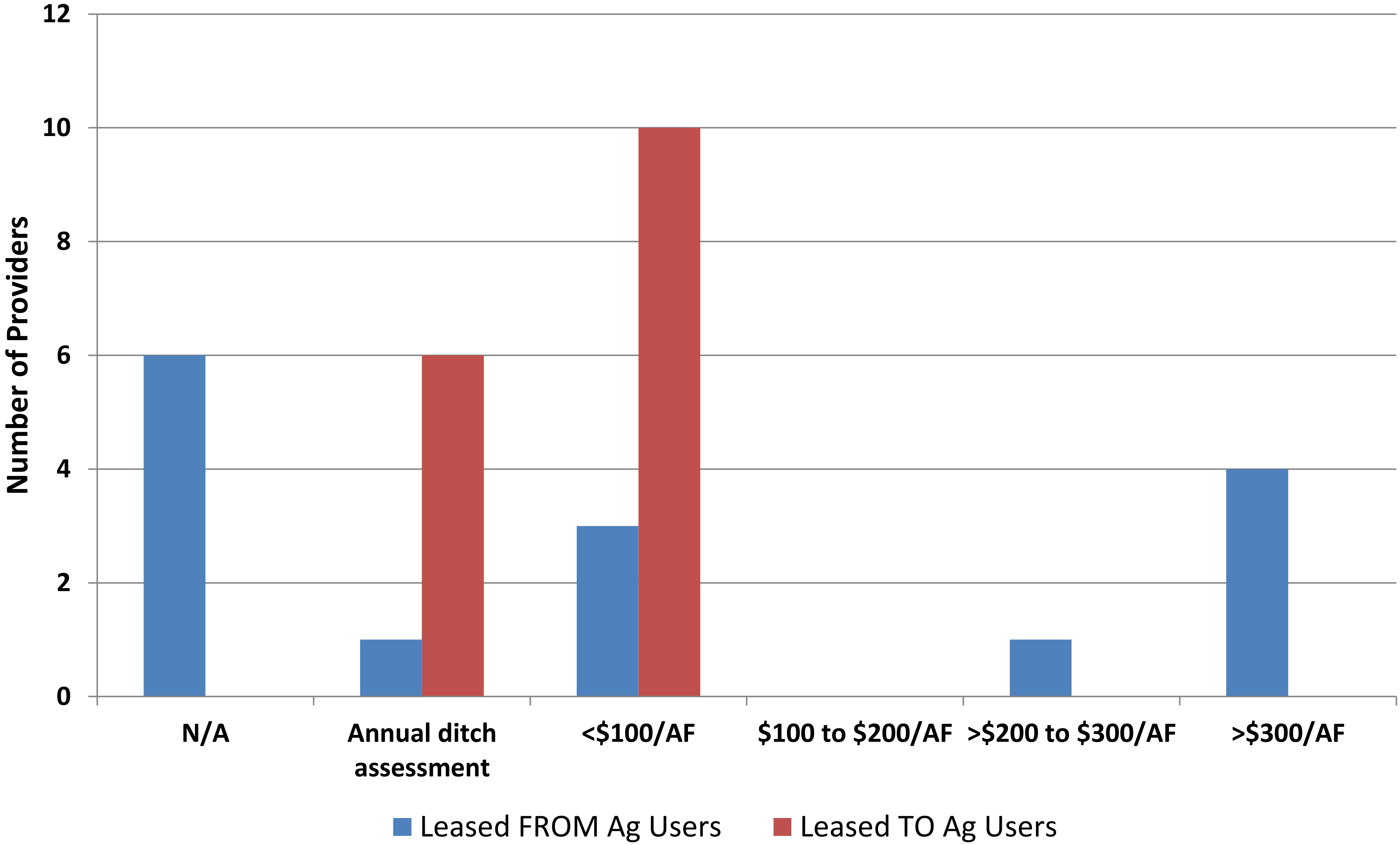
Have you ever leased agricultural water supplies FROM agricultural users to supplement your supply?



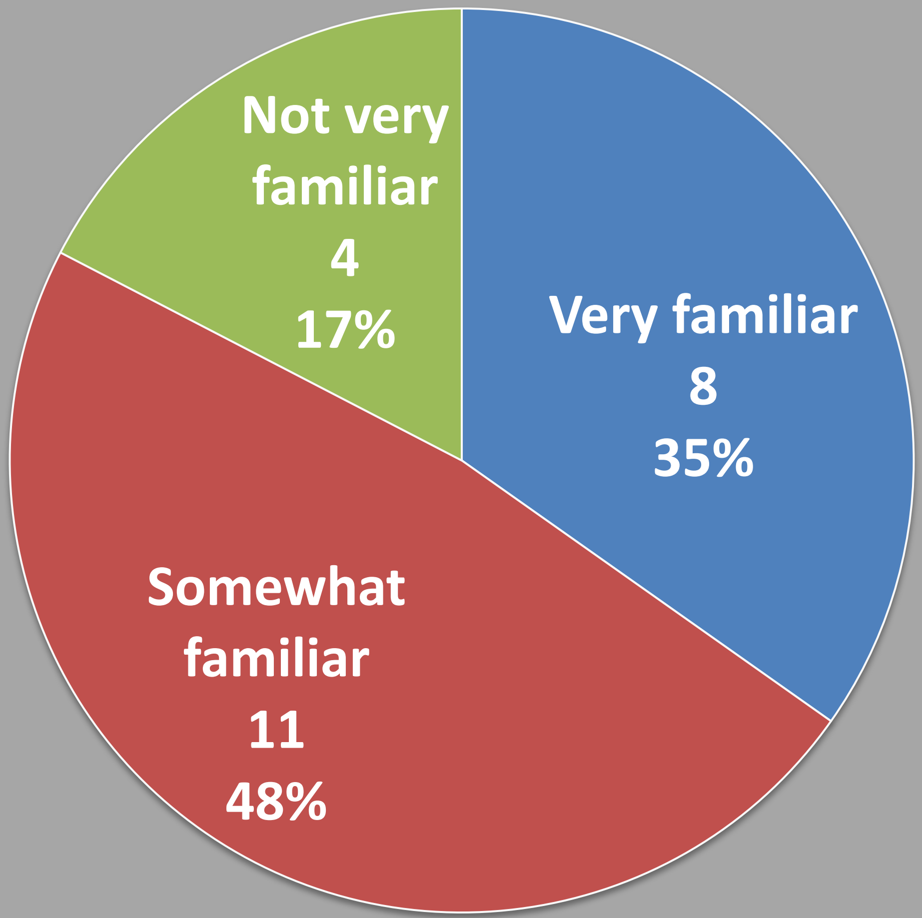
If you have leased agricultural water supplies FROM agricultural users, what was the typical per AF lease charge?



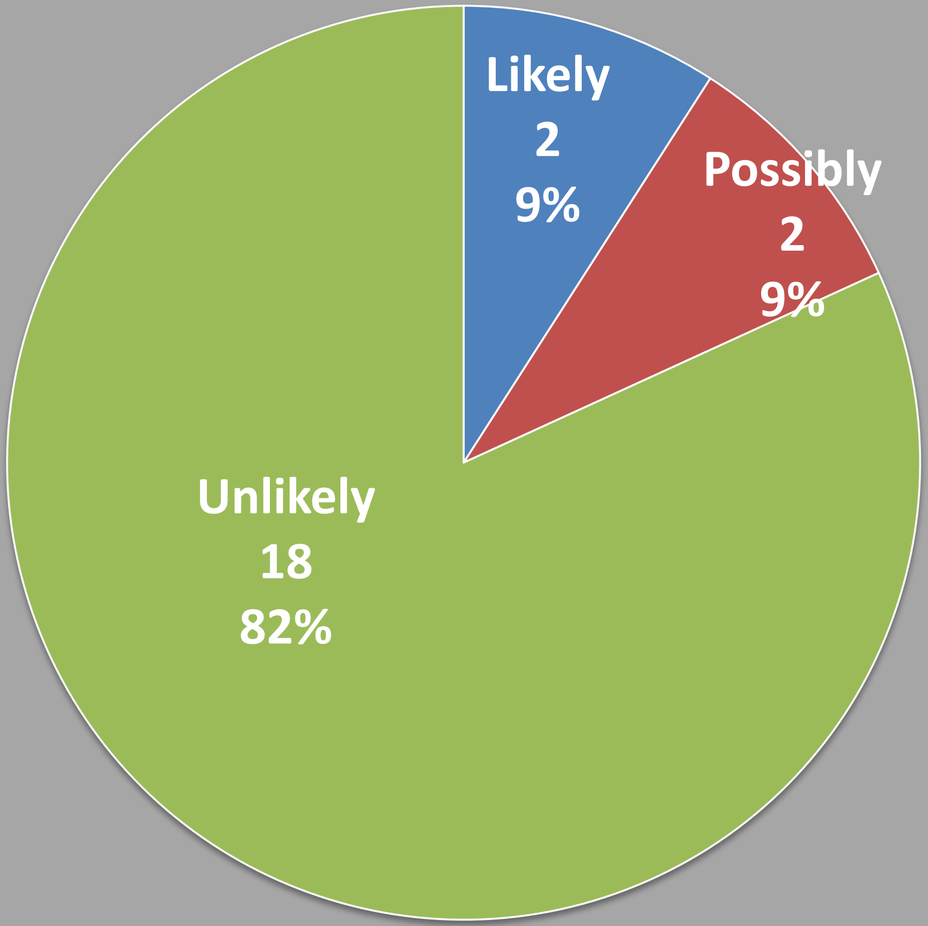
Typical per AF charge for leased agricultural water supplies



How familiar are you with the concept of "Extended Period Water Leases" as described above?

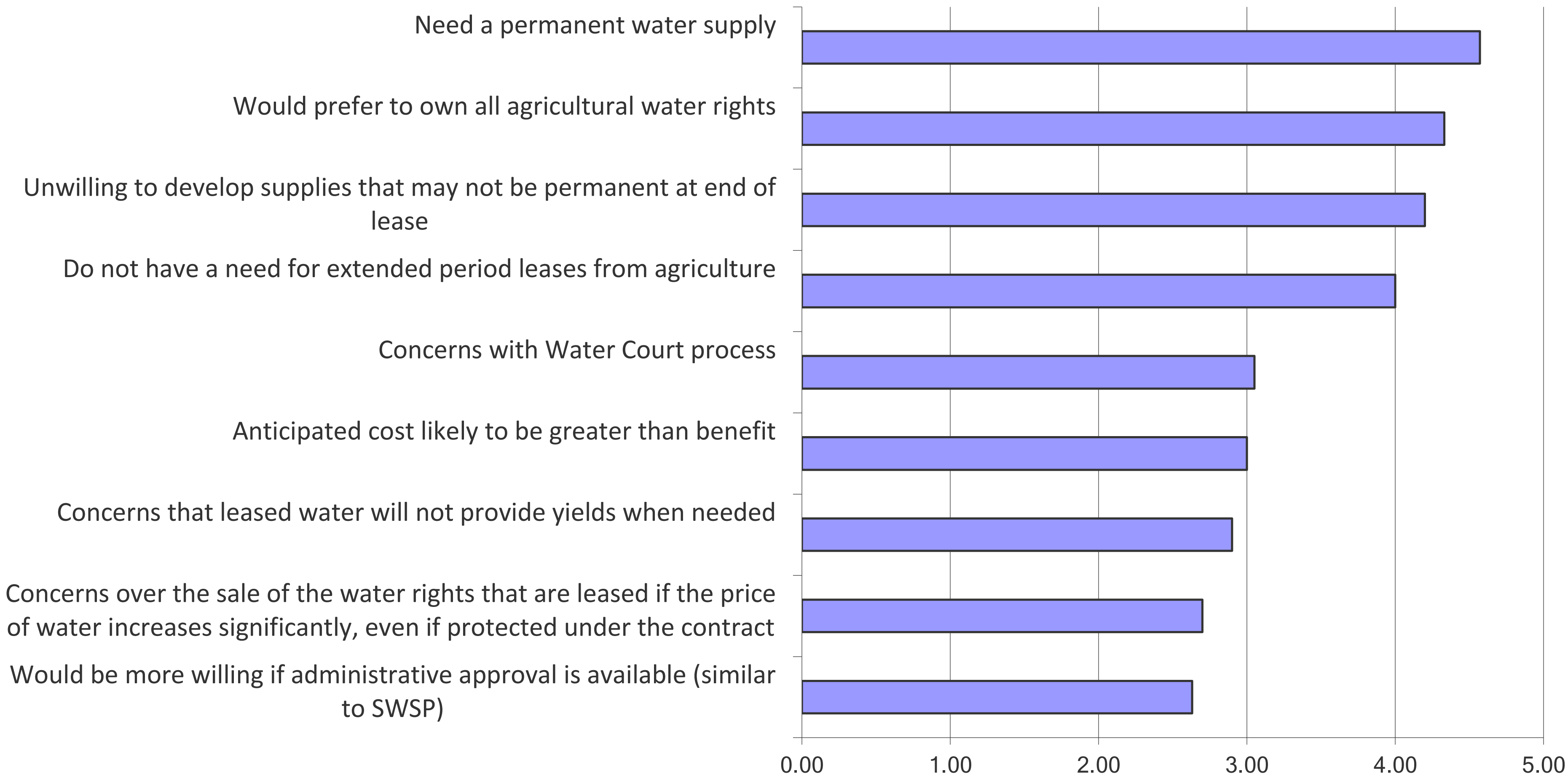


How likely is it that extended period water leases will be a part of your utility's future water supply portfolio?



