RECLAMATION
Managing Water in the West

Appendices to the Windy Gap Firming Project: Purpose and Need Report

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APPENDICES
PROJECT PARTICIPANT WATER SUPPLY AND DEMAND SUMMARIES
WINDY GAP FIRMING PROJECT

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WATER SUPPLY AND DEMAND

CITY AND COUNTY OF BROOMFIELD

Introduction

The City of Broomfield is located north of Denver and borders the intersection of Adams, Boulder, Jefferson, and Weld Counties. The community was established in the 1880s shortly after the Denver, Utah and Pacific Railroad established a train station in the area. The new railroad station was named Broomfield after the fields of broomcorn near the new depot that provided grain for Denver brewers. A farming community soon developed and by the early 1920s a small downtown had evolved (City of Broomfield 1995). Until the 1950s, only 100 people lived in the area. By 2004, Broomfield's population exceeded 50,000. A constitutional amendment was approved by Colorado voters that established the City and County of Broomfield, Colorado's 64th county. The city boundaries are identical to the county boundaries. A discussion of Broomfield's water supply and demand follows.

Water Supply

Broomfield relies primarily on C-BT and Denver Water for its potable water supply. Windy Gap water is used when available or through the C-BT in-lieu program. Broomfield's water reuse system and non-potable water supply utilizes Windy Gap effluent and flows from Clear Creek, Coal Creek, Walnut Creek, and Big Dry Creek when available. For purposes such as pond level maintenance and wetland support, shares have been purchased in the Farmers Reservoir and Irrigation Company's (FRICO) Marshall Division. Broomfield also owns ditch and reservoir shares that are used outside the City and County boundaries.

Transbasin Water

Colorado-Big Thompson Project

C-BT water accounts for about 50 percent of Broomfield's potable water supply. Broomfield owns 9,817 C-BT units and an interruptible C-BT contract with 1,906 units (Table A-1). The interruptible supply contract with Platte Valley Irrigation Company cannot be used when Windy Gap water is available because of the cap on maximum C-BT ownership. As Broomfield's demand increases and the C-BT cap increases, the interruptible C-BT units will be transferred to Broomfield. In addition, Broomfield leases 200 units of C-BT water to the Town of Erie until such time that these units can likewise be transferred for use by Broomfield.

Table A-1. Inventory of Broomfield Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	9,817[1]	5,890[2]
Interruptible C-BT Units	1,906	1,144[2]
Windy Gap Project	56	0
Contract Water		
Denver Water Contract	N.A.	6,500
Direct Flow Rights		
Walnut Creek	N.A.	0
Big Dry Creek	N.A.	20
Reservoir Storage		
Great Western Reservoir	2,370 AF	0
Glasser Reservoir	375 AF	0
Ditch Shares		
Coal Creek/McKay Ditch	102.6 cfs	0
Coal Creek/Upper Church Ditches	18.11 cfs	0
Clear Creek/ Church Ditch	61 inches	61
Non-potable Water Not Available or Used for M&I Uses		
Milton Reservoir (FRICO)	115.55 shares	unknown
Bar Reservoir (FRICO)	30.11 shares	unknown
Marshall Diversion (FRICO)	124.13 shares	124
Total		**13,739**

[1] Includes 249 C-BT units that are currently leased back to the sellers until 2007.

[2] C-BT yield is variable from year to year. C-BT's long-term yield firm yield is assumed to be 0.6 AF/unit for purposes of this analysis.

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Broomfield, like most municipalities, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons.

Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit. Broomfield's total C-BT water supplies from owned units and the interruptible contract is 7,124 AF using an average C-BT quota of 0.6 AF/unit. Broomfield has historically assumed a yield of 0.7 AF per share because the majority of Broomfield's units are under the "fixed quota" delivery program. Broomfield utilizes the in lieu borrowing program as needed. During times that the water stored in the C-BT project cannot meet the variable quotas desired by the Northern Colorado Water Conservancy District board, the uniform deliveries are reduced proportionately.

Windy Gap

The City and County of Broomfield owns 56 units of Windy Gap water. Windy Gap water currently provides zero firm yield, so Broomfield cannot rely on it when forecasting water supply/demand projections. When Windy Gap water is available, it is used primarily for construction purposes and as a raw water source to the Broadlands Golf Course and the Holy Family Catholic High School (ERO 2004). When it is not available, Broomfield uses the in-lieu borrowing of C-BT water whenever possible to take Windy Gap deliveries. Windy Gap water is delivered from Carter Lake via the Southern Water Supply Pipeline (SWSP) to Glasser Reservoir prior to treatment and distribution.

If firmed, Windy Gap would primarily be used during the winter when return flows to the wastewater treatment plant are highest and reuse efficiency can be maximized. Firmed Windy Gap water would provide a reliable water supply to meet municipal, industrial, and irrigation water requirements (City of Broomfield 2004a).

Contract Water

Broomfield has a contract in perpetuity with Denver Water to take up to 6,500 AF of treated water annually. A minimum, annual delivery is required under the contract, although in drought years Denver may reduce the minimum. This reduction is proportionally similar to what is expected of other customers. The contract calls for an increase in the minimum delivery up to 4,700 AF in 2011. Each year thereafter, Broomfield must take a minimum annual delivery of 4,700 AF with a maximum annual delivery of 6,500 AF. There is also a sliding window with a maximum delivery of 975 AF during any 30-day period or else a substantial surcharge is imposed. Broomfield has a peaking capacity delivery of 13 MG per day through Denver Water's Conduit 81.

Direct Flow Rights

Direct flow rights include Walnut Creek and Big Dry Creek. Big Dry Creek provides about 20 AF of firm yield and Walnut Creek water has zero firm yield. These direct flow rights are used when available for delivery to Great Western Reservoir and only for non-potable uses.

Reservoir Storage

Great Western Reservoir provides 2,370 AF of storage as part of Broomfield's non-potable and water reuse program. The reservoir has several sources of inflows. Clear Creek, Coal Creek and Walnut Creek flows are diverted to Great Western in mid-spring when they are in priority. The dry-year yield is at or close to zero for these three inflow sources. Therefore, these sources are not included in Broomfield's firm year calculations for the water reuse system. If firmed, Windy Gap water following initial potable use would provide the primary source for filling Great Western Reservoir via the wastewater treatment plant. In the future, Broomfield will try to fill Great Western during the winter and early spring months using Windy Gap return flow water and ditch water if available. Great Western Reservoir would provide non-potable storage for use in irrigation of parks, landscaping, and golf courses.

Glasser Reservoir provides 375 AF of terminal storage for delivery of C-BT and Windy Gap water (ERO 2004). This storage is used for operational “peaking” storage and does not provide any carry-over storage or firm yield.

Ditch Rights

Broomfield owns ditch rights in Coal Creek/McKay Ditch, Coal Creek/Upper Church Ditch, and Clear Creek/Church Ditch. Only the Clear Creek/Church Ditch shares provide an annual firm yield (61 AF). Ditch water is stored in Great Western Reservoir and used only for non-potable uses.

Other Non-Potable Water

Broomfield has three other sources of non-potable water from the FRICO system that are not used for municipal or industrial purposes: Milton Reservoir, Barr Reservoir, and the Marshall Division. Shares in Milton Reservoir and Barr Reservoir are used exclusively for drought-tolerant sod production and biosolid disposal in Weld County. The Baseline Land and Reservoir Company and New Lower Boulder Consolidated Ditch shares came with a land purchase and are not used by the City. The Marshall Division shares produce 124 AF of firm yield, most of which is currently leased back to farmers, but will eventually be used for pond and wetland maintenance. Only Marshall raw water is used within the City and County of Broomfield.

Water Reuse

Broomfield’s water reuse system became operational in the spring of 2004 and is dependent on Windy Gap water as a source of supply. The system consists of tertiary treatment and a pump station at the Wastewater Treatment Facility, day storage tanks, storage in Great Western Reservoir, a second treatment facility located near the Great Western Reservoir, and all necessary reuse water transmission and delivery pipelines. Although the current firm yield of Broomfield’s reuse system is zero, it is projected to provide 3,100 AF of non-potable water to the extent that Windy Gap water is firmed or in lieu borrowing of C-BT water is available (City of Broomfield 2004a). About 1,500 AF of the 2,000 AF of reuse water currently incorporated into reuse contracts is used by Interlocken. The projected demand for reuse water in 2004 is approximately 2,500 AF. Numerous connections were made in 2004 to convert potable water sources to the reuse water system, which allows delivery for parks, golf courses, and the high school (ERO 2004).

A firmed Windy Gap water supply is an important part of Broomfield’s future water portfolio. The reuse system’s firm yield is based entirely on Windy Gap water that reaches the Wastewater Treatment Facility, or the availability of in-lieu water. All other Broomfield-owned water sources are not reliable during dry years and have not been included in the firm-yield calculations.

Water Demands

Other than the City of Denver, the City of Broomfield is the only water provider in Colorado that is both a city and county. The County of Broomfield was formed in 2001 from parts of Weld County, Adams County, Boulder County and Jefferson County. Situated on the north side of the rapidly growing U.S. 36 corridor between Denver and Boulder, Broomfield experienced steady growth in population and employment from 1980 through 1990, but the pace of that growth accelerated from 1990 through the year 2002. Table A-2 reports Broomfield's population and employment growth since 1990.

Table A-2. Broomfield Population and Employment Growth, 1990 to 2004.

				Annual Growth Rate
1990	24,640	N.A.	9,260	N.A.
1991	24,980	1.4%	9,470	2.3%
1992	26,650	6.7%	9,530	0.6%
1993	28,030	5.2%	9,800	2.8%
1994	28,850	2.9%	10,410	6.2%
1995	30,670	6.3%	10,330	-0.8%
1996	32,410	5.7%	10,650	3.1%
1997	33,850	4.4%	11,560	8.5%
1998	34,760	2.7%	12,280	6.2%
1999	36,500	5.0%	14,020	14.2%
2000	38,270	4.8%	19,500	39.1%
2001	41,400	8.2%	26,500	35.9%
2002	43,000	3.9%	27,800	4.9%
2003	44,400	3.3%	27,930	0.5%
2004	46,400	4.5%	27,960	0.1%

Source: City and County of Broomfield 2004b.

Population almost doubled between 1990 and 2004, exhibiting an average annual growth rate of almost 5 percent. Employment rose three-fold from 1990 to the year 2004, experiencing an average annual growth rate of 9 percent. Broomfield's employment growth has benefited from its location along a major highway between Denver and Boulder.

Historical Water Use

The City and County of Broomfield's water system serves Broomfield out to the County boundary, plus the Jefferson County Airport and the Mile High Water District. Broomfield serves individual businesses at the airport, amounting to about 28 AF of demand, as of 2004. A portion of the Mile High Water District was annexed into Broomfield County, but the remaining portion continues to be served by Broomfield under contract. This water requirement is about 173 AF per year. Future water demand at the airport is likely to stay the same and the Mile High Water District demands are likely to increase no more than three taps per year (ERO 2004).

Potable Use. Table A-3 provides potable water deliveries by type of customer from 1992 to 2003, including the Jefferson County Airport and Mile High Water District customers.

Table A-3. Potable Water Deliveries to City and County of Broomfield Customers, 1992 to 2003.

					Total Potable Use
					AF
1992	1,140	450	80	1,670	5,125
1993	1,160	400	80	1,640	5,030
1994	1,430	440	120	1,990	6,110
1995	1,290	430	150	1,880	5,770
1996	1,520	520	130	2,170	6,660
1997	1,510	520	130	2,160	6,630
1998	1,700	580	150	2,420	7,430
1999	1,780	610	150	2,550	7,830
2000	2,200	760	190	3,150	9,670
2001	2,150	740	190	3,070	9,420
2002	2,300	790	200	3,290	10,100
2003	2,140	730	180	3,060	9,390

Source: City and County of Broomfield 2004b.

Total potable water use for the City and County of Broomfield peaked at about 3,300 MG (10,100 AF) in 2002, dropping in 2003 due to drought and related restrictions. Residential water use comprises an average of about 70 percent of total use. Potable residential water deliveries nearly doubled between 1992 and 2003. Commercial water use represents approximately one-fourth of total Broomfield water use; these water demands have been growing at a slightly slower pace than residential water use. Irrigation use relates to green spaces that are not presently amenable to non-potable irrigation, and they account for six percent of Broomfield's historical water use. Water use per capita for the City and County of Broomfield is set forth in Table A-4.

Table A-4. Potable Water Use Per Capita for the City and County of Broomfield, 1992 to 2003.

	gpcd	
1992	117	172
1993	114	160
1994	136	189
1995	115	168
1996	128	183
1997	122	175
1998	134	191
1999	134	192
2000	158	225
2001	142	203
2002	147	210
2003	132	189

Source: City and County of Broomfield 2004b; ERO 2004.

Total water use per capita per day has varied within a fairly narrow range during the 1990s, averaging 188 gpcd. Residential gpcd have averaged 132 gpcd from 1992 through the year 2003. In terms of commercial use, water demands have averaged 109 gallons per employee per day from 1992 through the year 2003 (City and County of Broomfield 2004b).

Non-potable Use. Broomfield relies on non-potable use for many of its parks, the high school and golf courses, including the Greenway Park Homeowners Association which includes a golf course. Table A-5 indicates non-potable water use from 1996 and estimated through 2004.

Table A-5. Non-Potable and Reuse Demand, 1996 through 2004.

	MG			
1996	0	15	0	15
1997	0	16	0	16
1998	73	18	0	91
1999	93	20	0	113
2000	143	21	0	164
2001	99	23	0	122
2002	489	23	0	512
2003	489	24	0	513
2004	435	25	343	803

Source: City and County of Broomfield, 2004d.

The City and County of Broomfield began delivery of reuse water in June of 2004. A total of 1,050 AF, or 343 MG, are expected to be delivered in 2004 (City and County of Broomfield 2004d).

Total Historical Water Requirements. Table A-6 depicts total water requirements for the City and County of Broomfield from 1992 through the year 2003.

Table A-6. Total Water Requirements for the City and County of Broomfield, 1992 to 2003.