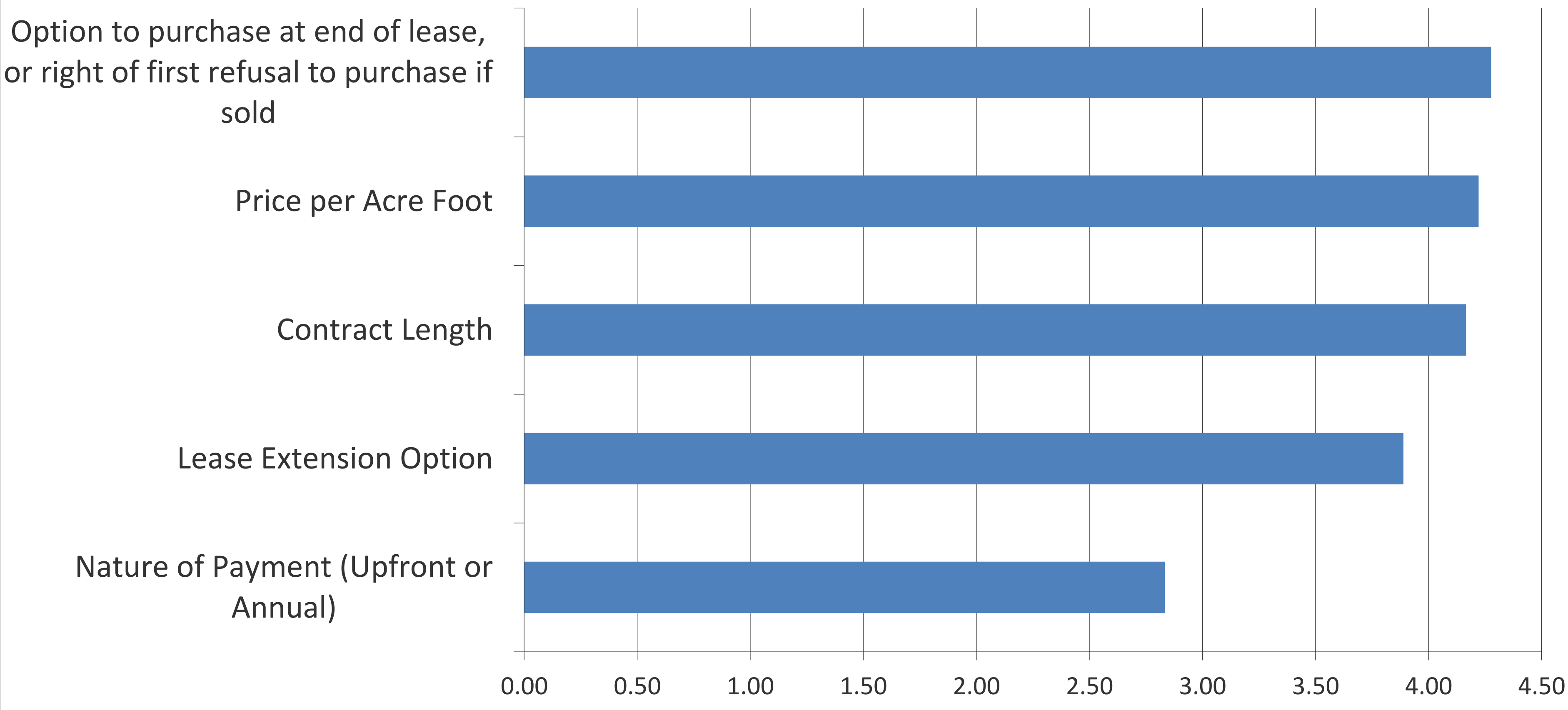
Ranking of Factors Preventing Signing an Extended Period Lease

If you answered 'possibly' or unlikely' please rank the following from least to most likely in terms of factors you currently see as preventing you from signing an extended period lease.



Factors Considered for Entering into Extended Period Lease

The following are factors that you may consider when evaluating deciding whether or not to enter into an extended period lease.



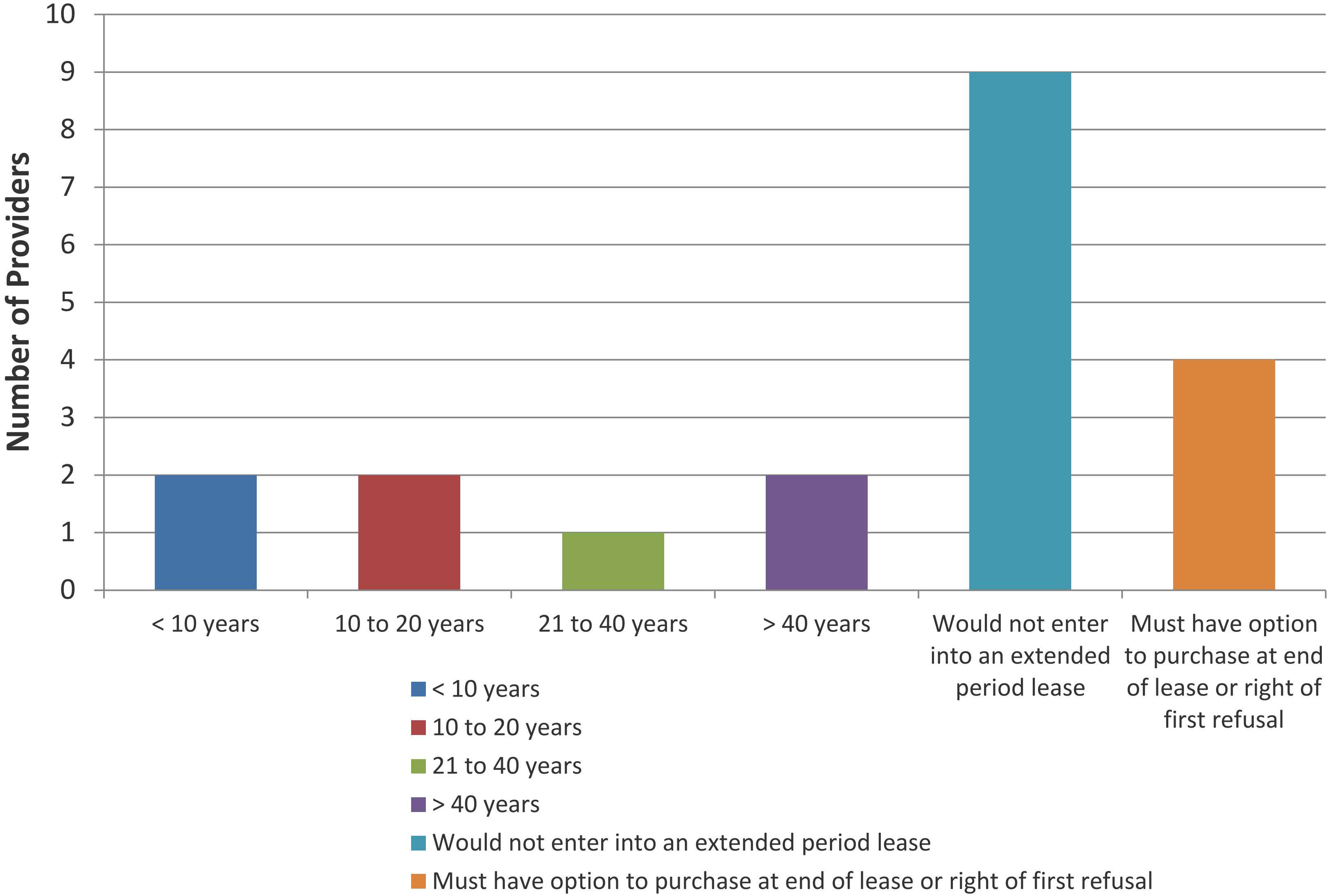
Comments on Extended Period Leases

- This process has not been extensively considered for our purposes because of the concerns pointed out earlier. Not sure what the position on this set of factors would be.
- XXX has no intention of entering into leases of agricultural water, so these factors are not relevant.
- Permanent supply is very important
- Extended period water leases are not needed, but the above responses reflect our opinion of what is important.
- Need long-term certainty

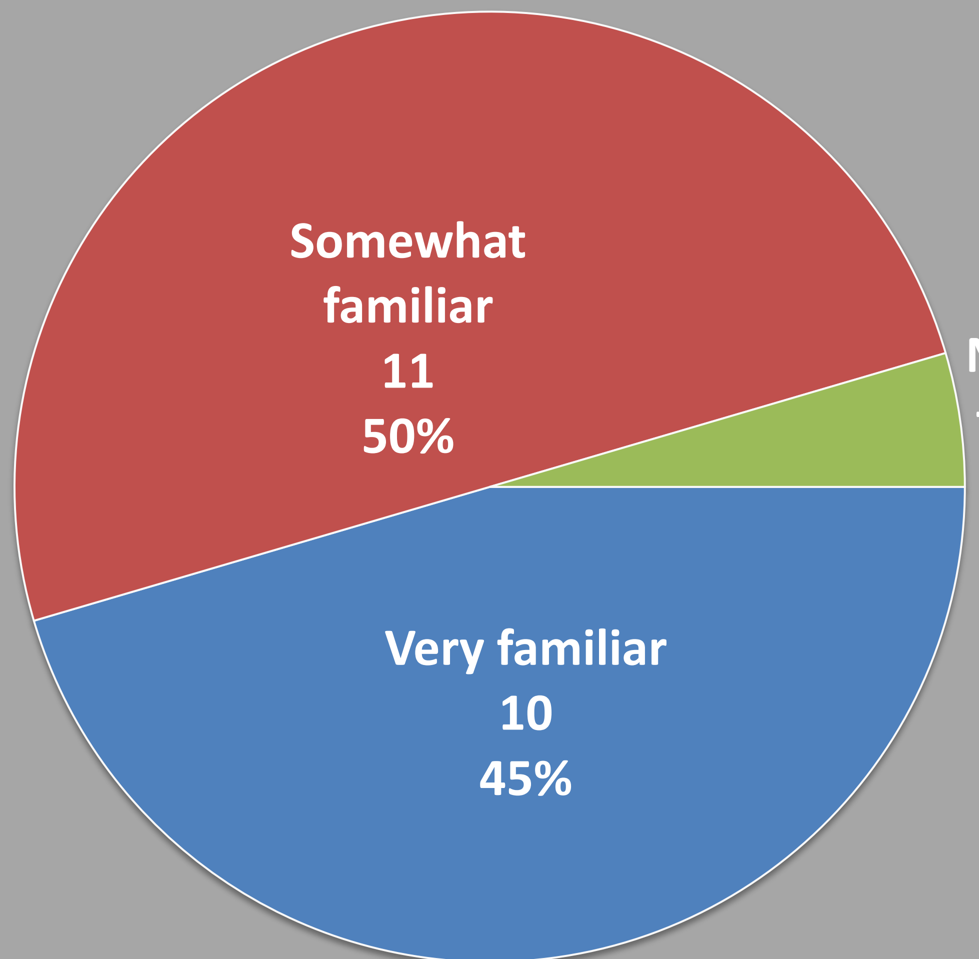
Comments on Extended Period Leases

- Ability to lease back to agriculture after purchase at end of lease - very important
- Because of huge cost of developing the facilities necessary to transport and treat the water (plus storage for delayed return flows), the need to have a permanent supply for taps and the expected completion for sources in the future, we would only be interested in permanent arrangements. We would not necessarily have to have ownership of the water rights but we would need certainty on the volume and price of water for the same reasons stated above. We would probably only need the ag water in drought periods. We would seek a partnership arrangement that made ag use sustainable and provided permanent drought supply for the city. Dry up would not be necessary but new legislation for water courts to approve creative arrangements might be needed.

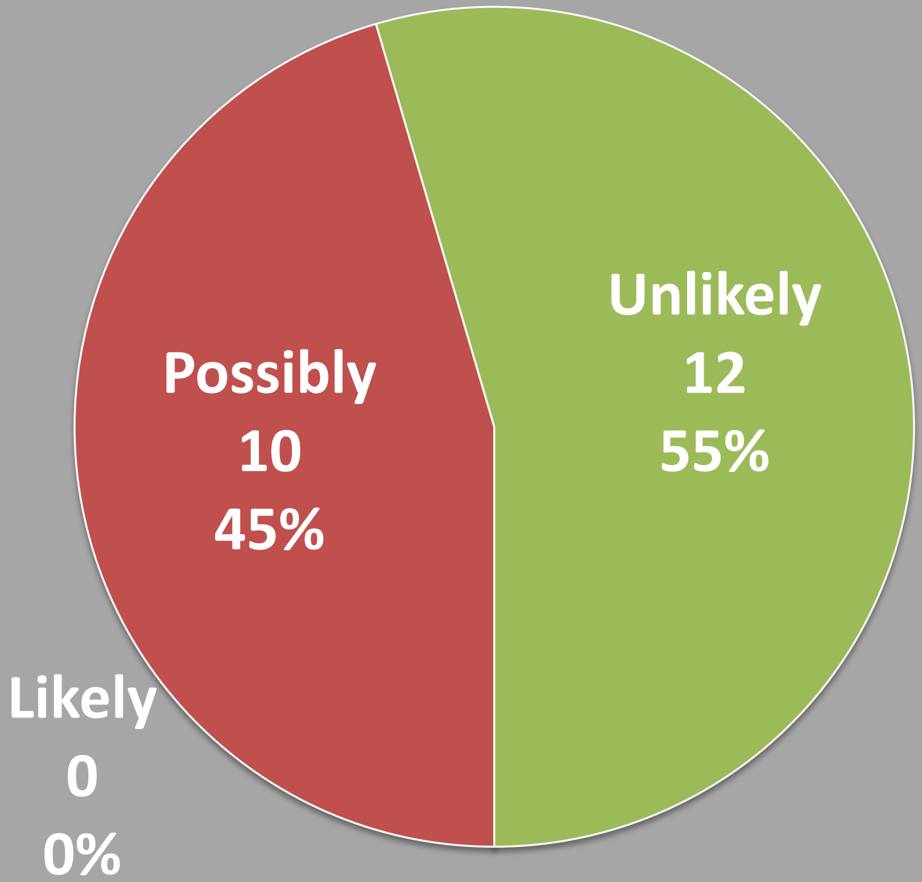
What is the MINIMUM number of years needed for you to consider entering into an extended period water lease?



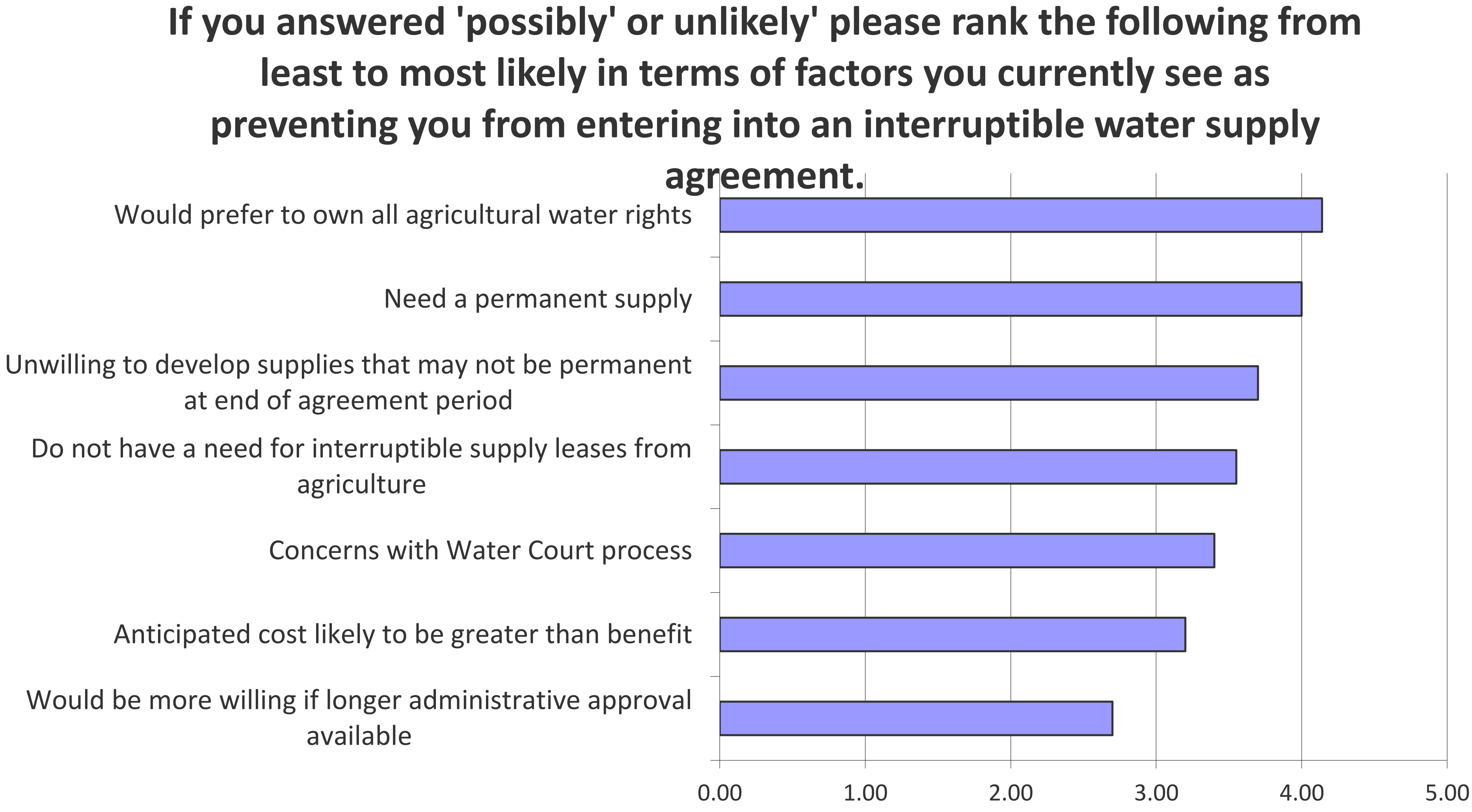
How familiar are you with the concept of "Interruptible Water Supply Agreements" described above?



How likely is it that interruptible water supply agreements will be a part of your utility's future water supply portfolio?



Ranking of Factors Preventing Entering into Interruptible Water Supply Agreement

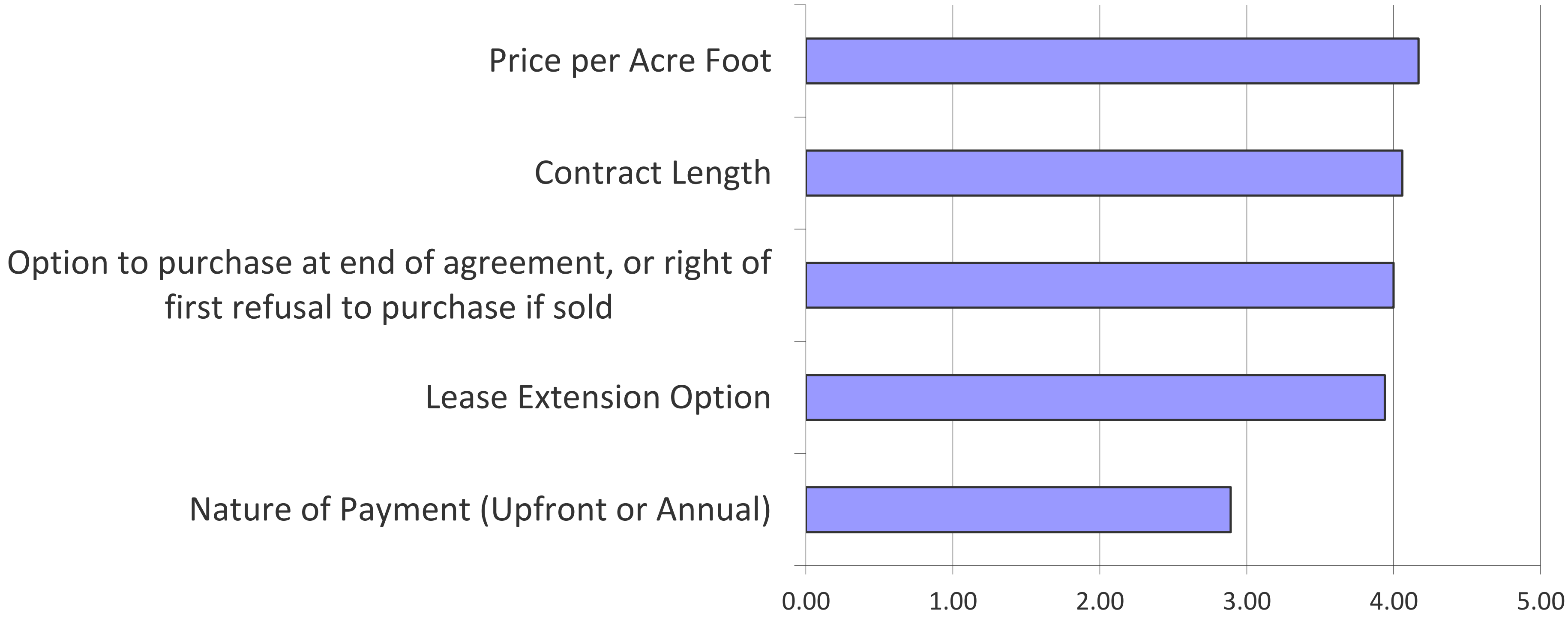


Comments on Interruptible Supply Agreements

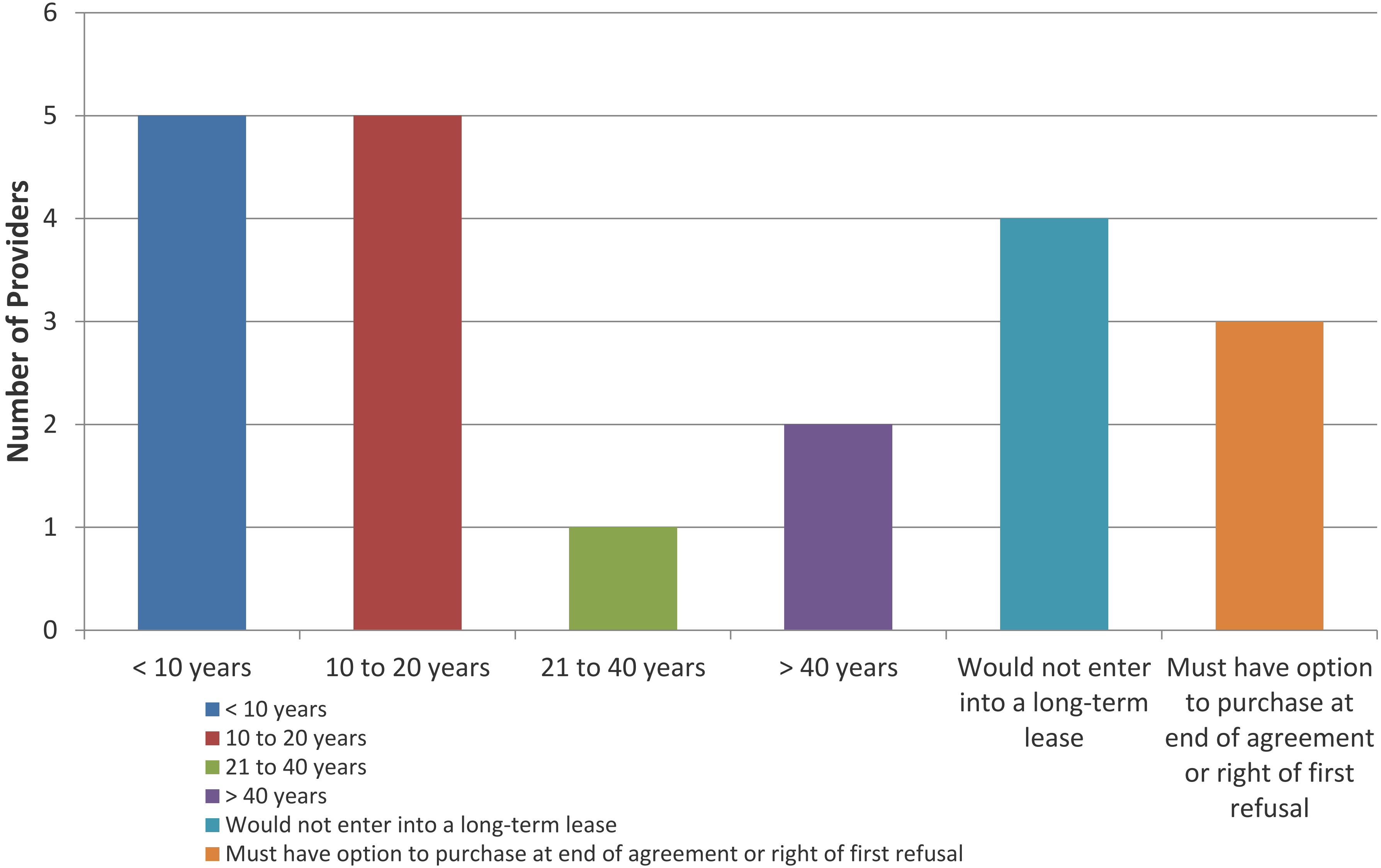
- XXX does not plan to enter into interruptible supply contracts for agricultural water, so questions below are not relevant.
- It has been our experience that these work better going the other way. We buy, transfer, and lease back.
- We would pursue this as a way to "tap" into an augmentation supply during an extreme drought.
- Boulder County has tied up much of the agricultural water in this area in open space and they are not inclined to do interruptible supply agreements.

Factors Considered for Entering into Interruptible Supply Agreement

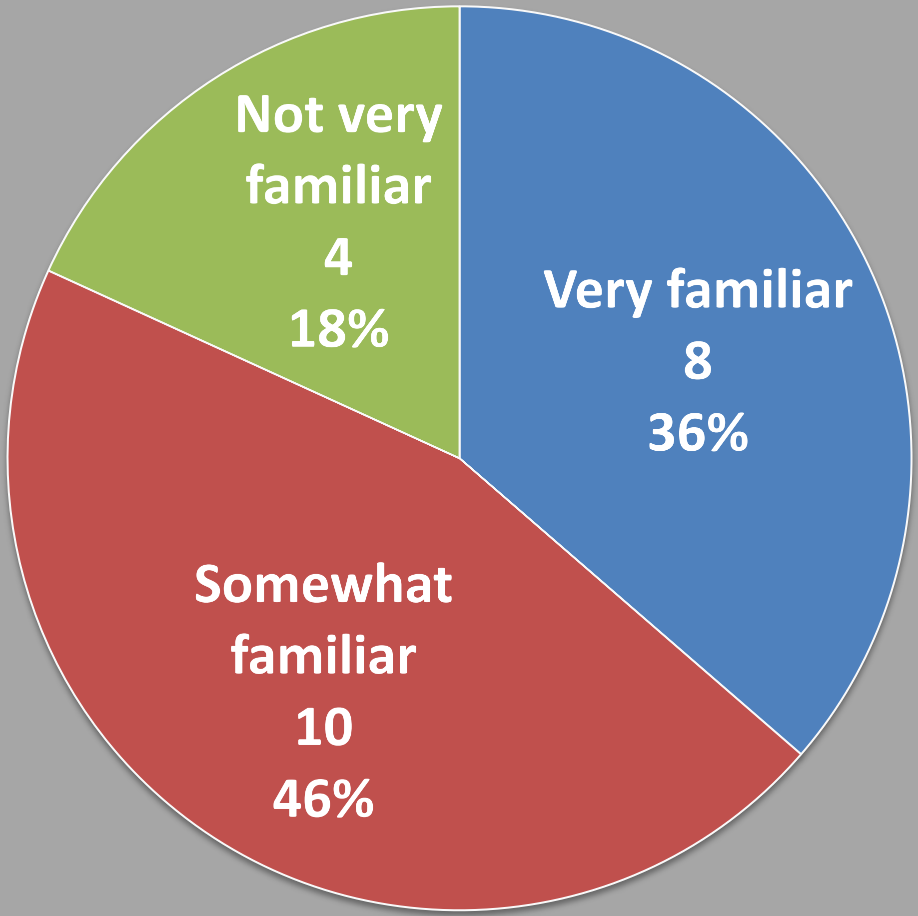
The following are factors that you may consider when evaluating deciding whether or not to enter into an interruptible supply agreement.