Year					Total Water Requirements[2]
				AF	
1992	1,670	N.A.	1,670	5,130	5,400
1993	1,640	N.A.	1,640	5,030	5,290
1994	1,990	N.A.	1,990	6,110	6,430
1995	1,880	N.A.	1,880	5,770	6,070
1996	2,170	15	2,185	6,710	7,060
1997	2,160	16	2,176	6,680	7,030
1998	2,420	91	2,511	7,710	8,120
1999	2,550	113	2,663	8,170	8,600
2000	3,150	164	3,314	10,170	10,710
2001	3,070	122	3,192	9,790	10,310
2002	3,290	512	3,802	11,670	12,280
2003	3,060	513	3,573	10,960	11,540

[1] Includes raw water, wastewater use and evaporation.

[2] Including system losses.

Source: City and County of Broomfield 2004a; City and County of Broomfield 2004b.

Potable use is added to non-potable use to arrive at total demand. Total requirements reflect total demand along with an assumed system loss of 5 percent (ERO 2004). During this historical period, total Broomfield water requirements peaked at 12,300 AF in 2002. These total requirements are more than twice the total water requirements evident in Broomfield ten years earlier.

Population Projections. Population and employment projections for the City and County of Broomfield have been prepared by the City and County of Broomfield Planning Department and the Water Department as set forth in Table A-7.

Table A-7. Population and Employment by Place of Work, Projected by the City and County of Broomfield through Buildout.

		Employment
1970	7,261	N.A.
1975	15,800	N.A.
1980	20,730	N.A.
1985	22,180	8,100
1990	24,638	9,469
1995	30,670	10,977
2000	38,272	19,500
2005	47,800	28,000
2010	55,100	34,066
2015	63,700	41,446
2020	73,500	50,426
2025	83,300	61,351
Buildout	83,300	140,000

Source: City and County of Broomfield 2004b.

These projections put buildout at 83,300 residents, which would be reached in the year 2025. Buildout of employment by place of work at 140,000 would occur presumably long after the year 2025. The City and County of Broomfield's population projections are based on a 2.9 percent annual increase from 2004 through buildout. This indicates an 80 percent increase in population in 20 years. Employment is expected to grow faster than population, more than doubling in the next twenty years.

The population and employment projections begin with the developer plans for both residential and commercial developments. These are then compared with comprehensive plan policies and goals to ensure consistency. The City and County of Broomfield has established the buildout population as its policy. However, the growth rate to achieve that buildout population is recognized as uncertain and a range of population growth rates are recognized in the City and County of Broomfield's Long Range Financial Plan (City and County of Broomfield 2004b). The Water Department's set of population projections set forth in Table A-7 are within the range of the projections assumed for the Long Range Financial Plan of the City and County of Broomfield.

Broomfield's demographic and economic projections are higher than those assumed by the Colorado Department of Local Affairs (DOLA 2004). These projections assume a population of 72,000 people for Broomfield by the year 2030. However, these state projections assume a current population that is 10 percent lower than the actual population of Broomfield in 2004, and the rapidly changing picture of development in this area is more dynamic than the state's population forecasting model can accommodate. Given historical population and employment growth experience for the City and County of Broomfield, the Water Department's projections are acceptable for this purpose.

Water Demand Projections. Water demand projections are based upon projections of tap equivalents by type for the City and County of Broomfield. Each projected tap equivalent is multiplied by 0.55 AF per tap equivalent (TE) to project total potable water use. (City and County of Broomfield 2004d).

Residential tap equivalents are based upon population projections, persons per household assumptions and land use considerations. Industrial, commercial and related uses are projected on a square footage basis, assuming 9,600 square feet equals a tap equivalent. The 9,600 square feet is based upon historical patterns of commercial and industrial water use. The 0.55 AF per TE assumption is based upon historical experience from 1996 to 2003 (City and County of Broomfield 2004c).

Both the methodology and the underlying assumptions of this forecasting approach are reasonable. Water use per TE is based upon historical experience. Projections of residential and commercial TEs are based upon projections of demographic and economic information by the Broomfield Planning Department using accepted methodologies. Table A-8 provides water demand projections for the City and County of Broomfield.

Table A-8. Water Demand Projections for the City and County of Broomfield, 2005 through 2035.

		AF			
2005	20,200	11,100	2,500	13,600	14,300
2010	24,600	13,500	2,900	16,400	17,300
2015	27,500	15,100	3,300	18,400	19,400
2020	29,500	16,200	3,300	19,500	20,500
2025	31,400	17,300	3,300	20,600	21,700
2030	33,800	18,600	3,300	21,900	23,100
2035	36,100	19,900	3,300	23,200	24,400

[1] Including system losses.

Source: City and County of Broomfield 2004b; ERO 2004.

Non-potable demands as projected by the City and County of Broomfield Water Department are added to potable demands to arrive at total demands. Total water requirements account for five percent system losses. Total requirements are projected to increase from 14,300 AF in 2005 to 24,400 AF in the year 2035.

As a check, the study team prepared water demand projections for the City and County of Broomfield applying average usage rates to residential and commercial customers, respectively. The study team applied average residential gpcd to population projections for the year 2025 and employment projections for the year 2025 to average gallons per employee per day, based upon historical experience in the 1990s. Irrigation water use was held constant at the year 2002 level. The study team's potable water demand projections in the year 2025 amount to almost 21,000 AF, compared with the potable water demand projections from the City and County of Broomfield of 17,300 AF.

This difference suggests that the demand projections prepared by the City and County of Broomfield are not over-stated.

Conservation

Broomfield enacted a water conservation plan in 1996. The elements of this plan include:

- Public education – Development and distribution of promotional materials, advertising and literature. Other educational efforts to promote conservation include water conservation kits provided to residents at no charge, xeriscape books placed at the library, xeriscape seminars held twice a year, composting seminars held twice a year, and a Broomfield website devoted to conservation.
- Non-potable – Broomfield's non-potable system was initiated after the 1996 Water Conservation Study and focused on City parks and golf courses.
- System-wide water audits and meter replacements – To reduce system losses, Broomfield conducts water audits to ensure the accuracy of records.
- Leak detection system – This program focuses on replacement of transmission and distribution lines within the City system attempting to find unwarranted system losses such as leaks, and repair them quickly.
- Residential landscape requirements – Prior to seeding turf grass, residential lots must be treated with organic soil amendments to reduce water requirements. Broomfield limits the amount of landscape that can be dedicated to turf grass on new lots. In addition, irrigation systems on residential lots must include drip irrigation for trees and shrubs. The City and County also requires water efficient irrigation system fittings.
- County Extension Agent – Since Broomfield is also a county, they qualify for a Colorado State University Extension Agent, who is responsible for educating residents on landscaping, soils, xeriscape concepts and other water conservation measures.
- The City and County of Broomfield is 100 percent metered.
- Low-flow toilets are required in all new buildings and homes.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand as described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Needs

Broomfield's current water needs are met primarily by C-BT Project and contract deliveries from Denver Water. Water demand is expected to exceed available firm water supplies by about 2005 (Figure A-1), which would affect the ability of the City to meet dry year water needs depending on C-BT deliveries. Broomfield's projected 2035 water requirements exceed available firm supplies by about 10,700 AF. Firming Broomfield's Windy Gap water would provide a firm annual yield of about 5,600 AF to meet potable needs plus sufficient reusable effluent (3,100 AF) to meet the majority of anticipated non-potable demands. A firm Windy Gap water supply would provide Broomfield about 23 percent of the City's 2035 water supply requirement (Figure A-2), not counting the potential reuse of Windy Gap water. Water conservation and other sources of water supply also will be needed to meet all of the estimated future water demands.

Figure A-1. Broomfield's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

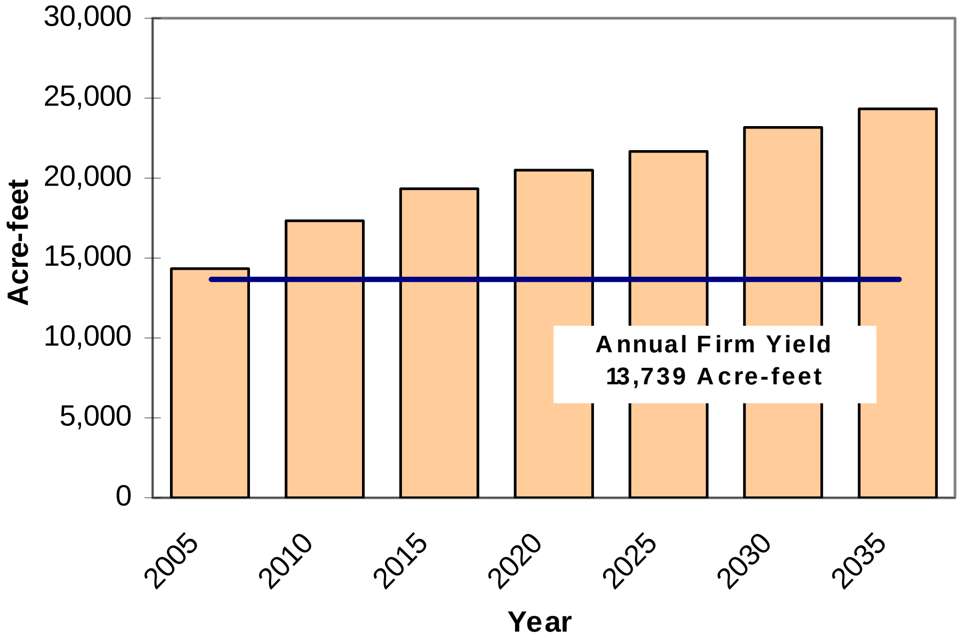
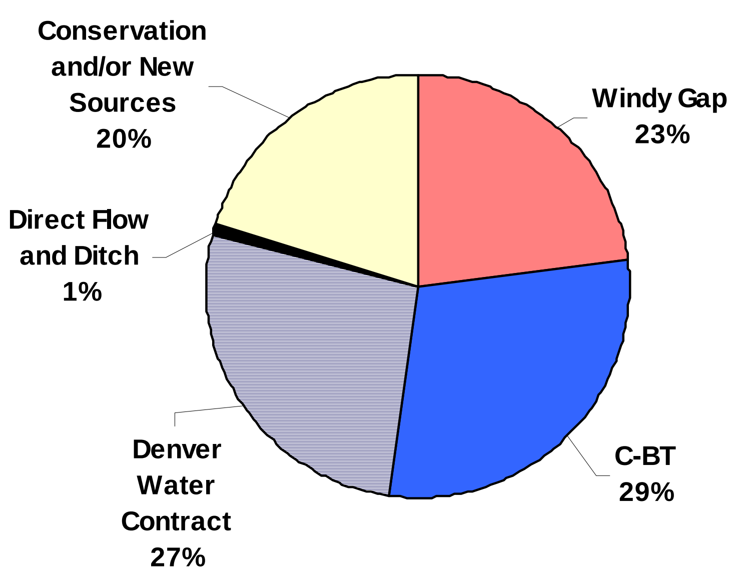


Figure A-2. Broomfield's 2035 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND
CENTRAL WELD COUNTY WATER DISTRICT

Introduction

Central Weld County Water District (CWCWD) was created in 1965 to serve a large rural portion of Weld County. The CWCWD's total service area is about 250 square miles generally located south of Greeley and spanning along the South Platte River to the area along I-25 south of Dacono. The CWCWD currently serves rural residential and commercial agricultural areas and treats water for several communities. In 2005, CWCWD began providing water to the communities of Firestone and Frederick. The following discussion provides a summary of CWCWD's water supply and demand.

Water Supply

The CWCWD's water supply consists of two main water categories: water owned by CWCWD which is treated and delivered to rural customers; water that is transferred to CWCWD, treated, and delivered to towns in the service area. This supply analysis only includes those sources of water owned by CWCWD. Water supplies under CWCWD ownership primarily include C-BT water, Windy Gap water, and ditch shares in the Greeley-Loveland Irrigation Company (GLIC). The CWCWD and the Little Thompson Water District jointly own and operate the Carter Lake Filter Plant, which includes a North and South Plant.

Transbasin Water Sources

Colorado-Big Thompson Project

The majority of CWCWD's water supply is from the C-BT Project. Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002-2004 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Like most water providers, CWCWD has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons.

Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit. The CWCWD owns 4,637 units in the C-BT Project, which provides a firm yield of about 2,782 AF using a C-BT quota of 0.6 AF/unit (Table B-1). C-BT water also is transferred from the towns of Dacono, Gilcrest, Kersey, LaSalle, Milliken, Platteville, and Aristocrat Ranchettes to CWCWD for water treatment and delivery. The CWCWD treats 100 percent of the potable water supply for these communities, except for Milliken and Gilcrest, which also use ground water (ERO 2004). This water is not included as part of CWCWD water supply since they only provide treatment and delivery services for these communities.

Windy Gap Project

The remaining transbasin source includes 1 unit of unfirmed Windy Gap water. Windy Gap water does not currently provide a firm annual yield. Towns served by CWCWD do not use any Windy Gap water. When available, CWCWD delivers Windy Gap water to rural residential customers outside the Northern Colorado Water Conservancy District (NCWCD) C-BT service boundary.

Ditch Shares

Central Weld owns 0.33 share of Greeley-Loveland Irrigation Company water, which provides about 4 AF of firm yield. This water is exchanged for C-BT water.

Table B-1. Inventory of CWCWD Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	4,637	2,782 [1]
Windy Gap Project	1	0
Ditch Shares		
Greeley-Loveland Irrigation Company	0.33	4
Total		2,786

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis.

Non-potable Water

CWCWD currently has no non-potable water sources or demand.

Reservoir Storage

CWCWD currently has no water reservoir storage and relies on existing C-BT and GLIC storage reservoirs for raw water storage. The CWCWD maintains six above-ground tanks for storage of up to 13.0 MG of treated water (CWCWD 2004b).

The CWCWD and Little Thompson Water District are jointly planning construction of Dry Creek Reservoir, which is scheduled for completion in 2006. Dry Creek Reservoir will allow CWCWD more storage of C-BT water independent of C-BT facilities to provide drought protection and increased operational flexibility. Additional storage will improve reliability should problems at the Carter Lake outlet occur. The new reservoir will have 8,800 AF of storage (ERO 2004).

Reuse

The CWCWD does not currently have a firm water supply source available for reuse or a mechanism to capture water for reuse. Because CWCWD uses Windy Gap water to serve rural customers and does not operate a waste water facility, there are no future plans to reuse Windy Gap water.