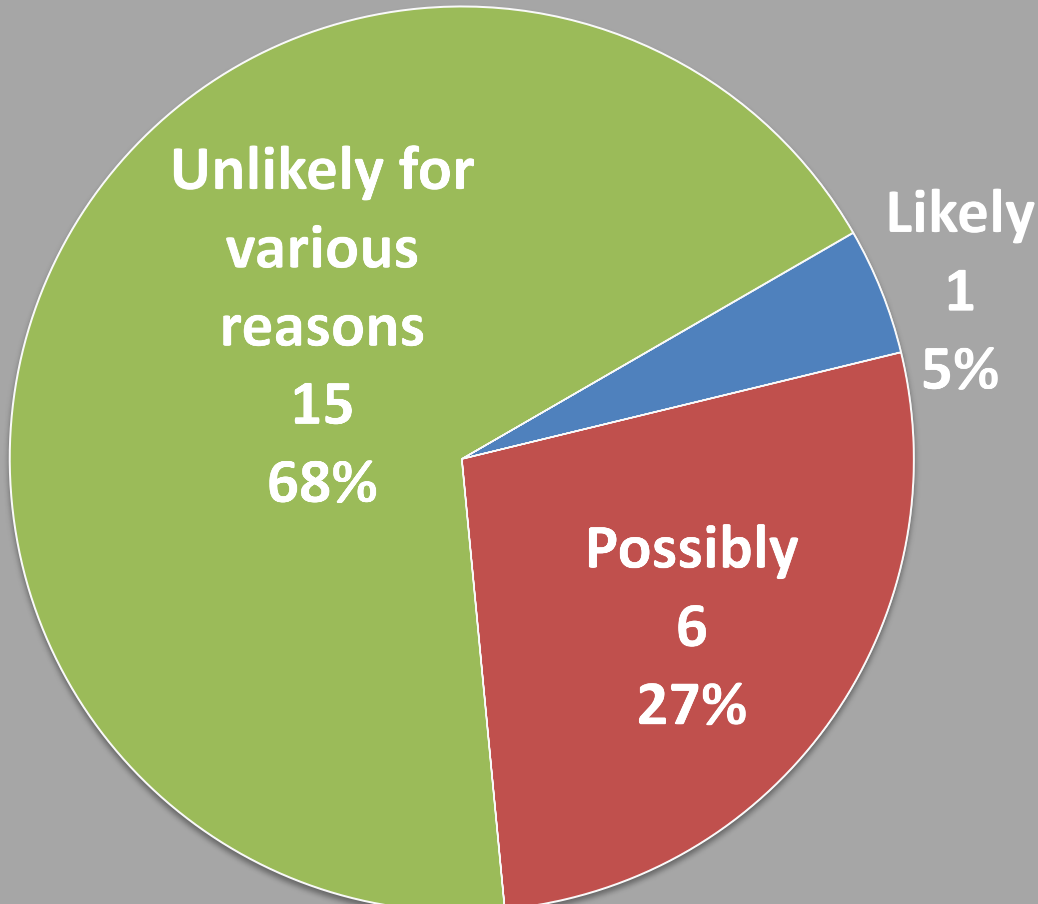
What is the MINIMUM number of years needed for you to consider entering into an interruptible supply agreement?



How familiar are you with the concept of "Rotational Fallowing" described above?

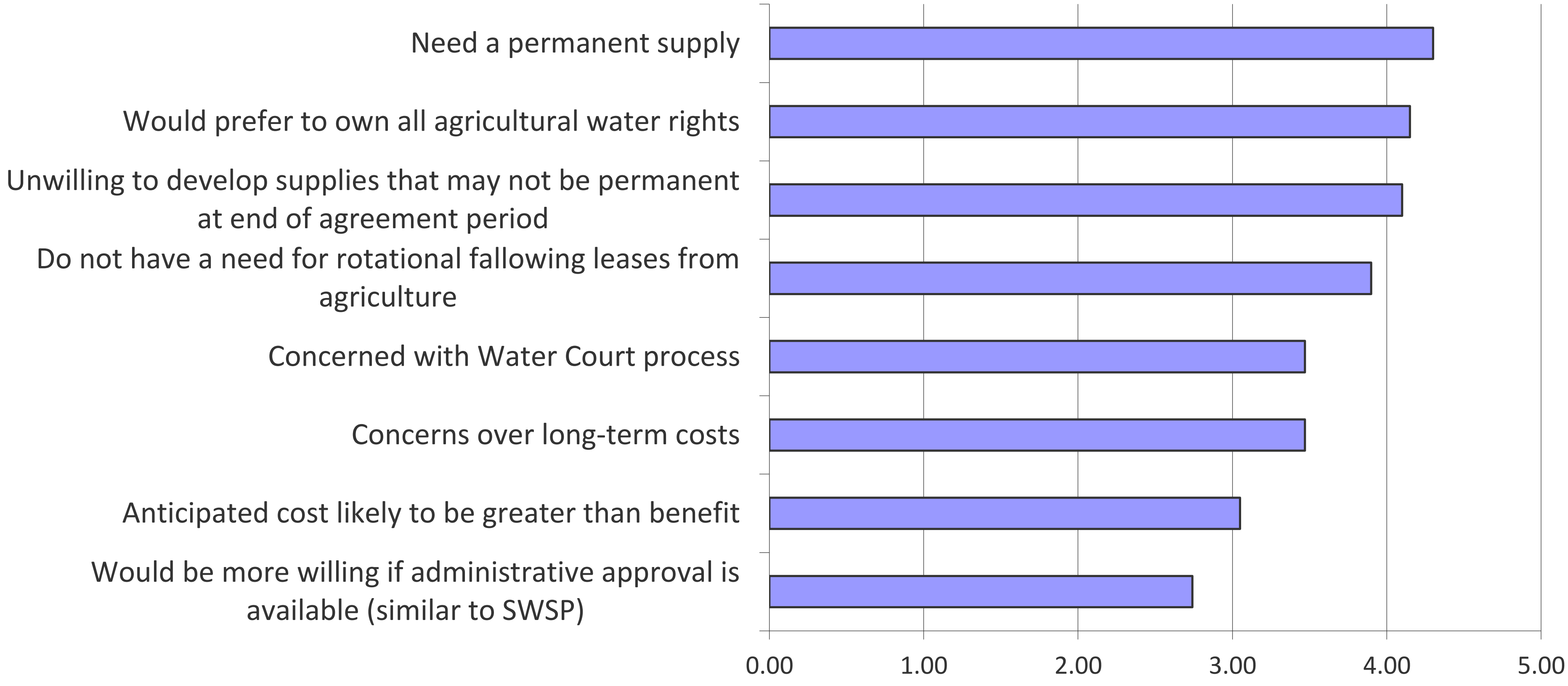


How likely is it that Rotational Fallowing Agreements will be a part of your utility's future water supply portfolio?



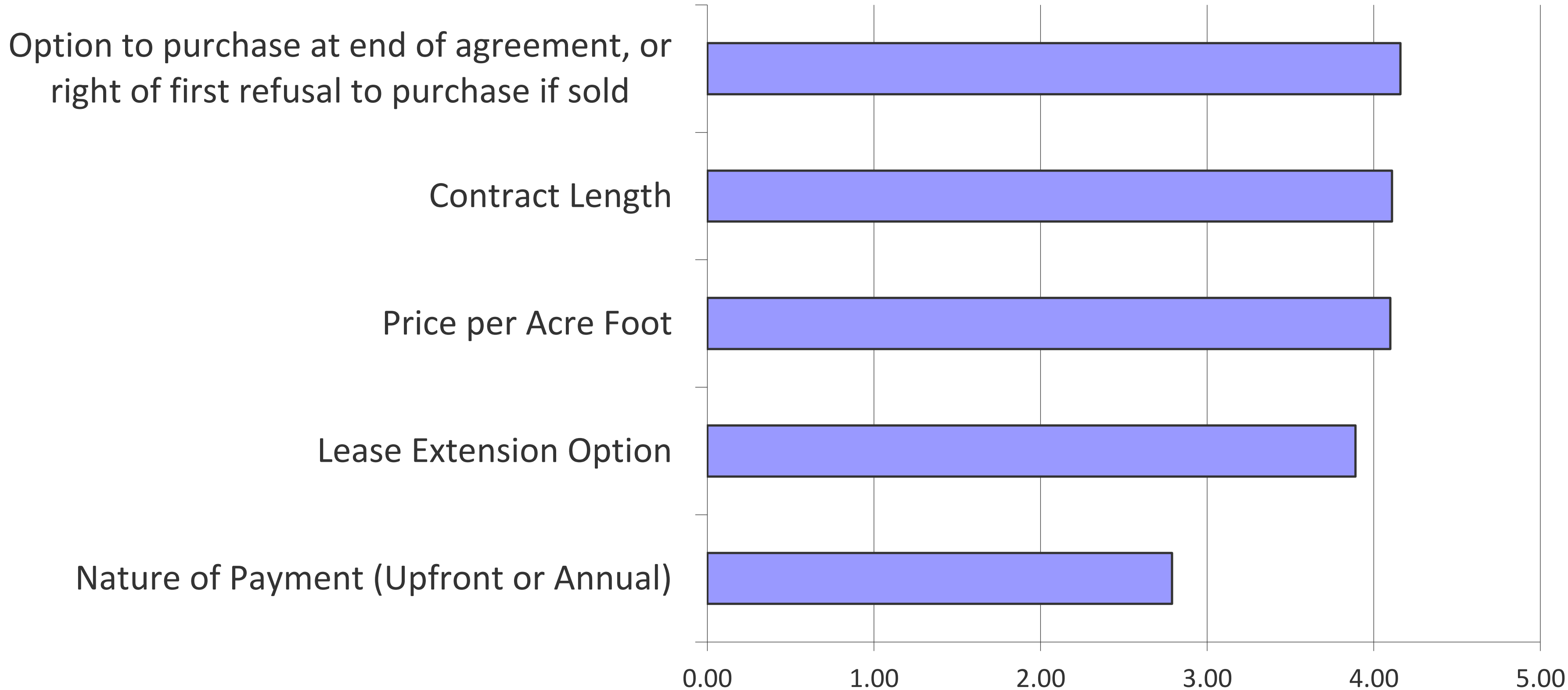
Ranking of Factors Preventing Entering into Rotational Fallowing Agreement

If you answered 'possibly' or unlikely' please rank the following from least to most likely in terms of factors you currently see as preventing you from entering into a rotational fallowing agreement.



Factors Considered for Entering into Rotational Fallowing Agreement

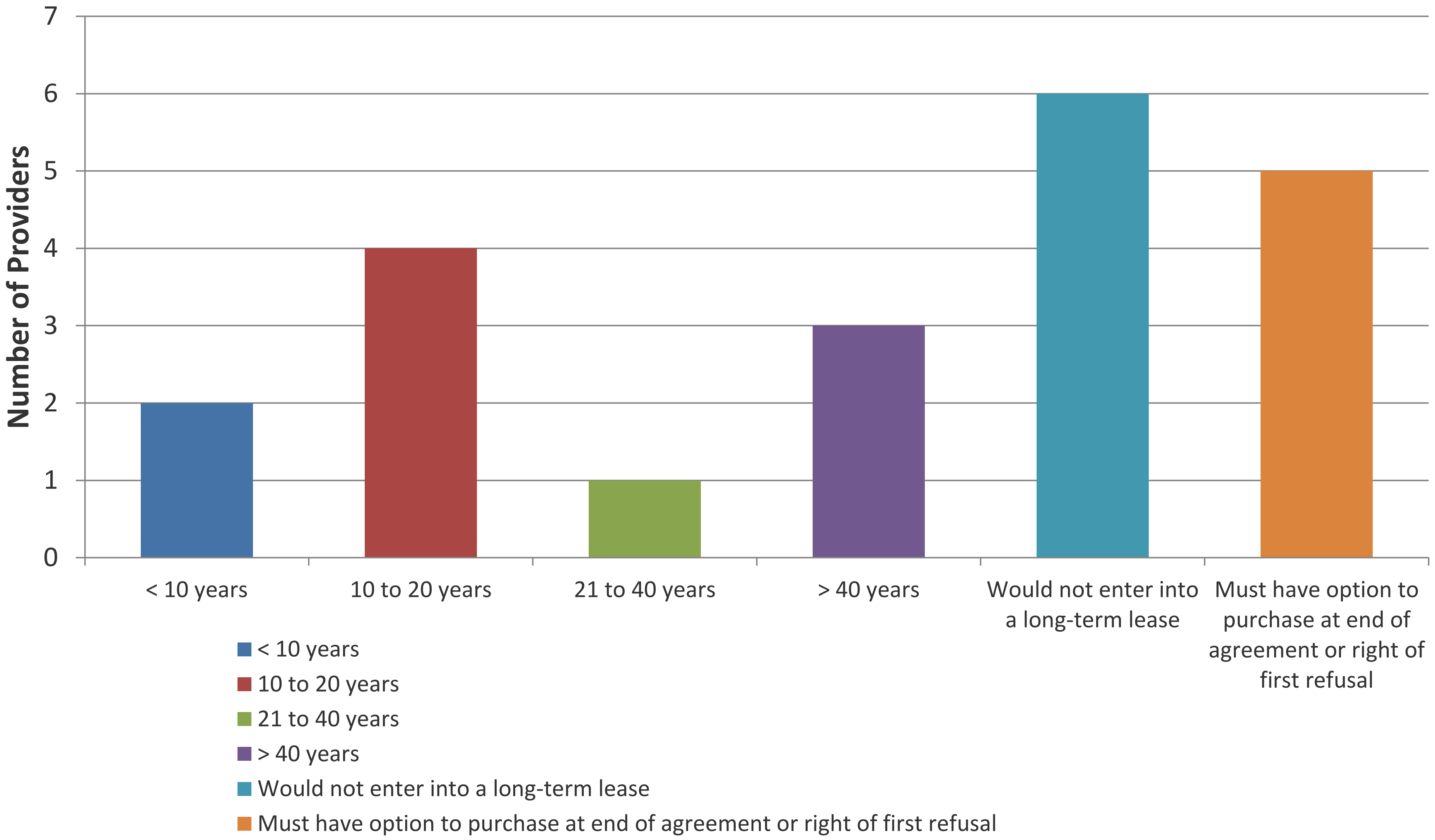
The following are factors that you may consider when evaluating deciding whether or not to enter into a rotational fallowing agreement.



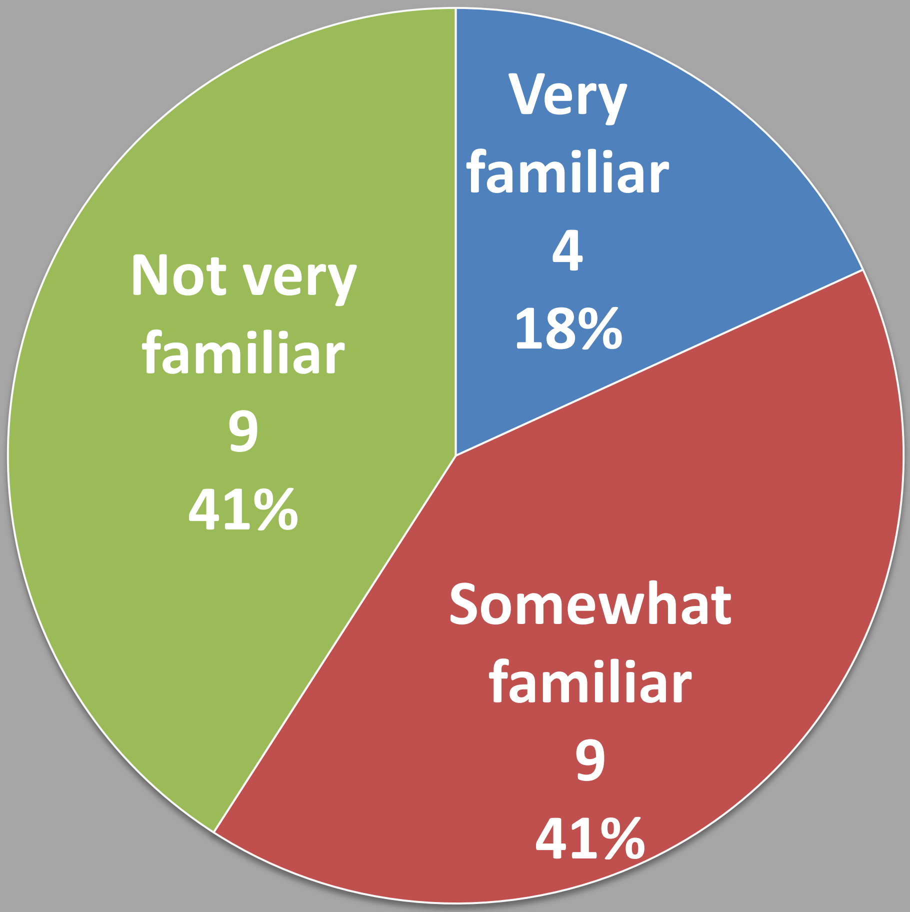
Comments on Rotational Fallowing Agreements

- We would not sell taps based on a temporary supply of water, because of the permanent nature of the demand. Unless this, and some of the other methods discussed here, could be done on a permanent basis, they raise significant concerns for raw water supply planning.
- If XXX enters into a rotational fallowing agreement, it will be for a known volume of water that is guaranteed in perpetuity. Any agreement that can be terminated would not be entered into by XXX.
- Infrequent need for additional supplies - very important in determining feasibility
- Please see the comment on question 27 (slide 32). This comment applies to all the proposed arrangements. None of the proposed arrangements would work for our situation. We need a permanent arrangement with certainties on volume on price but we would not need to dry up land or have ownership. I hope the survey can reflect that there was at least one provider that did not fit into the idea being promoted by this this survey. I hope the bias in this survey is accurately reported. In other words, it seems this survey is being done to justify a desired approach and this response is that the desired approach won't work.

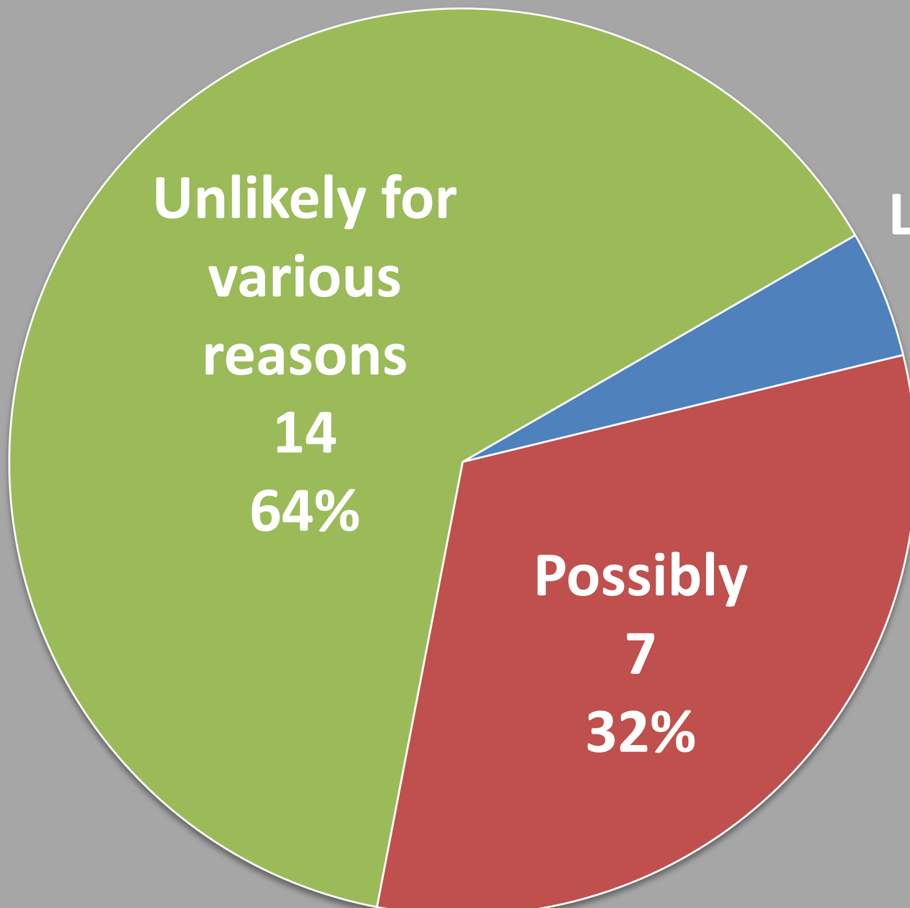
What is the MINIMUM number of years needed for you to consider entering into a rotational fallowing agreement?



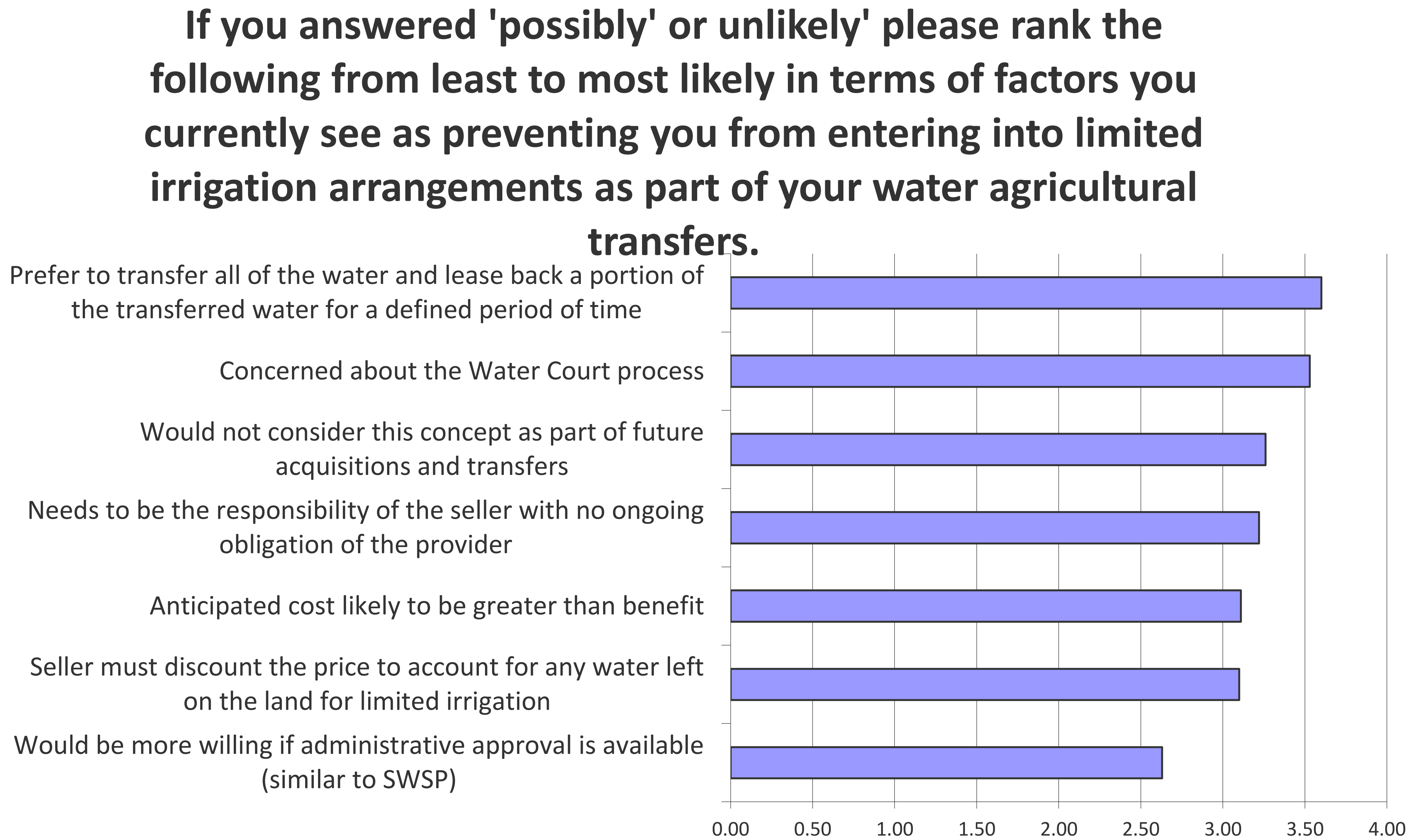
How familiar are you with the concept of "Limited Irrigation" described above?



How likely are limited irrigation strategies to be a part of your future water supply portfolio?