Water Demands

The CWCWD currently supplies water to rural customers within its district boundaries and treats water for the communities of Dacono, Kersey, Milliken, LaSalle, Gilcrest, Platteville, Left Hand and Aristocrat. CWCWD is currently responsible only for providing treatment and not for supplying the raw water for these communities; therefore, these communities were not included in the demand evaluation. Historically, CWCWD provided similar treatment-only services for the towns of Frederick and Firestone; however, these communities have applied through CWCWD for water supplies from the Northern Irrigated Supply Project. As a result, CWCWD will serve these towns in the future. The water supply and demand for Firestone and Frederick were not included in this evaluation because CWCWD's one unit of Windy Gap water will be used to meet the needs of existing rural customers. CWCWD's service area is approximately 250 square miles, all within Weld County (TEC 2003).

Historical Water Use

CWCWD's service area population was estimated at about 5,200 persons in 2002 (TEC 2003). Table B-2 provides population and historical water use for the CWCWD by customer class.

Table B-2. Historical Water Use for CWCWD.

						Total	
							Taps
1999	4,075	242	1363	532	119	774	1,482
2000	4,972	295	1663	597	130	891	1,793
2001	5,047	280	1688	619	133	899	1,821
2002	5,197	326	1738	588	137	914	1,875

Source: TEC 2003.

From 1999 through 2002, CWCWD's total taps increased by 27 percent, or at an average annual rate of 8.2 percent. CWCWD's total potable water deliveries increased by 18 percent from 1999 through 2002, or at an average annual rate of 5.7 percent, more slowly than tap growth but more quickly than population growth from 1990 through 2000.

Nonresidential demands accounted for nearly two thirds of total CWCWD demand in 2002. Nonresidential demand is mostly attributable to various agricultural and dairy users, with Aurora Dairy and Fort St. Vrain Power Generation representing the largest users (CWCWD 2004c; Zadel, pers. comm. 2004). Nonresidential water use grew by more than 10 percent from 1999 to 2002, while the total number of nonresidential taps grew by approximately 15 percent during this period. In 2002, annual nonresidential use per tap was 4.3 million gallons.

While the majority of CWCWD's use is agricultural, CWCWD has experienced growth in both the number of residential taps and use in recent years. From 1999 to 2002, the CWCWD residential water sales increased by nearly 35 percent, and its share of total use increased by almost 5 percent. Over this short period, the total number of residential taps grew by 8 percent per year on average.

Residential and total water use per capita per day averaged 162 and 495 gallons respectively, from 1999 to 2002 (Table B-3). A number of agricultural and large non-residential water users inflate the total water use per capita so it is not directly comparable to other water providers in the region.

Table B-3. Potable Water Use Per Capita for CWCWD.

Year		Total
	gpcd	
1999	163	521
2000	162	491
2001	152	488
2002	172	482
Average	162	496

Source: Table B-2

Potential Water Requirements

Residential Demands

CWCWD provided Harvey Economics with forecasts of future water demands through 2030. These projections were prepared by The Engineering Co. (TEC) for CWCWD's 2003 Water Master Plan (Master Plan). Projections were based on forecasted residential tap growth combined with average annual use per tap.

Analysis of annual residential tap sales (1997-present) by TEC suggested future growth would occur at a "base" rate of 60 residential taps per year (TEC 2003). In fact, the total number of residential taps has grown by an average of 125 taps per year since 1999. Given the small numbers involved and the availability of land to accommodate growth, this base rate growth assumption of 60 residential taps per year is considered reasonable.

In addition, the CWCWD has agreed to provide developers of the Beebe Draw subdivision up to 100 taps per year. Initial tap sales suggest that an additional 40 taps per year would be necessary to meet demands associated with the construction of the Beebe Draw Subdivision. At this rate the subdivision would reach build out by the year 2015, at that point district wide tap growth would revert to the base of 60 taps per year. This assumption is reasonable given Beebe Draw plans and rural county growth prospects.

Table B-4 presents future residential tap growth and the average annual rate of growth for each period presented through 2050. For comparison, during the period 1999-2002 (presented in Table B-2) the number of taps grew at an average annual rate of nearly 9 percent per year.

Table B-4. Projected Residential Taps for CWCWD through Year 2050.

		Average Annual Rate of Growth
2005	2,000	N.A.
2010	2,500	4.6%
2015	3,000	3.7%
2020	3,300	1.9%
2025	3,600	1.8%
2030	3,900	1.6%
2035	4,200	1.5%
2040	4,500	1.4%
2045	4,800	1.3%
2050	5,100	1.2%

Source: TEC 2003; Harvey Economics 2004a.

Non-Residential Demands

Due to the difficulty associated with predicting changes to its commercial, industrial and agricultural customer base, the CWCWD analysis did not include projections of non-residential demands. Analysis of recent trends by Harvey Economics suggested that the assumption of no growth for non-residential use would underestimate future demands.[1]

Projections of non-residential demands were calculated in a manner consistent with the approach taken by TEC in the Master Plan. Over the period 1992-2002 the total number of non-residential taps grew by an average of 3.5 new taps per year (Harvey Economics 2004b). For the purposes of projecting non-residential demand, it was assumed that the total number of non-residential taps would continue to increase by 3.5 per year (Table B-5).

[1] Additional support for this is provided in the Master Plan, which cites the availability of land and the presence of a reliable water source as likely reasons for continued growth within the District's agricultural customer base (CWCWD Master Plan, Pg. 7).

Table B-5. Projected Non-residential Taps for CWCWD through Year 2050.

		Average Annual Rate of Growth
2005	150	N.A.
2010	170	2.5%
2015	180	1.1%
2020	200	2.1%
2025	220	1.9%
2030	240	1.8%
2035	250	0.8%
2040	270	1.6%
2045	290	1.4%
2050	310	1.3%

Source: Harvey Economics 2004a.

The average annual use per non-residential tap varies greatly depending on the type of user and tap size. Within CWCWD, average annual use per tap has varied between a low of 895,483 gallons per year (3/4-inch taps in 1999) to a high of 59,220,667 (4-inch taps in 1999). To better characterize future non-residential demand, a comparison of annual changes in total non-residential use to annual growth in the number of non-residential taps was used to estimate average annual use per new non-residential tap. Based on this analysis, projected annual average use per non-residential tap was assumed to be 1.9 MG or 5,200 gallons per tap per day.[2] This figure reflects the fact that recent non-residential growth has primarily occurred at smaller tap sizes. To the extent that growth within the CWCWD's class of larger customers is likely, the resulting projections will underestimate actual demands. New non-residential demands were calculated as the product of the total number of new taps and the assumed average use per new non-residential tap. This figure was then added to existing non-residential demand (588 MG as of 2002) to arrive at the total for this customer class.

Total Water Demands

Table B-6 provides projected CWCWD residential, non-residential and total water demand projections for the period 2005 to 2050. Also included is the resulting average annual rate of growth.[3] Total water requirements include approximate system losses of 5 percent.

[2] For comparison, average annual use per non-residential tap has been approximately 4.5 million per tap, or 12,300 gallons per tap per day.

[3] By comparison, over the period 1992-2002 the districts total annual rural demand grew at an average annual rate of 3.6 percent.

Table B-6. Projected Water Demand for CWCWD through Year 2050.

					Average Annual Growth
2005	1,100	1,900	3,000	3,200	N.A.
2010	1,400	2,000	3,400	3,600	2.4%
2015	1,700	2,100	3,700	3,900	1.6%
2020	1,800	2,200	4,000	4,200	1.5%
2025	2,000	2,300	4,300	4,500	1.4%
2030	2,200	2,400	4,500	4,700	0.9%
2035	2,300	2,500	4,800	5,100	1.6%
2040	2,500	2,600	5,100	5,400	1.1%
2045	2,700	2,700	5,300	5,600	0.7%
2050	2,800	2,800	5,600	5,900	1.0%

[1] Including system losses.

Source: Harvey Economics 2004a.

These projections are consistent with recent use trends within the CWCWD. Projected residential use continues to grow as a percentage of total use, accounting for more than half of total demand by 2050.

CWCWD is responsible for securing raw water supplies for the rural customers in its service area and has recently agreed to serve the communities of Firestone and Frederick. The projections provided in Table B-6 reflect only the future demands of rural customers, not including Firestone and Frederick. Although CWCWD will serve Firestone and Frederick with existing and future water supplies, sources other than Windy Gap water would be used. At present, CWCWD is not responsible for securing the raw water necessary to meet future demands for the communities of Dacono, Kersey, Milliken, LaSalle, Gilcrest, Left Hand and Aristocrat. However, significant population growth in the future is expected to occur within these communities. In fact, water demand projections contained in CWCWD's 2003 Water System Master Plan suggest that deliveries to these communities are expected to increase by 9,457 AF, or 165 percent, between 2005 and 2030. Consultation with CWCWD suggested that, absent significant changes to current infrastructure, these communities have few supply options available to meet these demands (Zadel, pers. comm. 2004). If, at some point, the CWCWD assumes this responsibility, the projections in Table B-6 will understate CWCWD's actual needs (Zadel, pers. comm. 2004). Although these communities are small, it is quite possible that CWCWD might play a role in assisting them with future water supplies.

Conservation

In 2003, the CWCWD developed a Water Conservation Plan to "(1) raise the awareness level of all water users within CWCWD to conserve water at every level of use, (2) to encourage all CWCWD water users to use water more efficiently and (3) to satisfy the requirements of the Water Conservation Act of 1999" (TEC 2003). All water service connections are metered, including all inputs and outputs to the system.

Other components of CWCWD Water Conservation Plan include:

- Publication of CWCWD newsletter, which promotes voluntary upgrades to water efficient fixtures and appliances through its annual newsletter.
- Disseminates educational materials regarding efficient irrigation techniques.
- Plans to establish a library of water efficient literature available to all CWCWD customers.
- Since 1988 the CWCWD has also utilized an aggressive, advanced computer leak detection system to reduce inefficiencies in the distribution of its supplies. All water entering and leaving the distribution system is monitored and flow levels are reported every 2 ½ minutes. Such a system allows CWCWD to immediately detect and repair leaks. In addition, the CWCWD regularly upgrades its distribution lines to improve system efficiency and reliability.
- The CWCWD encourages dairy and other agricultural businesses to use non-treated water when possible.

The CWCWD's Conservation Plan includes implementation of other measures in the future including an evaluation of its water rate structure, water savings demonstrations, continued monitoring of water use with notifications of increases in use as an incentive/reward mechanism, and application of surcharges for water use above the base amount.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-

BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand as described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Need

The CWCWD current water needs are met primarily by the C-BT Project. Water demand is expected to exceed available firm water supplies by about 2005, which would affect the ability of CWCWD to meet dry year water needs depending on C-BT deliveries (Figure B-1). Projected water demand exceeds supply by about 1,900 AF in 2030 and by 2050 a shortage of about 3,100 AF is anticipated. Firming the Windy Gap water supply would provide about 100 AF of water or less than 2 percent of the CWCWD’s 2050 water supply (Figure B-2). Water conservation and other sources of water supply will be needed to meet future water demands.

Figure B-1. CWCWD's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

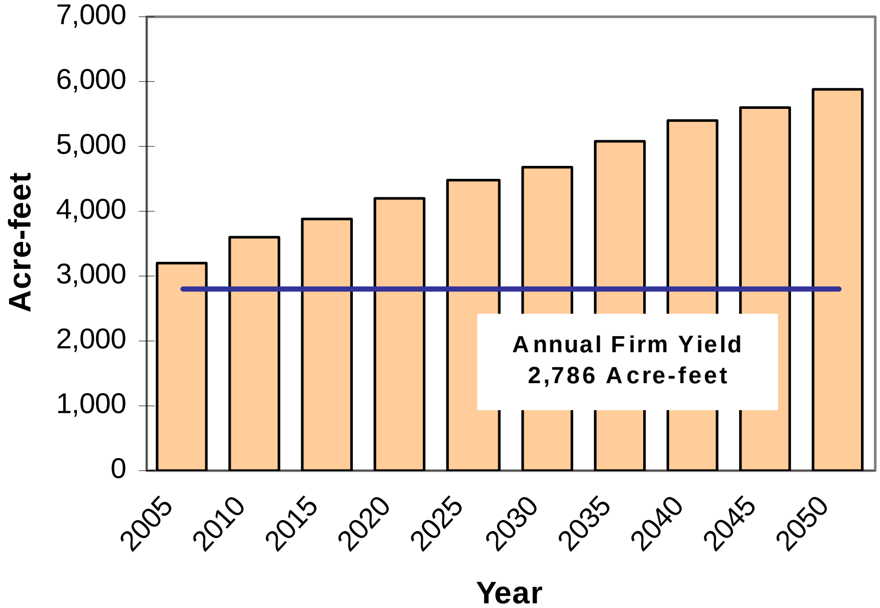
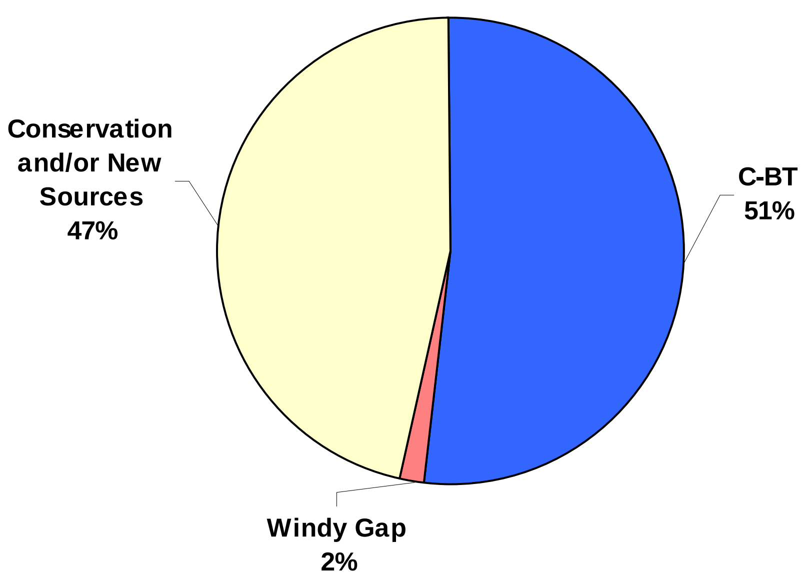


Figure B-2. CWCWD's 2050 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

TOWN OF ERIE

Introduction

The Town of Erie is located in Boulder County, Colorado just north of the City of Lafayette. Erie is a small but rapidly growing community on the northern edge of the Denver metropolitan area. Incorporated in 1874, this historic coal mining community provided coal to residents and businesses in the region as well as to the steam locomotives that passed through northern Colorado. The following discussion provides a summary of Erie's water supply and demand.