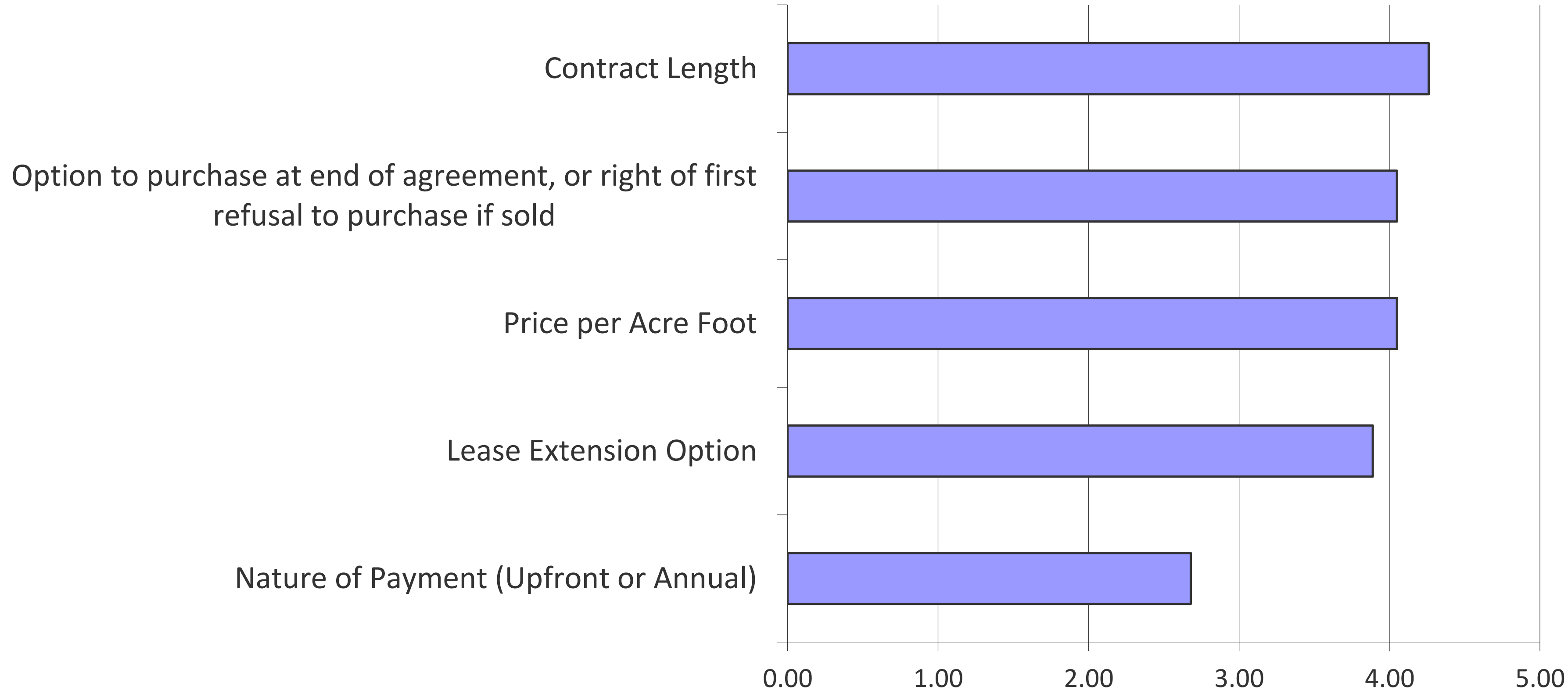


Ranking of Factors Preventing Entering into Limited Irrigation Agreement

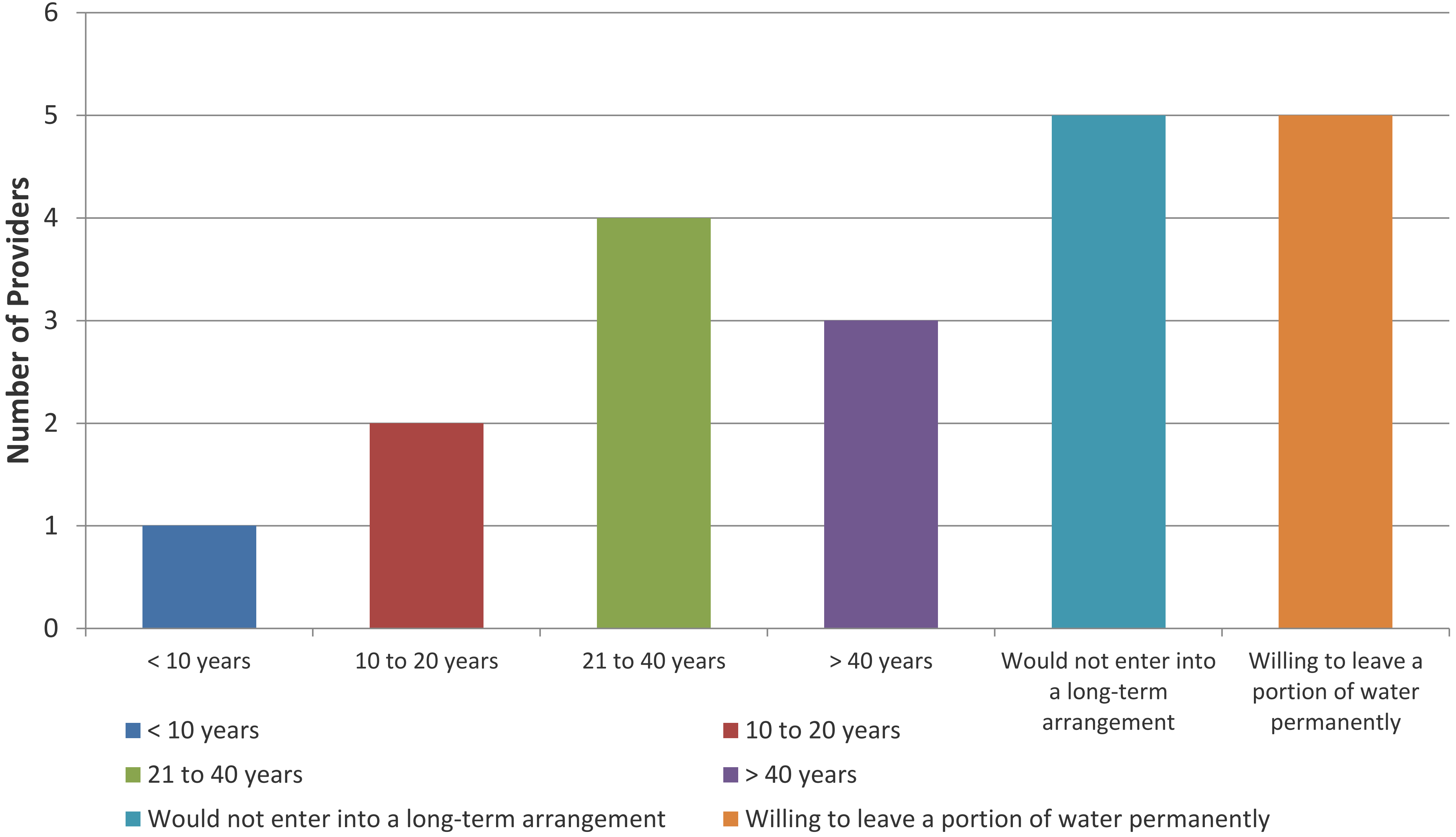


Factors Considered for Entering into Limited Irrigation Agreement

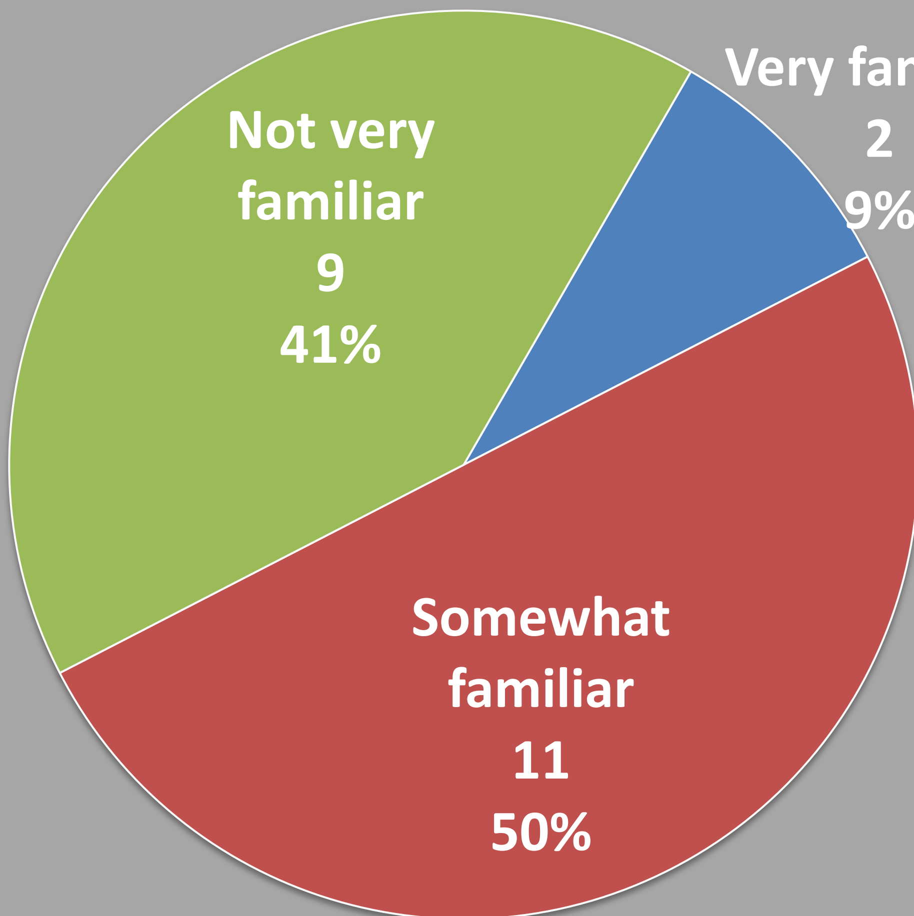
The following are factors that you may consider when evaluating deciding whether or not to enter into a limited irrigation arrangement.



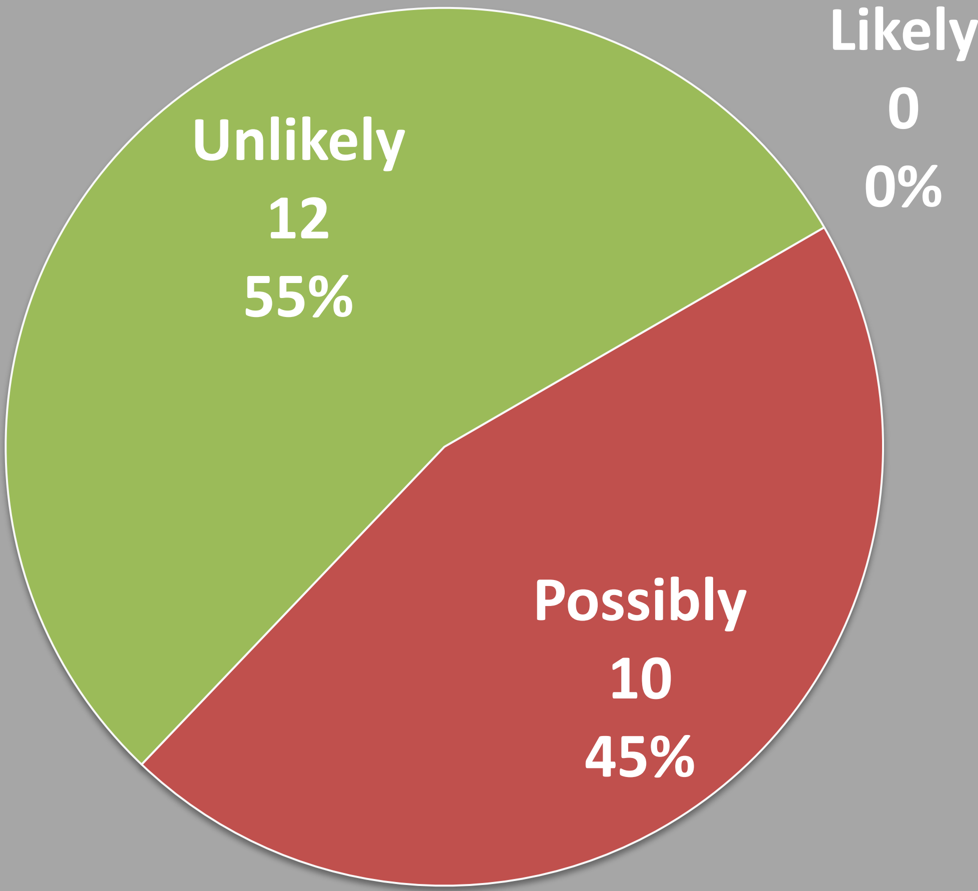
What is the MAXIMUM number of years you would consider for a a limited irrigation arrangement?



How familiar are you with the concept of a "Shared Water Bank" as described above?