Water Supply

Erie's water supply has grown sharply to keep pace with the rapid population growth that began in the mid 1990s. Erie purchased C-BT Project water from 1992 to the present, which currently provides more than 75 percent of its water supply (Town of Erie 2004b). Other water sources include unfirmed Windy Gap water, reservoir storage rights, and various ditch shares.

Erie's current reliance on C-BT water can leave it subject to shortages when delivery quotas are low. During the drought in 2002, the Town had to lease additional C-BT units to meet its demands (Id).

Transbasin Water

Colorado Big-Thompson

The Town of Erie owns 3,353 units of C-BT water, which is delivered via the Southern Water Supply Pipeline (SWSP) from Carter Lake. C-BT water is delivered to Erie by the SWSP directly to the Town's water treatment plant. Erie owns a capacity of 5.5 cfs in the SWSP and has a lease for excess capacity from Superior during the irrigation season.

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Like most municipalities, Erie has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons.

Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit. Erie's C-BT water delivery yields about 2,012 AF based on a 0.6 AF/unit yield and up to 3,353 AF in dry years based upon a 1.0 AF/unit yield.

Windy Gap

Erie has 20 Windy Gap units in the Windy Gap Firming Project, including 7 units it currently owns and the planned acquisition of up to 13 additional units from other Windy Gap owners. In addition, Erie has a 5-year lease with an option for an extension from Longmont for 8 units of unfirmed Windy Gap water. When available, Windy Gap water is delivered to Erie for municipal use through the SWSP along with C-BT water. Windy Gap water is delivered to Erie's water treatment plant and is generally used from April through October. Future firmed Windy Gap water would be used in a similar manner as it has been used historically, although reuse would be expanded. Erie anticipates that it will use Windy Gap water as soon as it is firmed (ERO 2004).

Ditch Shares

Erie owns a total of 484.5 ditch shares in Leyner Cottonwood Ditch, South Boulder Canon Ditch, Erie Coal Creek Ditch, and the FRICO – Marshall Lake Diversion (Table C-1). Leyner and South Boulder Canon Ditches together account for the majority of ditch shares (over 99 percent). The Town recently purchased an additional 100 shares in the Leyner-Cottonwood Ditch for irrigation purposes, but those shares have not yet been formally issued to the Town so they are not included in the totals below. All but 2.5 shares of Leyner Cottonwood Ditch have been changed from irrigation to municipal use. Sixty of Erie's 203 South Boulder Canon Ditch shares have been changed from irrigation to municipal use. All of the Erie Coal Creek Ditch and FRICO shares are decreed for irrigation. In the future, Erie plans to continue to change some of its ditch shares to municipal use and dedicate other shares for irrigation purposes within the Town (Town of Erie 2004a).

Reservoir Storage

Erie owns storage in Erie, Prince, and Thomas Reservoir, which have a combined storage capacity of 652 AF (Table C-1). Water deliveries to Erie through the SWSP can be stored in all of these reservoirs. The South Boulder Canon Ditch is diverted from South Boulder Creek and flows into Erie Reservoir. The Leyner-Cottonwood Ditch water can also be diverted in the South Boulder Canon Ditch and is decreed for storage in any of the Town's reservoirs. All three reservoirs have conveyance to the water treatment plant.

Table C-1. Inventory of Erie Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	3,353 units	2,012[1]
Windy Gap Project	20 units[2]	0
Reservoir Storage		
Erie Reservoir	239 AF	72
Prince Reservoir	200 AF	24
Thomas Reservoir	213 AF	0
Ditch Shares		
Leyner Cottonwood Ditch	257.5 shares	36
South Boulder Canon Ditch	203 shares	0
Erie Coal Creek Ditch and Res. Co.	23 shares	0
FRICO – Marshall Lake Diversion	1 share	1
Total		2,145[3]

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis; however, C-BT water may yield more in dry years.

[2] In addition, Erie has a temporary lease with Longmont for 8 unfirmed Windy Gap units.

[3] The firm yield for purposes of this analysis is 2,145 AF. Erie has maintained a sufficient water portfolio to meet all demands to date. It uses increased quotas from its C-BT Units in dry years and Windy Gap yields in wet years when C-BT quotas are typically lower. It also operates pursuant to the Integrated Operating Criteria, which allows Erie to collateralize Windy Gap water with C-BT water. In doing so, it has reuse water available for irrigation purposes. The Windy Gap Firming Project is essential to meet future demands. Upon completion of the Project, Erie will be able to use its C-BT units to meet future demands rather than as collateral for Windy Gap units.

Water Reuse

Currently, Erie discharges effluent from its wastewater treatment plant to Coal Creek. Reusable effluent is used at the Vista Ridge Golf Course and development via an upstream exchange. Windy Gap water is currently the only source of water used in the Town's reuse program, which currently needs to be firmed using C-BT water as collateral. When the Windy Gap water is firmed, Erie will no longer need to use its C-BT water to collateralize its Windy Gap units. Those C-BT units will be used to meet future demands. . Erie estimates about 50 percent of its Windy Gap water could be reused if the Firming Project is implemented.

Water Demand

Prior to 1995, the Town of Erie was small and rural in nature; considerable growth occurred after 1997 and continues through 2004. Currently, Erie is a bedroom community for the Denver metropolitan area. Encompassing about 14 square miles, the Town of Erie and its water department serves most of the water consumers within its service area. Left Hand Water District temporarily serves a portion of Erie's service area (Town of Erie 2004c). No large industrial or other water users were evident as of mid-2004.

Historical Water Demands

The Town of Erie's population has grown from about 1,260 persons in 1990 to 6,300 persons in 2000; 2004 is estimated at 10,390 persons. Population growth and the change in the number of housing units since 1980 are depicted in Table C-2.

Table C-2. Population and Housing Unit Change for the Town of Erie, 1980 to 2004.

				Annual Percent Change
1980	1,254	N.A.	440	N.A.
1990	1,258	>0.1%	460	>0.1%
2000	6,291	17.5%	2,282	17.4%
2001[1]	7,580	20.5%	2,748	20.4%
2002[1]	8,190	8.0%	2,968	8.0%
2003[1]	8,930	9.0%	3,236	9.0%
2004[1]	10,390	16.3%	3,714	14.8%

[1] Beginning of the year estimates.

Source: U.S. Bureau of Census; DRCOG, Metro Vision Resource Center 2004; Clarion Associates, Erie Comprehensive Plan Update Draft, August 2004.

From 1990 to 2004, Erie's population and number of housing units have grown by the extraordinary rate of 729 percent and 744 percent, respectively. This rapid growth has continued during 2004: the September 30, 2004 total residential taps amounted to 4,238, or about a 500 tap increase since the beginning of the year (Town of Erie 2004d).

Potable Water Demands

The Town of Erie's water demands also show considerable growth since the mid 1990s. Table C-3 provides a breakdown of residential and non-residential water deliveries to end users in the Town of Erie from 1995 to 2004.

From 1997 through 2003, total water deliveries for the Town of Erie increased 6.4 times. Water deliveries declined by about 10 percent from 2002 to 2003 owing to the drought and related restrictions. Year 2004 water demands are on pace to exceed those of 2002. In 2002, residential water use comprised 76 percent of total water sales, and residential use has averaged 88 percent of total water sales from 1997 through 2004. Commercial water sales were rather modest in the late 1990s but have grown considerably since 2001. In 2003 and 2004, commercial water sales accounted for more than 15 percent of total water sales.

Table C-3. Town of Erie Potable Water Deliveries, 1995 to 2004.

	Deliveries to End Users (M				Total Number of Water Taps[2]
1995	N.A.	N.A.	65	N.A.	647
1996	N.A.	N.A.	74	14%	737
1997	70	5	75	1%	904
1998	153	18	171	128%	1,243
1999	N.A.	N.A.	251	47%	2,104
2000	346	30	376	50%	2,248
2001	427	37	464	23%	2,900
2002	416	132	548	18%	3,157
2003	394	86	480	-12%	3,409
2004[3]	232	77	309	N.A.	4,049

[1] Non-residential includes water hydrants.

[2] Number of taps at the beginning of the year.

[3] Data through July 2004.

Source: Tetra Tech RMC 2001b. Additional information provided by the Town of Erie Accounting Office.

Table C-4 provides Erie's gallons per capita and per tap data from 1995 through 2004.

Table C-4. Potable Water Use per Capita and per Tap for the Town of Erie.

Year		Total	Gallons per Tap per Day
	gpcd		
1995	**N.A.**	105	275
1996	N.A.	98	275
1997	98	105	227
1998	93	104	376
1999	**N.A.**	125	327
2000	115	155	458
2001	140	180	438
2002	155	179	476
2003	108	143	386

Note: Values are based on population and taps at the beginning of each year.

Source: Tetra Tech RMC 2001b. Additional information provided by the Town of Erie Accounting Office.

Gpcd between 2000 and 2003 averaged 164 for total water use and 129 for residential water use. Gallons per tap per day averaged 440 during this period. Annual fluctuations are likely attributable to weather, with some upward trend in these data as new, larger lot houses have been built in recent years.

Non-potable Demands

Erie's non-potable demands include watering the green space for parks, ball fields and a golf course, although the golf course utilizes some of its own water for irrigation (Town of Erie 2004c). Erie estimates its non-potable water requirements at 2.5 acre-feet per acre for water intensive irrigation and 1.33 acre-feet per acre for native irrigation (Id). The Town of Erie initiated non-potable water use in 2001 and averaged about 80 acre-feet of deliveries between 2001 and 2003. Non-potable water demands are met from the reuse capability of the Town's Windy Gap units, which it owns and leases, as of 2004.

Total Water Requirements

The Town of Erie's total requirements are the sum of potable water deliveries, non-potable water deliveries and an accounting for system losses of 13 percent, 8 percent of which is lost from the treatment plant to the tap. Table C-5 offers a summary of total water requirements for the Town of Erie through 2003.

Table C-5. Total Water Requirements for the Town of Erie, 1995 through 2003.

	Potable Water Deliveries				Total Water
			AF		
1995	65	199	0	199	229
1996	74	227	0	227	261
1997	75	229	0	229	263
1998	170	523	0	523	601
1999	251	770	0	770	885
2000	376	1,154	0	1,154	1,326
2001	464	1,424	80	1,504	1,729
2002	548	1,682	80	1,762	2,025
2003	480	1,474	80	1,554	1,786

[1] Including system losses.

Source: Tetra Tech RMC 2004. Additional information provided by the Town of Erie Accounting Office, and the Town of Erie Public Works Department.

Total water requirements for the Town of Erie increased from 229 AF in 1995 to 1,786 AF in 2003, an increase of 1,557 AF over that period.

Projected Water Requirements

Tetra Tech RMC developed water demand projections for the Town of Erie are found in the *2001 Raw Water Supply Study* (Tetra Tech RMC 2001b). Tetra Tech RMC developed these projections by applying population projections to an assumed raw water demand in gpcd. These projections are summarized in Table C-6.

Table C-6. Tetra Tech RMC Water Demand Projections for the Town of Erie, 2005 to Buildout.

			Raw Water Demand	
				AF per Year
2005	Projected water usage	14,600-18,100[1]	220	3,600-4,500[1]
2010	Projected water usage	22,700-30,600[2]	220	5,600-7,500[1]
2015	Projected water usage	30,800-38,000[3]	220	7,600-9,600[1]
2020+	Ultimate population with “moderate” water demand estimate	38,000	225	9,600[1]
2020+	Ultimate population with “high” water demand estimate	38,000	484	20,600[2, 3]

[1] Lower range based on growth of 650 taps per year. Upper range based on growth of 1,000 taps per year. Excludes raw water demand for irrigation of parks, open space, arterials, etc.

[2] Includes raw water demand for irrigation of parks, open pace, arterials, etc.

[3] Based on Town of Erie 1996 Comprehensive Plan and 1999 Update as described in RMC draft memorandum re: Town of Erie Water Demand Projections, October 3, 2000.

Source: Tetra Tech RMC 2001a.

The above water demand projections assume a growth rate of between 650 and 1,000 taps per year, stemming from Tetra Tech RMC’s consultations with Town of Erie staff in the year 2000. Buildout was assumed to be a population of 38,000 people. The gpcd assumption of 220, based upon discussions with the Town of Erie staff, was noted by Tetra Tech RMC to be on the upper range of per capita use compared to other Colorado water providers. Tetra Tech RMC also looked at a higher range of water demand for planning purposes, assuming 484 gpcd, but the planning focus was on the lower gpcd figure.

The methodology employed by Tetra Tech RMC is appropriate, given the level of information available in the year 2000. A calculation of population multiplied by gpcd to develop water demand projections is a commonly used technique.

Study Team Water Demand Projections

The Town of Erie has undergone considerable changes since the year 2000 and information available in 2004 offers an opportunity to both update and refine water demand projections prepared by Tetra Tech RMC. First, revised population and housing unit projections have been developed for the 2004 Erie Master Plan Update, as presented in Table C-7. Buildout population is estimated to occur in the year 2025, with a population of about 40,700 and 14,600 housing units.

Table C-7. Housing Unit and Population Projections for the Town of Erie, 2004 to 2025 (Buildout).

			Average Annual Growth Rate
2004	4,180	11,600	N.A.
2007	5,950	16,640	12.78%
2012	7,960	22,270	6.00%
2017	10,650	29,800	6.00%
2025	14,580	40,680	3.97%

Source: Clarion Associates 2004.

The growth rates suggested in the Erie Master Plan Update are extraordinary but in keeping with past experience. Clarion Associates thoroughly considered growth influences including development plans, available land and Town policies. Growth rates are assumed to decline as the population gets larger. This current evaluation of Erie's growth prospects, coupled with extraordinary historical growth that the Town has experienced, suggests that these projections are reasonable.

The study team revised water demand projections for the Town of Erie based upon information available in the fall of 2004. Potable water demands were projected based upon the average gpcd for the years 2000 to 2003, multiplied by population projections as indicated in Table C-8. Non-potable demand was projected based upon the current percentage of use as compared with potable deliveries (Zilas 2005). Total Erie water requirements assume a 13 percent total loss, including losses from the point of diversion to the tap. Table C-8 presents these demand projections for the Town of Erie.

Table C-8. Revised Water Demand Projections for the Town of Erie, 2005 to Buildout.

	AF			
2005	2,100	80	2,200	2,500
2010	3,700	100	3,800	4,400
2015	4,900	200	5,100	5,900
2020	6,200	200	6,500	7,400
2025	7,500	300	7,800	8,900

[1] Erie has maintained a sufficient water portfolio to meet water requirements to date. It uses increased quotas from its C-BT units in dry years and Windy Gap yields in wet years when C-BT quotas are lower. It has also maximized the carryover program for its C-BT water. The Windy Gap Firming Project is essential to meet future demands. Total water requirements include system losses.

Source: Projections developed by Harvey Economics (Harvey Economics 2004).

Total Erie water requirements are expected to increase from about 2,500 AF in the year 2005 to about 8,900 AF in the year 2025 when buildout is reached. This represents about a 256 percent change over that period of time.

Conservation

The Town of Erie has implemented several conservation measures to reduce water use. Erie has undertaken a public education effort to apprise its customers about efficient water use practices and offers conservation tips on its website and links to other conservation sites. The Town distributes a water conservation flyer, and it has sponsored a six-part series on water conservation on local television.

Erie actively promotes water conservation through requirements for native seeding and xeriscaping in open space and for new parks. This effort could eventually save as much as 1,100 acre-feet by the year 2020.[1]

The Town of Erie has an inclining block rate structure. The Public Works Department continually monitors for leaks in water lines and sprinklers, making the necessary repairs.

Erie participates in the irrigation audit program, conducted by the Center for Resource Conservation. This program tests irrigation systems for efficiency and makes recommendations for improvements.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

[1]Town of Erie. Interview with Gary Behlen, Town of Erie Public Works Director, and Paul Zilis, attorney, conducted by Ed Harvey. June 2004.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

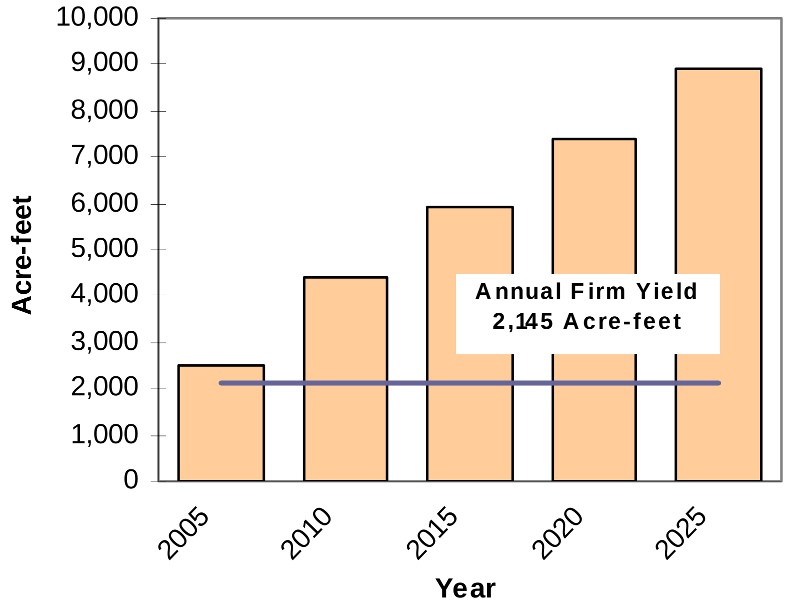
For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Needs

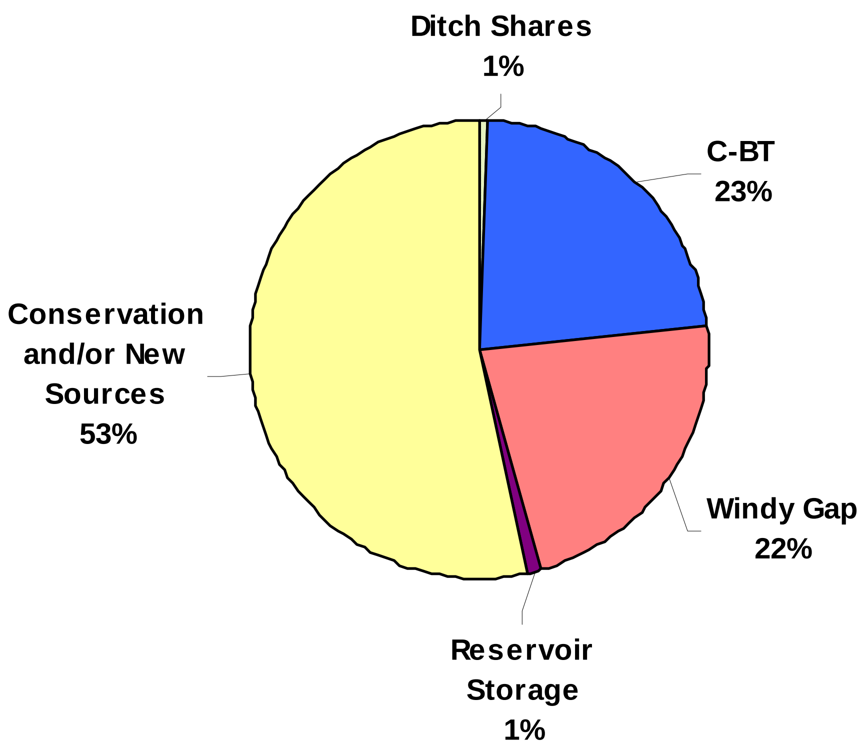
Current water demands are met primarily by C-BT water. A firm water supply shortage of about 6,800 AF is estimated by buildout in 2025 (Figure C-1). Firming Erie's Windy Gap Project water supply would provide about 2,000 AF of water or about 22 percent of the Town's 2025 water supply (Figure C-2), not including the reuse of about 50 percent of the Windy Gap yield to meet irrigation demands. Water conservation and other sources of water supply also will be needed to meet future water demands.

Figure C-1. Erie's 2005 Annual Firm Yield vs. Total Projected Water Requirements.[1]



[1] This report does not include reuse water as a part of Erie's firm yield.

Figure C-2. Erie's 2025 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

CITY OF EVANS

The City of Evans is located in south-central Weld County just south of the City of Greeley. The South Platte River flows along the edge of the community and is an important natural resource. Evans is a highly diversified and stable community experiencing significant growth and development. The following discussion provides a summary of Evans' water supply and demand.

Water Supply

The City of Evans currently relies on transbasin water and ditch shares for its water supply (Table D-1). Transbasin supplies consist of C-BT units and recently acquired Windy Gap units. Five ditch companies including the Evans Town Ditch, Greeley and Loveland Irrigation Company, Seven Lakes Irrigation Company, Loveland and Greeley Reservoir, and the Godfrey Ditch provide local sources of water. Water from Greeley and Loveland Irrigation Company, Seven Lakes Irrigation Company, and Loveland and Greeley Reservoir can be delivered to Greeley for treatment and potable use (ERO 2004). Evans has a dual delivery system for potable and non-potable use in portions of the community. The current water distribution system was constructed beginning in 1904 and has had many recent additions to improve efficiency and expand delivery.

Transbasin Supplies

Colorado-Big Thompson Project

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Evans, like most municipalities, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

The City of Evans owns 3,294 units in the C-BT Project, which provides a firm yield of about 1,976 AF using a C-BT quota of 0.6 AF/unit (Table D-1). Evans transfers its C-BT water to Greeley for treatment at the Bellevue water treatment plant and treated water is then delivered into Evans. On occasion, Evans will transfer C-BT water to the Greeley and Loveland Irrigation Company for delivery into Boyd Lake. From Boyd Lake, Evans can take delivery of the C-BT through the Greeley and Loveland system for non-potable use or treat the water at the Boyd water treatment plant for potable use deliveries.

Table D-1. Inventory of Evans Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	3,294	1,976[1]
Windy Gap Project	5	0
Ditch Shares		
Evans Town Ditch	100%	6,117
Greeley-Loveland System	120.42	60
Loveland-Greeley Reservoir	15.75	372
Seven Lakes System	40.83	208
Godfrey Ditch	19	565
Total		9,298

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for the purpose of this analysis.

Windy Gap Project

In 2004, Evans completed a lease/purchase contract with the City of Greeley to acquire 5 units of Windy Gap water. Evans will exercise its purchase of the Windy Gap units upon completion of Windy Gap Firming Project permitting and in the interim will receive delivery of Windy Gap water when available. Currently no firm yield is associated with Windy Gap units.

Ditch Shares

The Evans Town Ditch can supply a firm yield of about 6,100 AF of water. This water is used entirely for non-potable irrigation because the diversion is downstream of Greeley water treatment facilities. Non-potable uses include irrigation of agricultural land and urban areas to reduce use of potable water for irrigation. About 1,700 acres can be served by the Evans Town Ditch, of which 900 acres are within the present city limits. Evans Town Ditch water exceeds current and projected non-potable demand, so a portion of this water may eventually be exchanged upstream for delivery to Greeley's water treatment facilities and helping to meet potable water demands. The yield from this type of exchange is unknown, but if feasible, would be substantially less than non-potable yields.

Evans owns other ditch rights in the Greeley-Loveland, Seven Lakes, Lake Loveland Irrigation Companies, and Godfrey Ditch. Ditch rights in these companies provide an additional 1,205 AF of firm yield.

Water Reuse

Evans has occasional excess municipal return flow credits from the Greeley Loveland Irrigation Company, Lake Loveland, and Seven Lakes water supplies that can be used be used to meet return flow obligations. In 2004, about 36 percent of these sources of water were available for credit. Reuse credits fluctuate month to month, but based on the firm yield from these native sources and consumptive use and losses from first use, about 400

AF of return flow could be available for reuse. Firming the Windy Gap water supply would provide an additional reliable source for reuse. Because of its small ownership in Windy Gap, direct reuse is probably not likely, but return flows would help satisfy Evan's augmentation requirements (ERO 2004). Future reuse of Windy Gap water could approach 85 percent if Evans yield from the Firming Project is taken in the winter (Seely 2005).

Water Demand

The City of Evans is responsible for providing water to the residential, commercial, industrial and public users located within its service area (ERO 2004). Approximately 95 percent of Evans' customers are residential. Currently no large water users are served by the City. While the City of Greeley distributes treated water to Evans' customers, Evans is responsible for securing the raw water necessary to meet those demands (City of Evans 2004c).

Evans' city limits comprises about 5,930 acres, or 9.26 square miles, of land, of which 3,597 acres are presently developed (Evans 2004b). Evans currently serves 14,860 residents within the city. The City is also responsible for providing water to the 2,394 residents within the Arrowhead and Hill-N-Park subdivisions (Tetra Tech 2003).

Between 2000 and 2002, the City of Evans ranked among the fastest growing cities in Colorado. Table D-2 provides population estimates for the City for the period 1990 to 2004. Over this period, the City grew at an average annual rate of 7 percent. By comparison, the average annual rate of growth for the city between 1960 and 2000 was 4.8 percent.

Table D-2. City of Evans Population, 1990 to 2004.

					Annual Change
1990	5,876	N.A.	1998	8,313	3.3%
1991	6,018	2.4%	1999	8,988	8.1%
1992	6,250	3.9%	2000	9,514	5.9%
1993	6,516	4.3%	2001	11,557	21.5%
1994	6,880	5.6%	2002	13,289	15.0%
1995	7,178	4.3%	2003	14,288	7.5%
1996	7,538	5.0%	2004	14,860	4.0%
1997	8,048	6.8%	—	—	—

Note: These figures do not reflect customers within Arrowhead and Hill-N-Park subdivision.

Source: Clarion Associates 2002.

Historical Water Demands

Potable Use

Table D-3 provides residential, non-residential and total treated water deliveries to end users in Evans and the two subdivisions, Arrowhead and Hill-N-Park.

Water use within the City of Evans increased by 317 MG, or 76 percent, over the period 1990 to 2002, and decreased in 2003, due somewhat to drought restrictions. Residential water use increased by 62 percent since 1990. Non-residential water use more than doubled, but part of this increase was due to accounting changes for parks and open space. Historically, treated water deliveries to residential users have accounted for 85 percent of total treated water deliveries; that figure fell to 78 percent in 2002.

Table D-3. City of Evans Treated Water Sales, 1990 to 2004.

							Total
				MG			
1990	352	63	415	1997	446	67	513
1991	365	61	426	1998	N.A.	N.A.	601
1992	357	59	416	1999	N.A.	N.A.	569
1993	394	85	479	2000	524	158	682
1994	439	72	512	2001	530	177	707
1995	396	68	464	2002	597	153	750
1996	444	87	531	2003	540	127	667
1997	446	67	513	2004	527	149	676

Note: Figures represent final sales to end users, excluding any losses.

Source: City of Evans 2004d; Tetra Tech RMC 2003.

Over the period 1990-2002, total per capita water use ranged from approximately 167 to 204 gallons per day, and residential per capita use ranged from 151 to 166 gallons per day. Average gpcd over this period were 188 for total water use and 157 for residential water use. Although per capita water use fluctuates with weather and water use restrictions, analysis of this record does not suggest any long-term trends, rather fluctuations within a relatively narrow range.

Non-potable Use

In addition to these potable delivery requirements, the City provides approximately 1,223 AF of non-potable water (Tetra Tech RMC 2003). This supply is delivered via the Evans Town Ditch and has traditionally been used for irrigation on rural properties, city parks, schools, open space, and for two small subdivisions. The introduction of dual use water systems explains, in part, why population has grown at a faster rate than potable water demands.

Total Historical Use

Potable and non-potable deliveries to end users do not reflect total raw water demand for the City of Evans without accounting for distribution system losses and additional charges imposed by the City of Greeley, which include treatment losses and losses associated with Greeley's Boyd as well as the Bellevue systems:

- 8 percent distribution system loss (Tetra Tech RMC 2003)
- 15 percent shrinkage loss (Greeley 2004)

Non-potable use will not face the treatment plant loss, but will incur higher conveyance water losses since open ditches are used for this purpose. The study team assumes those losses will equal an additional 15 percent, so that non-potable deliveries face similar shrinkage and distribution losses as potable deliveries. Treatment and conveyance losses are not accounted for by Evans, but are reflected in the charges imposed by Greeley who treats the water for Evans. Table D-4 presents historical raw water requirements for the City of Evans. Evans' total raw water requirements amounted to almost 4,600 AF in 2002, an increase over 1990 of 1,980 AF or 76 percent.