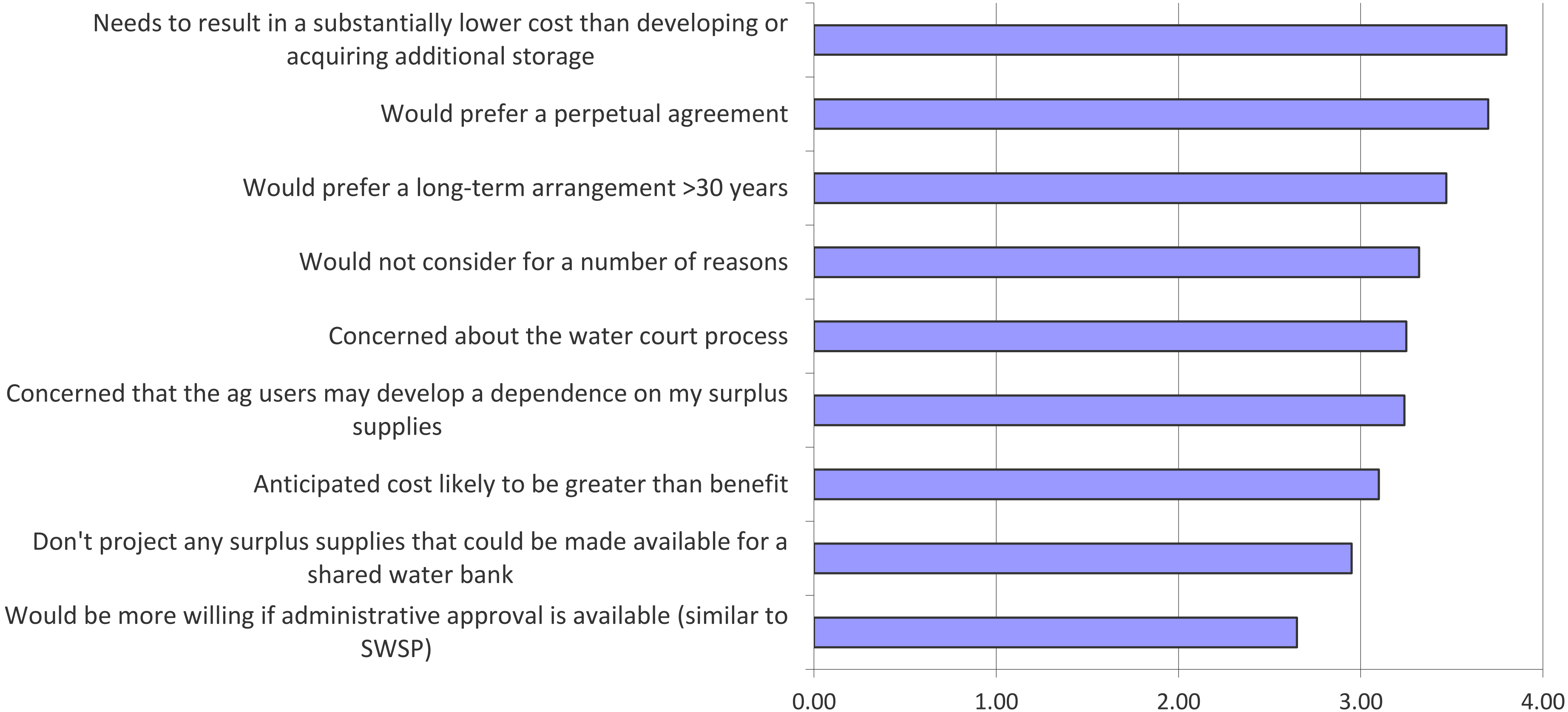


How likely are shared water banks to be a part of your future water supply portfolio?



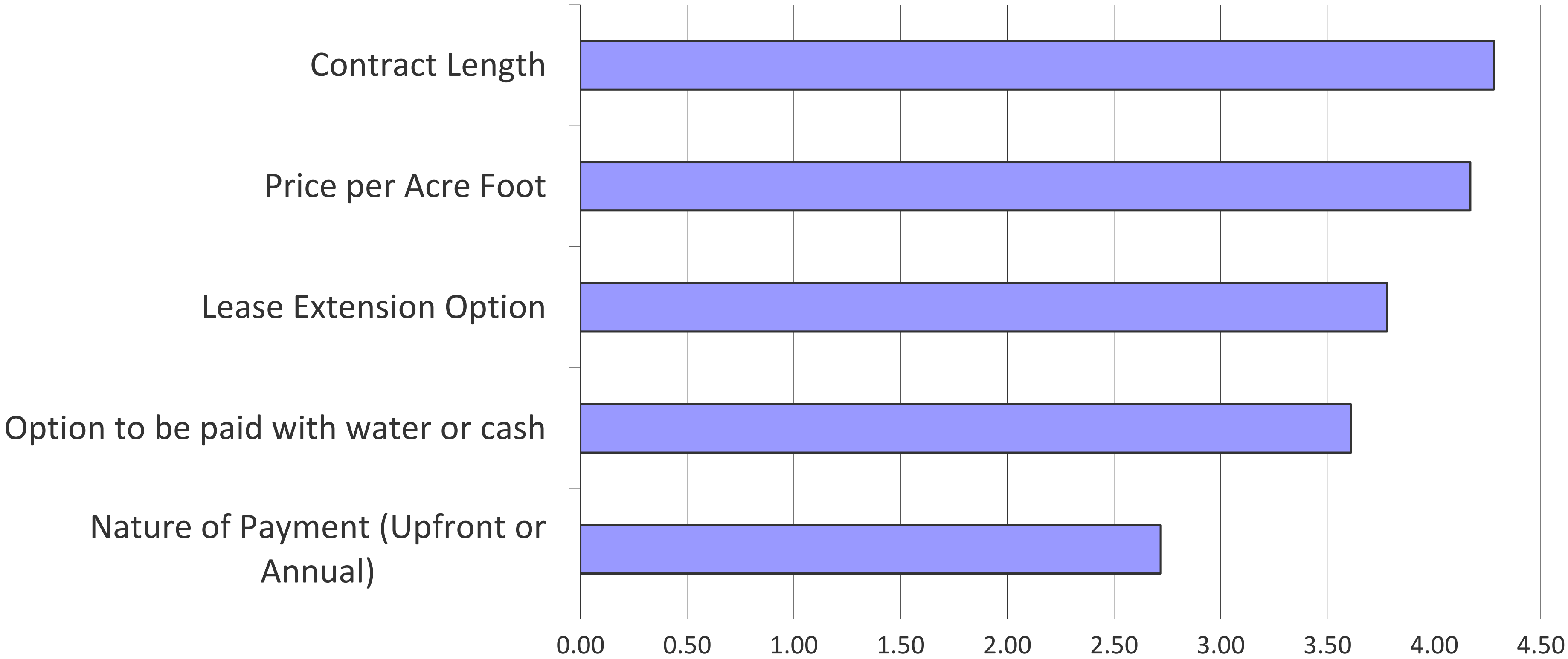
Ranking of Factors Preventing Entering into Shared Water Bank Agreement

If you answered 'possibly' or unlikely' please rank the following from least to most likely in terms of factors you currently see as preventing you from entering into a shared water bank arrangement.

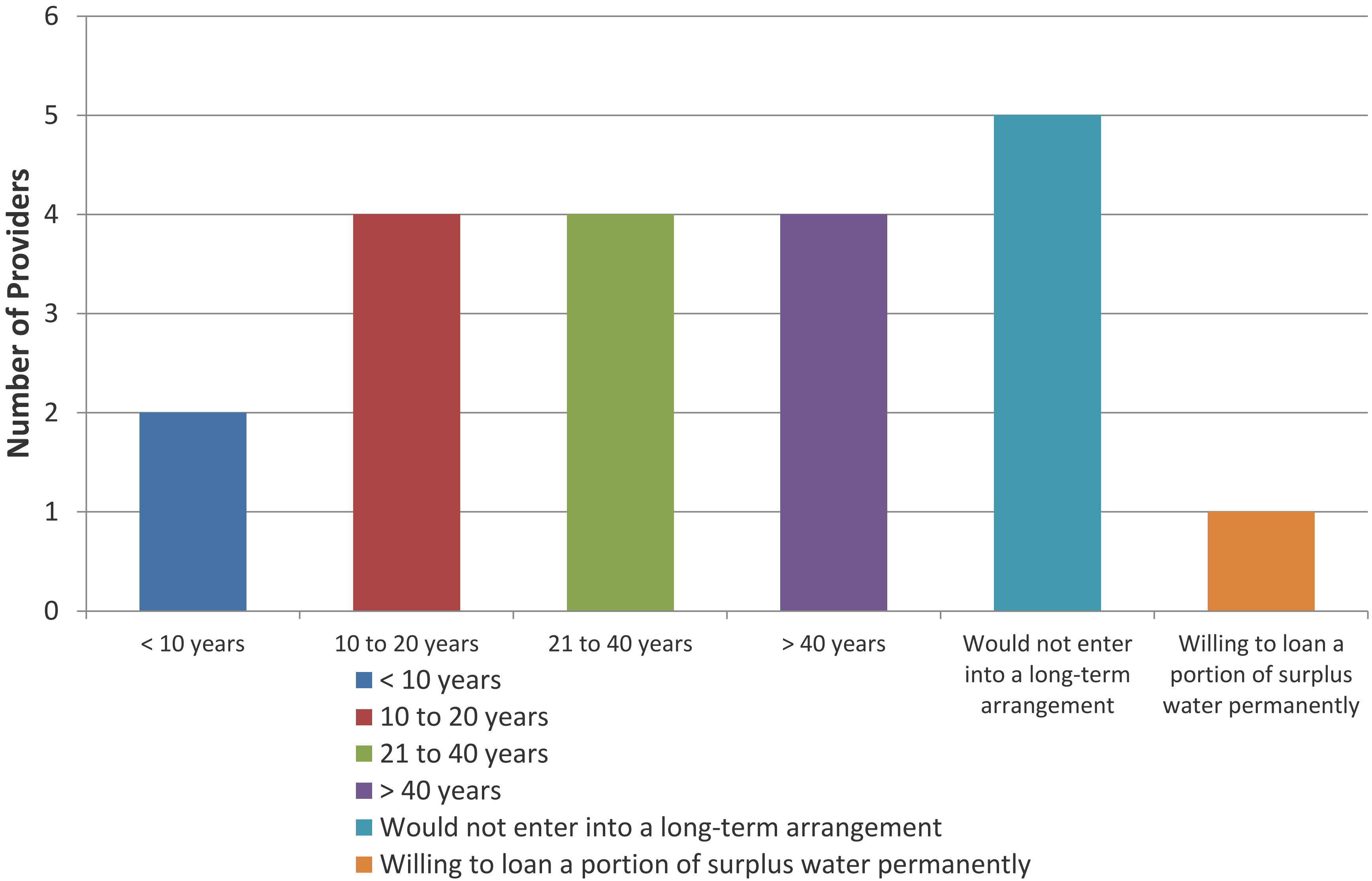


Factors Considered for Entering into Shared Water Bank Agreement

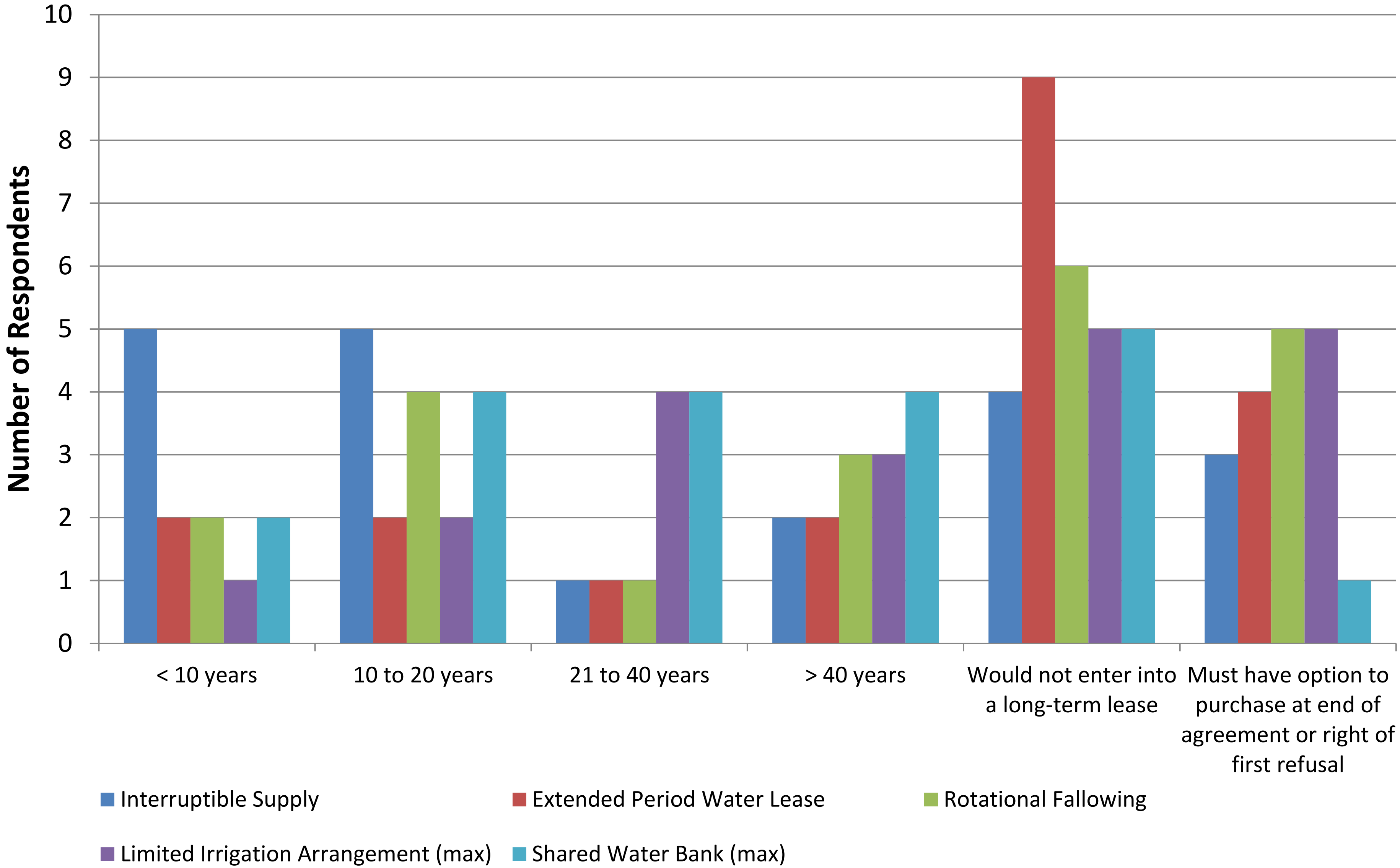
The following are factors that you may consider when evaluating deciding whether or not to enter into a shared water bank arrangement.



What is the MAXIMUM number of years you would consider for a shared water bank arrangement?