Table D-4. Total City of Evans Raw Water Requirements, 1990 through 2003.

			Total Water Requirements[1]
		AF	
1990	641	1,970	2,600
1991	658	2,020	2,660
1992	643	1,970	2,600
1993	740	2,270	2,990
1994	790	2,430	3,210
1995	717	2,200	2,900
1996	821	2,520	3,320
1997	792	2,430	3,210
1998	929	2,850	3,760
1999	880	2,700	3,560
2000	1,060	3,250	4,290
2001	1,086	3,330	4,390
2002	1,131	3,470	4,580
2003	911	2,800	3,690

[1] Including system losses.

Source: City of Evans 2004d; Tetra Tech RMC 2003; estimates of 2003 demand provided by Harvey Economics.

Projected Water Requirements

Tetra Tech RMC 2003 Projections

The City of Evans provided the study team with water demand projections for 2008 and 2018 (Tetra Tech 2003). Projected water demands were derived using land use plans developed by the City. Tetra Tech indicates that, as part of its 2002 Comprehensive Plan the City of Evans developed intermediate and ultimate build-out land use plans for development within its priority growth area. This area was “based on the location of the City’s existing and planned infrastructure (i.e., water, sewer, stormwater), and the City’s anticipated ability to efficiently provide services” (Clarion Associates 2002). Tetra Tech used future land assumptions to determine the total or maximum number of people that might be accommodated under these plans, and projected water demand for 2008 as the intermediate period, and 2018 as ultimate buildout. Population projections were used to identify the years in which the City of Evans would reach the intermediate and ultimate levels of development.

Tetra Tech RMC based projected potable and non-potable residential water demand on water use inside and outside the dwellings, assuming lot sizes and irrigation requirements. Dwelling units were related to population through person per household assumptions. Non-residential demands, including commercial and industrial, were also based upon indoor and outdoor use, tied to building square footages. The dwelling unit and building square foot assumptions tied back to the Comprehensive Plan. In addition, Tetra Tech RMC assumed that 80 percent of new irrigation demands would be met by non-potable supplies.

The study team evaluated the methodology utilized by Tetra Tech RMC and found that the methods used to calculate water demands were generally sound, given the availability of data. One exception to this pertains to the approach taken to develop projections of population. Table D-5 provides the short-term growth rates that were applied to current City population estimates to develop the projections used by Tetra Tech RMC. Population beyond the year 2008 was assumed to grow at a constant annual rate of three percent. Table D-5 also includes the resulting annual changes in total population.

Table D-5. City of Evans Populations Projections.

					Annual Change
2003	N.A.	14,700	2,394	17,094	N.A.
2004	8%	15,876	2,394	18,270	1,176
2005	8%	17,146	2,394	19,540	1,270
2006	6%	18,175	2,394	20,569	1,029
2007	5%	19,084	2,394	21,478	909
2008	5%	20,038	2,394	22,432	954

Source: Tetra Tech RMC 2003.

Comparison of these figures with historical population growth suggests that these growth rates and the resulting changes in population are unlikely. With the exception of 2001 through 2003, growth has been much less than the projected increases to 2008 as indicated above. The long-term average is 4.8 percent and this rate is calculated using a small population base. As the population base rises, it is likely that the rate of growth will decline.

A second modification to the Tetra Tech projections was required. The total land area within Evans City limits has also grown since the development of the 2003 demand projections. This change required the study team to update future land use so that it was consistent with current City totals.

To develop residential, non-residential, and total water demands, the study team revised population projections, updated land use estimates, and applied them using the methodology utilized by Tetra Tech RMC. The following provides a detailed description of the water demand revisions made by the study team.

Study Team Demand Projections

The study team projected population forecasts based on an assumed annual rate of growth of 4 percent through 2010, 3 percent through 2020, and 2.5 percent thereafter (City of Evans 1998).[1] This represents a decrease in the rate of growth in recent years; however, it results in total growth more consistent with recent trends. Furthermore, this growth is consistent with that assumed by the State Demographer for Weld County and slightly less than the rate assumed by Greeley for Evans in its 2002 water demand study (EDAW 2002). Table D-6 provides the study teams' population projections for water demand forecasting purposes.

Table D-6. Revised Population Projections for the City of Evans.

					Annual Change
2004		14,900	2,400	17,300	N.A.
2005	4.0%	15,500	2,400	17,800	500
2010	4.0%	18,800	2,400	21,200	700
2015	3.0%	21,800	2,400	24,200	600
2020	3.0%	25,300	2,400	27,700	700
2025	2.5%	28,600	2,400	31,000	700
2030	2.5%	32,300	2,400	34,700	700
2035	2.5%	36,600	2,400	39,000	900
2040	0.8%	38,000	2,400	40,400	300
2045	0%	38,000	2,400	40,400	0
2050	0%	38,000	2,400	40,400	0

Source: Harvey Economics 2004.

Residential, non-residential, and total water demands were derived by applying the revised population projections to updated land use projections in the manner utilized by Tetra Tech RMC. To account for changes since 2002, the City's build-out estimates were updated to be consistent with new acreage totals, representing about 1,500 more acres

[1] The growth rates were not applied to the Arrowhead and Hill-N-Park areas because they have already reached build-out.

than accounted for in the Tetra Tech RMC study.[2] Table D-7 provides a summary of the land use projections used to determine future demands.

Table D-7. Revised Land Use Projections for the City of Evans.

			Acres
Rural Density	1,112	Local	124
Low Density	850	General	280
Medium Density	232	Industrial	478
Urban Density	1,271	Mixed Use/Employment	261
High Density	205	Parks/Trails/Open Space	1,117
Sub-total	3,669	Sub-total	2,261
Total Residential and Commercial			**5,930**

Source: Harvey Economics 2004.

The total area presented in Table D-7 is capable of accommodating approximately 38,000 people. Assuming population growth consistent with Figure 5, the City of Evans revised city limits, which will be served by the Evans water utility, will be fully developed by 2037. Residential, non-residential and total water demands were projected for 2037 based on the land use at that time. Values between 2002 and 2038 were estimated from annual population changes. Table D-8 provides residential, non-residential and total water demand through 2050.

Table D-8. Revised Water Demand Projections for the City of Evans.

					ter		**Total Water Requirements[1] (AF)**
2005	610	170	780	430	1,210	3,700	4600
2010	780	220	1,000	540	1,540	4,700	5,900
2015	930	270	1,200	650	1,850	5700	7,000
2020	1,110	320	1,430	770	2,200	6800	8,400
2025	1,280	370	1,650	890	2,540	7800	9,700
2030	1,470	420	1,890	1,020	2,910	9000	11,100
2035	1,690	480	2,170	1,170	3,340	10,300	12,800
2040	1,760	500	2,260	1,220	3,480	10,700	13,300
2045	1,760	500	2,260	1,220	3,480	10,700	13,300
2050	1,760	500	2,260	1,220	3,480	10,700	13,300

[1] Including system losses.

Source: Harvey Economics 2004.

[2] Land development since the 2002 Comprehensive Plan was assumed to occur as described in the Comprehensive Plan. For each development type the percentage of total acreage as defined in the Comprehensive Plan was used to allocate the new acreage.

Non-potable water demand is projected to peak at about 3,750 AF (1,220 MG). The Evans Town Ditch currently provides a firm yield of about 6,100 AF, which would meet projected non-potable demands. Excess Evans Town Ditch water could not be readily used to meet potable demands because the diversion is located downstream of Greeley's water treatment facilities.

In addition to the end user demands derived from future land use, system losses consistent with the earlier discussion regarding historical water use were added to all demands. Although the demand projections were performed using Tetra Tech's indoor and outdoor water use technique, the results suggest that water use per capita would rise from historical averages. Average total per capita per day use between 2005 and 2050 would average 238 gallons over the forecast period, whereas residential per capita per day use averages 173 gallons. After considering future suburban house and lot sizes, non-potable use, disproportionate growth in non-residential demand, both figures are consistent with historical per capita per day use totals.[3]

Conservation

The City of Evans has implemented several measures to promote conservation throughout its system. Following the completion of its 2001 water rate study, Evans has begun pricing water according to an increasing block rate structure (City of Evans 2004c). Other conservation measures include (ERO 2004):

- Prohibiting residential irrigation during the day
- Prohibiting watering on consecutive days.
- Active leak detection
- Participation in the Green Task Force along with Greeley
- Metering
- Use of non-potable supplies for residential irrigation
- Changing from quarterly billing to monthly billing

In addition to the measures presented above, Evans also is also considering the following items (ERO 2004):

- Targeting educational material for the top 60 water users served and send the material to them directly
- Hiring an intern for the summer to educate about conservation door-to-door and to monitor outdoor water use
- Public education through billing and website

[3] Increases in total per capita per day use are reflective of a greater percentage of land being dedicated to non-residential uses.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Need

The City of Evans currently has an adequate firm yield to meet existing water delivery requirements in dry years (Figure D-1). Water demand is expected to exceed available firm water supplies by about 2025, which would affect the ability of the City to meet dry year water needs depending on C-BT deliveries. However, the Evans Town Ditch, which is included in Evan's total water supply, currently can only be used for non-potable uses because the source of water is located well downstream of Greeley's water treatment plant, who treats water for Evans. Thus, a shortage in firm potable water supplies may occur much sooner. Based on total water supply without accounting for source of water, a firm water supply shortage of about 4,000 AF is anticipated by about 2040 when water demand is projected to level off. Firming the Windy Gap water supply will provide Evans about 500 AF of water or about 4 percent of the City's 2050 water supply requirement, not including the reuse of about 85 percent of the Windy Gap yield to meet return flow obligations (Figure D-2). Water conservation and other sources of water supply also will be needed to meet all of the estimated future water demands.

Figure D-1. Evan's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

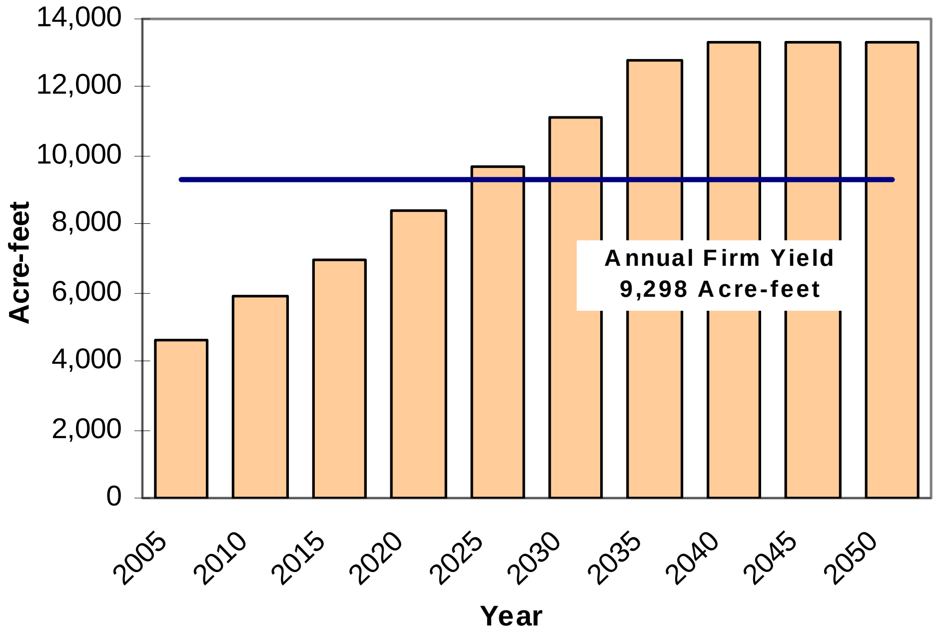
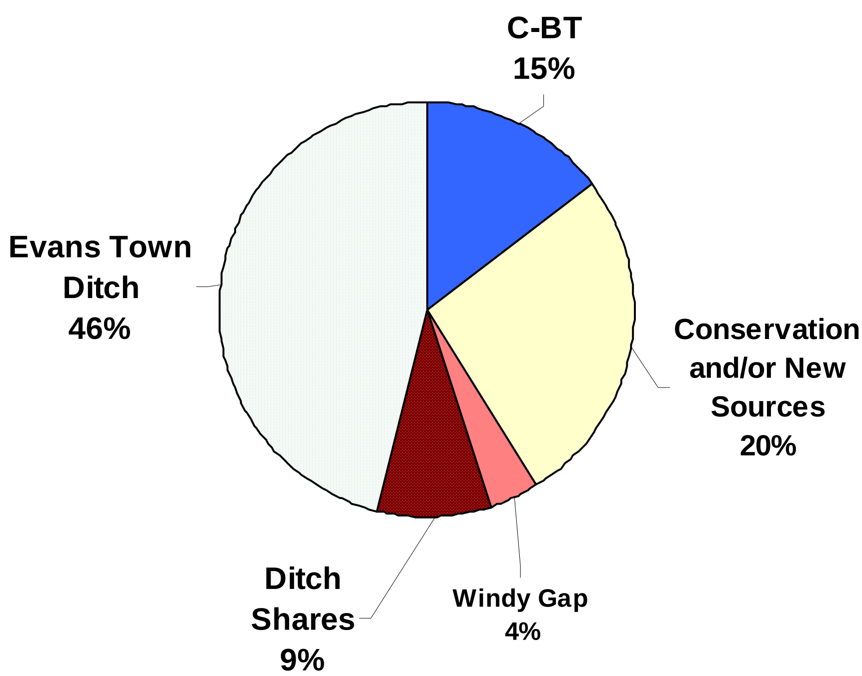


Figure D-2. Evan's 2050 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

CITY OF FORT LUPTON

Introduction

The City of Fort Lupton is located in south-central Weld County about 25 miles north of Denver. Nearby cities include Brighton, Platteville, Firestone, Frederick, and Dacono. Fort Lupton began as a trading fort in 1836 and since that time the community has expanded with its business, agriculture, and oil and gas based economy. In 1974, Fort Lupton became an official Colorado City and the City continues to grow and diversify as a rural community. The following discussion provides a summary of Fort Lupton's water supply and demand.