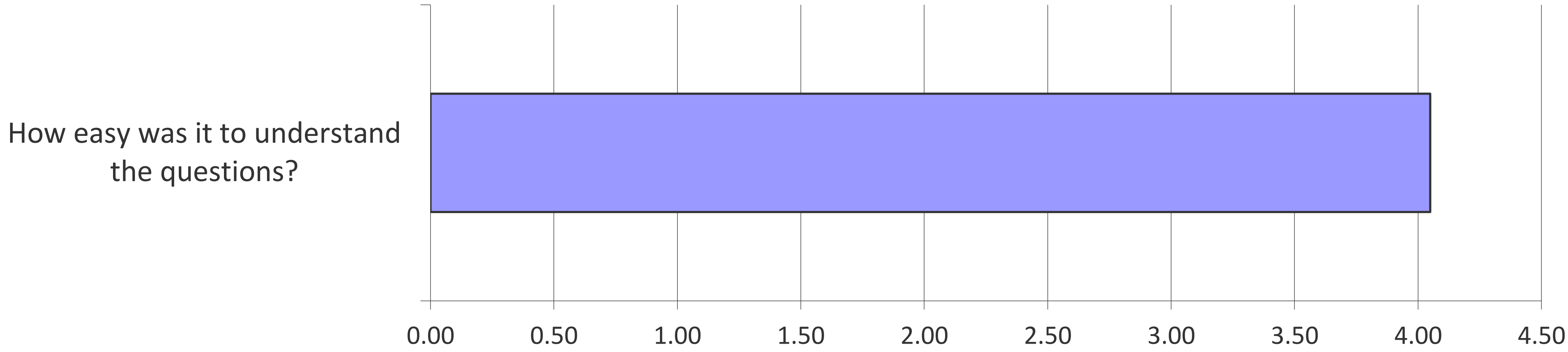


Minimum (Maximum) number of years considered for alternative agriculture methods leases

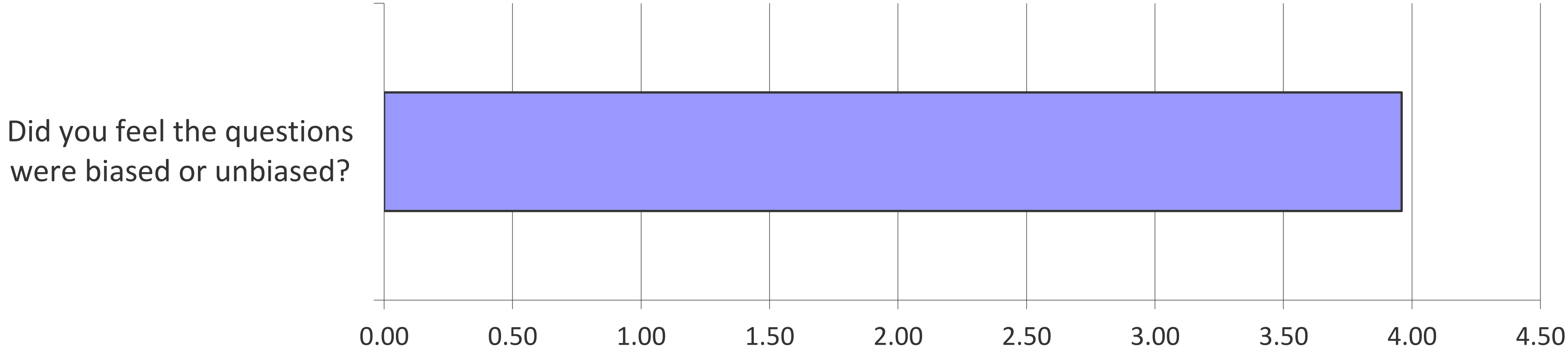


Survey Evaluation

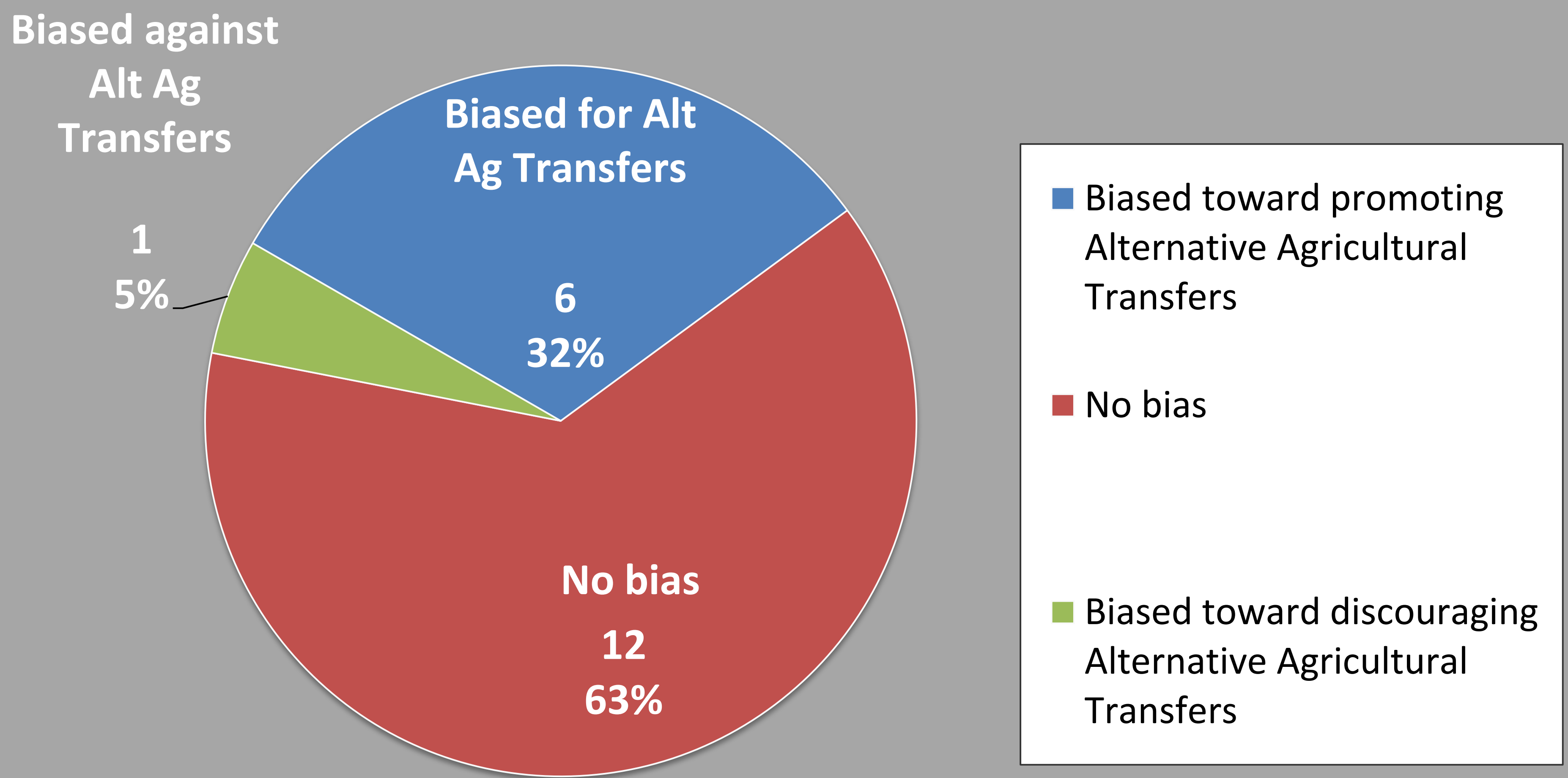
Overall, how easy or difficult did you find it to understand the questions? On a scale of 1 to 5 where 1 means the survey was 'difficult to understand' and 5 means the survey was 'easy to understand'



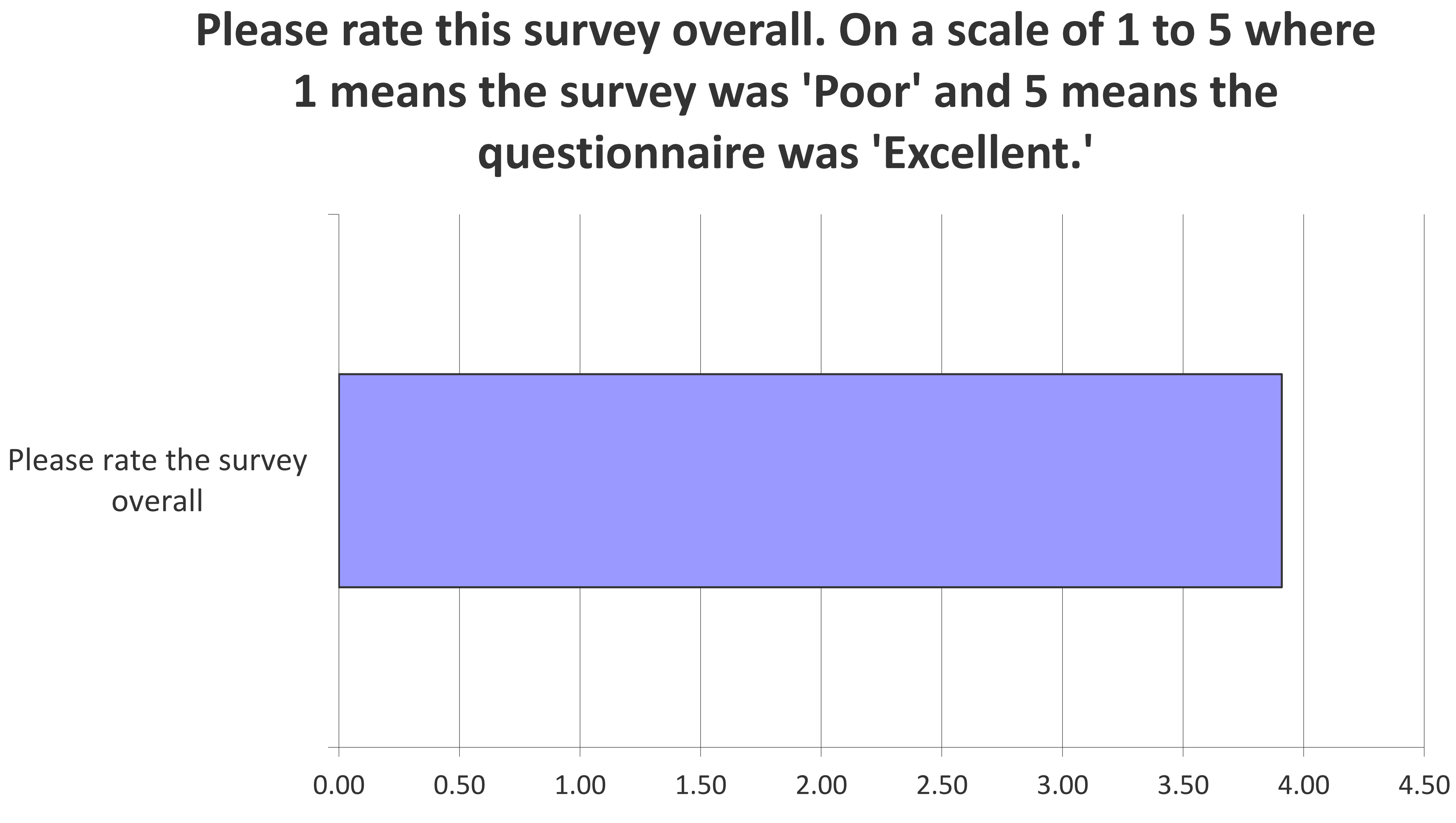
Overall, how biased or unbiased did you find the questions? On a scale of 1 to 5 where 1 means 'all of the questions were biased' and 5 means 'all of the questions were unbiased'.



If you felt that the questions were biased, please note if they were biased toward promoting or discouraging Alternative Agricultural Transfer Methods



Overall Survey Rating



Survey General Comments

General Comments:

- I put 'unfamiliar' with the options discussed as we have no direct experience with them. However, we have discussed them at meetings and with other parties. If future conditions warrant evaluation of these or other options, of course they would be considered in greater detail.
- I think the concept is good in trying to figure out on a state wide basis how to meet all water users needs. It only works for us if it is perpetual, as I don't want to burden my replacement 100 years from now
- We don't like to see dry-up of agriculture, and support means of preventing that as an alternative. That said, the assumption seems to be that agriculture can never pay anything for any alternatives that benefit them is disturbing, since cooperative agreements and projects are assumed to be paid 100% by municipal providers, and it is very expensive to build projects. We are a participant in NISP, and it is well constructed to benefit both ag and municipal, with exchanges but total ownership of the water shares by the participants. You will find that very few municipal providers can afford to gamble on impermanent supplies.

Survey General Comments

General Comments:

- Lease back question should have included more than just CBT and native (reusable effluent? transmountain return flows? Lawn Irrigation Return Flows?) Some of the questions didn't fit the available answers - somewhat confusing: question said least to most likely, scale said least/most important. Were rankings supposed to be relative and distributed evenly (one in each of the 5 categories when there were 5 questions) or supposed to be non-relative (.i.e, all could be very important).
- Kelly, thanks for including XXX in this process. We are currently developing our water supply and are likely approaching this issue differently than more mature utilities who need only drought protection. Much of the information and the alternatives presented in this survey have not been evaluated or discussed in detail to determine if they would more cost-effective in developing its water supply at this time. We look forward to continued participation in the process and may find new ideas which could be applied at XXX.

Survey General Comments

General Comments:

- Survey is good but may not recognize the differences in water providers. The survey seems to focus on year to year supplies for municipal water providers, which may be appropriate for some entities. Many providers, however, have surplus water in most years and only need additional supplies during critical drought years. To keep viable agricultural economies, it may be helpful to look more closely at ways that Municipal owners can rent back already owned water rights without so many legal or decree constraints. Most municipal providers are looking for reliability and certainty but would like to be able to provide surplus water for agricultural use if system allowed it.