Water Supply

Fort Lupton is located near the South Platte River where the accessibility of clean water supplies is not readily available. Historically, the City relied on ground water to meet its municipal water needs. With increasing growth and development along the Front Range, the water quality of the groundwater from Fort Lupton's wells in the South Platte River alluvium has gradually declined. With federal regulated drinking water standards becoming more stringent, the City ground water supply approached the limits of hardness level standards. For these reasons, the City decided to acquire C-BT Project water in 1997. Soon after, Fort Lupton realized that C-BT water was too soft, resulting in a mineral buildup in the pipes, which sloughed off into the water supply, requiring C-BT water and ground water to be blended to maintain an acceptable hardness level (Applegate Group 2003a). Fort Lupton blends about 5.5 percent ground water with C-BT water, but hopes cease blending by early 2005 (Fort Lupton 2004a).

Transbasin Water

Colorado-Big Thompson Project

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Fort Lupton, like most municipalities, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

Fort Lupton currently owns 294 variable C-BT units and 2,782 fixed C-BT units. The firm yield from these units is 1,845 AF based on a yield of 0.6 AF per unit. Fort Lupton uses C-BT year round to meet its municipal water demand. The C-BT is delivered through the Southern Water Supply Pipeline (SWSP), treated, blended with well water, and then delivered for municipal use.

Windy Gap

Fort Lupton acquired 3 units of Windy Gap water from the City of Greeley. Firmed Windy Gap water would provide Fort Lupton water for both domestic use and well augmentation. Fort Lupton would take delivery of Windy Gap Project water for municipal use and use the return from the wastewater treatment plant for augmentation of its ground water withdrawals. Similar to C-BT water, Windy Gap water would be delivered to Fort Lupton via the existing SWSP.

Prior to 1997, Fort Lupton relied on Groundwater Appropriators of the South Platte River Basin, Inc (GASP) to meet all of its augmentation needs. In 2001, it was determined to be in Fort Lupton's best interest to move from GASP and begin developing its own augmentation supplies. The 2003 Water Master Plan identified that Windy Gap reusable effluent would be a valuable augmentation source for Fort Lupton (Applegate Group 2003b).

Ditch Shares

Fort Lupton also owns 184 shares of the Fulton Ditch with an annual firm yield of 322 AF. About 77 AF of Fulton Ditch water is used to irrigate a portion of the local golf course and the cemetery. The remaining 245 AF of Fulton water is used for augmentation of ground water withdrawals and thus is not included in the total water supply.

Ground Water

Fort Lupton has five alluvial wells that connect to a manifold system that delivers water to a 1 MG storage tank. Water is delivered to the Thermo Co-Generation Power Plant from this raw water tank. Two other 1 MG tanks receive treated C-BT water and are blended with well water prior to delivery. The wells are pumped throughout the year (Fort Lupton 2004a). Firm deliveries of ground water are about 1,600 AF per year. Once groundwater is no longer blended for drinking water it will be pumped in the summer for non-potable irrigation and year-round for Thermo Co-Generating cooling water and greenhouse use.

Reservoirs

Fort Lupton does not have any storage reservoirs; however, the City owns three 1 MG above-ground water storage tanks. One is used for storage of ground water and the other two store treated C-BT water blended with well water. There is no separate firm yield associated with these storage tanks. Currently, Fort Lupton is looking into water storage options along the South Platte River for possible storage of effluent for meeting augmentation requirements (Fort Lupton 2004a).

Water Reuse

Fort Lupton does not currently have a reuse program because none of its sources of water supply are reusable. If Windy Gap Project water is firmed, the reusable effluent would be used for augmentation of ground water pumping. Windy Gap water would be used in the winter months when effluent return flows are highest, and then discharged as required to satisfy downstream augmentation requirements. Fort Lupton estimates that as much as 80 percent of the yield from the Windy Gap Firming Project could be reused (Sidebottom 2005).

Table E-1. Inventory of Fort Lupton Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	3,101	1,861[1]
Windy Gap Project	3	0
Ditch Shares		
Fulton Ditch	183.9	77[2]
Ground Water		
South Platte River alluvial wells	N.A.	1,600
Total	—	3,538

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis.

[2] An additional 245 AF of Fulton Ditch water firm yield is used to augment a portion of the ground water withdrawals; thus, it is not included in the total supply.

Water Demand

The City of Fort Lupton is located northeast of Denver in the rural Front Range of Colorado. In 2003, the City served 2,139 water taps, with a service area population of about 7,100 persons. The City supplies water only inside its city limits and has a water treatment agreement with the City of Hudson, which is responsible for its own water supply and compensates Fort Lupton for water treatment. The Hudson agreement is not included in Fort Lupton's historical or future water demands because Fort Lupton is not responsible for current or future Hudson water supplies.

Historical Water Demands

The City of Fort Lupton's current population is estimated at 7,071 persons, and the City's service area is coincident with its city limits (U.S. Census Bureau 2004; Sidebottom, pers. comm. 2004). Table E-2 provides historical population estimates, the number of total water taps, and annual growth rates for each.

Table E-2. City of Fort Lupton Population and Total Taps Change, 1990 to 2003.

				Annual Change
1990	5,159	N.A.	N.A.	N.A.
1991	5,398	4.6%	N.A.	N.A.
1992	5,459	1.1%	N.A.	N.A.
1993	5,586	2.3%	N.A.	N.A.
1994	5,674	1.6%	N.A.	N.A.
1995	5,785	2.0%	N.A.	N.A.
1996	5,879	1.6%	N.A.	N.A.
1997	5,988	1.9%	1,805	N.A.
1998	6,054	1.1%	1,901	5.3%
1999	6,215	2.7%	2,004	5.4%
2000	6,787	9.2%	2,111	5.3%
2001	7,088	4.4%	2,153	2.0%
2002	7,119	0.4%	2,174	1.0%
2003	7,071	-0.7%	2,139	-1.6%

Source: U.S. Census Bureau 2004; City of Fort Lupton 2004b.

From 1990 through 2003, population grew at an average annual rate of 2.5 percent. Total water taps increased by an average annual rate of 2.9 percent from 1997 through 2003. Annual growth rates have fluctuated since 1990, with the most significant growth occurring in 2000 and 2001. The U.S. Census Bureau estimates that the City's population dropped slightly in 2003, from 7,119 persons in 2002 to 7,071 persons, a 48-person decrease. It is uncertain why such a decrease is estimated or whether it is accurate given past growth in the City; it is assumed to be correct but unrepresentative for this study. Future estimates do begin with the 2003 figure for population.

Potable Water Demands. Historical potable water use is summarized by customer type in Table E-3 below.

Table E-3. Potable Water Use by Customer Type for the City of Fort Lupton, 1997 to 2003.

	MG			
1997	210	60	270	N.A.
1998	216	65	281	4.2%
1999	212	62	274	-2.4%
2000	256	62	318	15.9%
2001	249	61	310	-2.5%
2002	248	61	309	-0.3%
2003	194	88	282	-8.8%

Source: City of Fort Lupton 2004c.

Fort Lupton tap and water use data are unavailable prior to 1997. Potable water demands rose at an annual average rate of 2.7 percent from 1997 through 2002, with a noticeable drop in demands in 2003. Year 2003 was unusual in that the City imposed watering restrictions on outdoor irrigation to limit watering to morning and nighttime hours. Those restrictions drove down residential usage while commercial and industrial usage actually rose due to growth at two industrial users and the addition of a new Safeway supermarket. Residential use has traditionally comprised the majority of potable water demands in the City of Fort Lupton, accounting for an average of 77 percent during the 1997 to 2003 period. The City expects residential usage to rebound and commercial/industrial usage to come back in line with past proportions of total potable water demands (Sidebottom, pers. comm. 2004).

Table E-4 presents residential and total gpcd and total gallons per total tap per day for 1997 through 2003.

Table E-4. Potable Water use per Capita and per Tap for Fort Lupton.

Year			Total Water Use Per Total Tap
	gpcd[1]		
1997	96	123	410
1998	98	127	405
1999	94	121	375
2000	103	128	413
2001	96	120	394
2002	96	119	389
2003	75	109	361

[1] Values are based on the data presented in Tables E-2 and E-3.

From 1997 to 2002, residential water usage per capita per day averaged 97 gallons and total water usage per capita per day averaged 123 gallons. Total water usage per total tap per day during this periods averaged 398 gallons. Although usage dropped in 2003, it is expected to return to average usage in the future (Sidebottom, pers. comm. 2004). No trends in per capita or per tap water usage are apparent from 1997 to 2003.

Non-Potable Water Demands. A large portion of the City of Fort Lupton's water demands come from non-potable water needs. From 1997 through 2003, Thermo Cogeneration power plant used, on average, 530 MG of water annually, while other non-potable users, including the City's parks and schools, outdoor irrigation and golf course, used 180 millions gallons annually on average. These non-potable water deliveries are made with both groundwater and ditch water.

Thermo is the City's single largest water user at 415 MG in 2003, and its demands are expected to remain stable into the future. To plan conservatively for Thermo's potential water needs, the study team assumes Thermo's demands into the future at its highest point from 1997 to 2003 at 643 MG annually. Thermo pays the City to pump its groundwater and to run it through its distribution system to deliver the non-potable water to Thermo. Thermo is contractually obligated to meeting the augmentation requirements for this water.

Non-potable water usage for the golf course from 1997 through 2003 was unmetered. The City estimates that its usage for those years was equivalent to 2.5 AF of water deliveries per acre of irrigated turf over the golf course's 170 acres, or 425 AF annually, which the study team has assumed for 1997 through 2050 for this analysis (Nguyen, pers. comm. 2004).

Total Water Requirements. Table E-5 below indicates total potable and non-potable water deliveries and total water requirements for the City of Fort Lupton from 1997 through 2003.

Table E-5. Total Water Requirements for the City of Fort Lupton, 1997 to 2003.

						Total -	Annual Percent Change
1997	270	386	176	831	2,550	2,834	N.A.
1998	281	517	176	974	2,988	3,320	17.1%
1999	274	538	180	992	3,045	3,384	1.9%
2000	318	643	186	1,147	3,520	3,911	15.6%
2001	310	636	186	1,132	3,473	3,859	-1.3%
2002	309	558	198	1,064	3,266	3,629	-6.0%
2003	282	415	170	866	2,659	2,954	-18.6%

[1] Including system losses.

Source: City of Fort Lupton 2004d.

Total water requirements reflect an adjustment made to account for approximate distribution system losses of 10 percent (Nguyen, pers. comm. 2004). From 1997 to 2003, water requirements fluctuated because of weather, drought restrictions and varied demands at Thermo. Peak water demands were reached in year 2000 at more than 3,900 AF. Water restrictions caused a major drop in Fort Lupton in 2003.

Projected Water Requirements

Applegate's Projected Water Demands. The City of Fort Lupton provided the study team with projections of water demand through 2025 in the City's Water Master Plan, prepared by Applegate Group, Inc., and dated October 2003. The projections included forecasts of population based on historical growth from 1990 to 2002 that estimated a near doubling of the City's population by 2025 to 14,281 people. An overall 196 gpcd was then applied to this population forecast to estimate future water demands for the residential, commercial and industrial water use sectors. Applegate utilized total water use in 2002, including all potable and non-potable water uses except Thermo, divided by population in 2002, to derive the 196 gpcd that it then applied to population in the future to derive total potable water usage (Nguyen, pers. comm. 2004). Thermo's water demands were not projected into the future. Non-potable water uses for schools, parks and irrigation were assumed to rise at the same rate as the population of the city. Golf course non-potable irrigation was assumed to remain steady into the future. In sum, the Water Master Plan projections indicate a water demand of 3,131 AF by 2025, not including Thermo's usage but including distribution system losses.

The team analyzed the methods implemented by Applegate in its forecasts and generally finds its approaches sound for the purposes of this study, although the team updated the data and subsequent assumptions upon which the forecasts were based.

Study Team Demand Projections. To arrive at projections of total water demands between now and 2050 for the City of Fort Lupton, the study team first re-estimated population and total taps for the City. The team collected population figures for 1990 to 2003 (see Table E-2), which have been updated since Applegate's report was published. The new data resulted in a revised average annual population growth rate of 2.5 percent instead of Applegate's 3.0 percent. The new population projections are presented in Table E-6.

Table E-6. Population and Total Tap Forecasts for the City of Fort Lupton, 2005 to 2050.

	Population
2005	7,900
2010	8,900
2015	10,100
2020	11,400
2025	12,800
2030	14,500
2035	16,300
2040	18,400
2045	20,800
2050	23,500

Source: Harvey Economics 2004.

Based on an annual growth rate of 2.5 percent, the City of Fort Lupton is expected to reach nearly 24,000 people by 2050. Residential, commercial, industrial, schools, city parks and irrigation water usage are all expected to track population growth, as assumed in the Applegate report. The study team applied a gpcd of 120 gallons in lieu of Applegate's 196 gallons to project water demands, as the 120 gpcd is based upon an average gpcd from 1997 to 2003 of potable water served to residential, commercial and industrial users, which the team believes is the more appropriate measure of water usage for this purpose.

Based upon discussions with the City, the study team assumed that Thermo's usage and future usage for golf course irrigation will remain steady from 2003 to 2050, assuming normal year hydrology. The study team also assumed that current non-potable irrigation of schools, city parks and other irrigated lands will continue at the same rate into the future. For supply planning purposes, the study team assumed annual non-potable usage from 2003 through 2050 at the highest usage from 1997 through 2003, or 59 MG. Growth in irrigation water usage for schools, parks and other green spaces, which the study team assumes, like Applegate, will grow with population, will be served potable water. The study team's updated water demand forecasts are presented in Table E-7.

Table E-7. Water Demand Projections for the City of Fort Lupton, 2005 to 2050.

			-		
	AF				
2005	1,100	2,000	600	3,700	4,100
2010	1,200	2,000	600	3,800	4,200
2015	1,400	2,000	600	4,000	4,400
2020	1,600	2,000	600	4,200	4,700
2025	1,900	2,000	600	4,500	5,000
2030	2,100	2,000	600	4,700	5,200
2035	2,400	2,000	600	5,000	5,600
2040	2,700	2,000	600	5,300	**5,900**
2045	3,100	2,000	600	5,700	6,300
2050	3,500	2,000	600	6,100	6,800

[1] Including system losses.

Source: Harvey Economics 2004.

An additional 10 percent was added to all water demands to account for distribution system losses. Total Fort Lupton water requirements are projected to increase from 2,954 AF in 2003 to 5,000 AF in 2025, an increase of 2,046 AF.

Conservation

The City of Fort Lupton has implemented a range of conservation measures (Northern Colorado Water Conservancy District 2003) as outlined in its 2003 Drought Response Plan. The goal of this plan was to reduce water usage by 15 percent into the future. The main points of the plan included:

- Annual spring time system audit and quick response to sprinkler leaks;
- Volunteer program to help seniors and handicapped individuals replace leaky faucets;
- Increased re-use of backwash at water treatment plant;
- Reduced rough area watering on golf course;
- Restaurants to serve water upon request only;
- Public education in newspaper, newsletters, City's web page and television channel;
- Monthly monitoring and public display of results;

- Educational classes for fifth graders, seniors and general public;
- Restricted outdoor watering from 10:00 A.M. to 6:00 P.M., April to October, except for golf course greens and tees and new lawns;
- Surcharge for use above allotment;
- Enforcement of water regulations by Police Force and Code Enforcement employees;
- Car washing on weekends only with bucket and hand held hose with a shut-off nozzle;
- Prohibition of subdivision covenants that prevent xeriscaping; and
- Required installation of water saving devices for new construction.

It is uncertain at this time what kind of water savings has been achieved since the implementation of this plan. The City also implemented a significant rate structure increase for its water deliveries in June 2004, which will be ongoing and will encourage further water conservation. Additional conservations programs are not contemplated as of 2004.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most

Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand as described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Need

Fort Lupton's current water needs are met primarily by the C-BT Project and ground water. Water demand is expected to exceed available firm water supplies by about 2005, which would affect the ability of the City to meet dry year water needs depending on C-BT deliveries (Figure E-1). By 2030 a water supply shortage of about 1,700 AF is anticipated, and by 2050 about 3,300 AF of additional water will be needed. Firming the Windy Gap water supply will provide Fort Lupton with 300 AF of water or about 6 percent of the City's 2030 water supply requirement and 5 percent of its 2050 water needs, not including reuse of up to 80 percent of Windy Gap water (Figure E-2). Water conservation and other sources of water supply also will be needed to meet future water demands.

Figure E-1. Fort Lupton's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

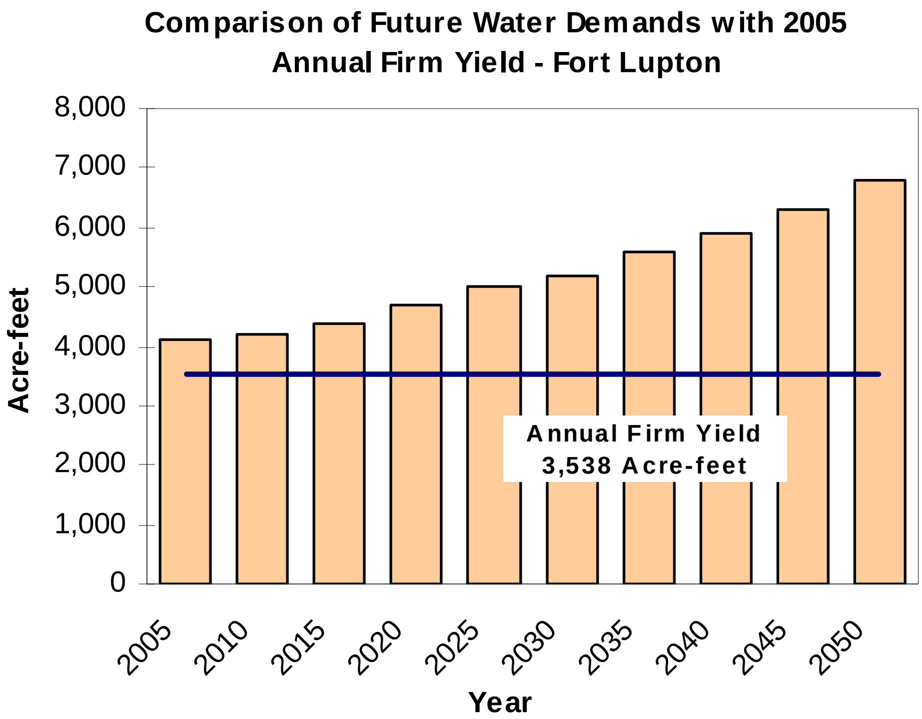
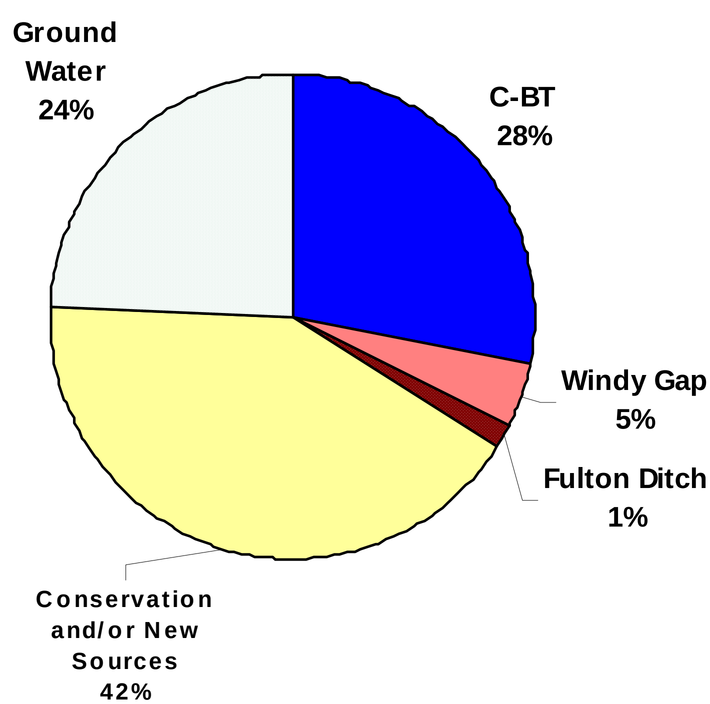


Figure E-2. Fort Lupton's 2050 Project Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

CITY OF GREELEY

Introduction

Greeley is the largest city in Weld County and is located about 50 miles north of Denver. The City is located in a semi-arid environment that receives only about 12 inches of precipitation annually. Greeley was originally an agricultural based community, but continues to diversify and support a variety of businesses and commercial industries. Greeley has experienced significant population and economic growth in recent decades. The following discussion provides a detailed summary of Greeley's water supply and demand.

Water Supply

Greeley's water supply system is diverse and complex, and uses carryover storage from existing reservoirs, proactive water management, and system integration to increase the efficiency and yield of the City's water rights. Greeley's water supply system is often operationally constrained by water supplies that are limited by a variety of timing issues (i.e., a given source of water may be available, but it may not be available at the time and location needed). In addition, much of Greeley's current water supply portfolio consists of junior water rights, which provide adequate amounts only in average and wet years. These conditions have created the need for additional storage to carry the City through drier years (ERO 2004).

Greeley's water supply varies in any given year based on a number of factors including the snowpack, available storage, and operational issues. To help manage and predict its annual water supply, Greeley uses the MODSIM model. The model predicts the amount of Greeley's potable water demands that can be satisfied without shortages during a 50-year drought. The results of this analysis provide the firm yield of Greeley's water supply system (Greeley 2003). This model simulates the distribution of Greeley's available water supply for a given year to provide a yearly estimate of the demand that can be satisfied. Greeley's water supplies include water from the C-BT Project, Windy Gap Firming Project, and approximately 50 percent of the Greeley-Loveland Ditch system. Key assumptions incorporated into the model include Greeley recovering the one-third of the total shares that Greeley owns, but is legally obligated to lease to farmers in the area, and that drought restrictions will be instituted to reduce demand when necessary (Id.).

This model, as reported in the City's Water Master Plan (2003), estimated that the current firm yield of Greeley's potable water system in a 50-year drought is 42,500 AF. The hydrologic period simulated with the MODSIM model is based upon a synthetic dataset of stream flow generated by Colorado State University. The synthetic stream flows represent the statistical 1-in-50 drought. A water supply of 42,500 AF reflects a theoretical maximum yield of the system, and must be evaluated with an understanding of operational constraints. Achieving a yield of 42,500 AF/year during a 50-year drought would require every system component to perform flawlessly every year of the drought.

Because the use of non-potable water (Greeley Irrigation Company, Greeley Canal No. 3) is not legally or physically available to all of the City's parks, the use of Greeley Loveland Irrigation Company (GLIC) (a potable source) is necessary on a portion of the City's park system. The GLIC shares used on these parks are part of Greeley's potable supply. Thus only 41,500 AF of water is available for potable use. Table F-1 provides an estimate of Greeley's firm water supply from each of the sources based on MODSIM results, although actual yields available would vary from year to year. Greeley's water supply includes 2,350 AF of non-potable water for irrigation and other purposes.

Table F-1. Inventory of Greeley Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	22,480	13,488[1]
Windy Gap Project	64[2]	0
Direct Flow Rights		
Cache la Poudre	100%	9,050
Reservoir Storage		
Hourglass	1,693	600
Comanche	2,629	900
Twin Lake	460	200
Barnes Meadow	2,349	1,200
Peterson	1,252	700
Seaman	5,008	2,700
Ditch Shares		
Greeley-Loveland Irr. Company	758	8,162
Loveland-Greeley Res. Company	135	2,500
Seven Lakes	185	2,000
Total Potable Water Supply		**41,500**
Non-potable Water not Available or Used for M&I Uses		
Greeley Canal No. 3	0.375[3]	700
Greeley Irrigation Co.	82	650
Greeley-Loveland Irrigation Company	N.A.	1,000
Total non-Potable Water Supply		**2,350**
Total		**43,850**[4]

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purpose of this analysis.

[2] Greeley is currently in the process of selling 20 Windy Gap units to other Project Participants.

[3] Greeley owns three-eighths of the water rights and structures of Greeley Canal No. 3.

[4] MODSIM model optimization of available firm water supplies varies annually depending on operational constraints, including available storage, distribution limitations, and climatic conditions.

Transbasin Water

Colorado-Big Thompson Project

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF per unit in dry years and as little as 0.5 AF per unit in wet years or in extremely dry years, such as the drought of 2002 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Greeley, like most municipalities, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years, such as 2002, for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

The City of Greeley owns 22,480 units of the C-BT Project, which provides a long-term average yield of 13,488 AF using a C-BT quota of 0.6 AF/unit. C-BT water represents about 30 percent of Greeley's existing potable water supply.

Windy Gap

As of January 2005, the City of Greeley owns 64 unencumbered units of Windy Gap water, of which 44 are in the Windy Gap Firming Project. The City plans to sell 20 Windy Gap units from the Firming Project to other entities. To further this goal, Greeley has entered a contract to sell 3 units to Fort Lupton and a lease of 5 units to Evans with an option to purchase, and is currently negotiating a lease of 12 units to Little Thompson, with an option to purchase.

Greeley uses Windy Gap water when it is available at its Bellvue Water Treatment Plant. The City exchanges the majority of Windy Gap water used at Bellvue into one or more of its reservoirs situated in the Poudre Basin during the spring and summer months, and then uses the water to meet a portion of Greeley's winter demands. Use of Windy Gap water in the winter allows the most efficient use of this water supply because about 80 to 90 percent of the Windy Gap water can be captured and reused. By comparison, during the summer, Greeley would only be able to reuse between 25 and 40 percent of the Windy Gap water due to lower return flows from outdoor irrigation (Greeley 2004a).

Firming Windy Gap water would provide Greeley with additional potable water resources, and reusable effluent. Greeley uses the wholly consumable effluent generated from the use of Windy Gap water to increase the efficiency of its system in three ways: 1) to partially offset historical return flow obligations associated with ditch shares that Greeley has changed from agricultural to municipal uses; 2) to meet lagged non-potable demands associated with pumping of wells used to irrigate parks within the City; and 3) to meet augmentation water leases with local water users (Id.). Currently, Greeley cannot depend on the yield of its Windy Gap water due to its typically low or non-existent yields in both wet and dry years. This requires the City to have alternate water supplies ready to meet these needs if no Windy Gap water is available. Without firming, Windy Gap yield is so unpredictable that Greeley cannot effectively plan for its availability in the City's annual water resource management efforts (Id.).

Direct Flow Rights

Direct flow rights from the Cache la Poudre River provide about 20 percent of Greeley's potable water supply and contribute a firm annual yield of about 9,050 AF (Table F-1). These senior water rights provide a consistent yield to Greeley's Bellvue Water Treatment Plant in most hydrologic conditions with the exception of a drought such as what was experienced in 2002.

Storage Rights

Greeley has water storage rights at six mountain reservoirs (Barnes Meadow, Peterson, Comanche, Hourglass, Milton Seaman, and Twin Lakes), all of which are located in the Cache la Poudre River Basin. The firm annual yield from these reservoirs is about 6,300 AF. These reservoirs have different water right priorities, but in general, all of Greeley's mountain reservoirs are junior water rights with low yields during times of drought.

Ditch Shares

Greeley's ditch shares from the Big Thompson River are associated with the Greeley-Loveland Irrigation System, with additional ditch shares associated with the Loveland-Greeley Res. Co, and Seven Lakes. The Greeley-Loveland Irrigation System consists of three interrelated ditch companies that historically provided irrigation water to farmland between Loveland and Greeley. Greeley-Loveland Irrigation System shares are delivered to the Boyd Lake Water Treatment Plant through Lake Loveland and Boyd Lake. Total ditch shares provide a firm annual yield of about 12,700 AF (approximately 1/3 of this yield is tied up in agricultural leases with local farmers).

Non-potable Water

Greeley has several sources of non-potable water supply. Most of the City's non-potable water is diverted out of the Cache la Poudre River near Greeley and is too far downstream to be delivered to the Bellvue or Boyd Lake water treatment plants. The primary non-potable water supplies are three-eighths City interest of the Canal No. 3, Greeley Irrigation Company shares, Windy Gap units (reusable effluent), and Greeley-Loveland Irrigation System shares. Greeley's non-potable supplies are currently used to meet Greeley-Loveland Irrigation System return flow obligations as required by change-of-use decrees, for non-potable irrigation, and for augmentation purposes. To deliver Greeley-Loveland Irrigation System water for non-potable purposes, water travels over 16 miles from Loveland to Greeley via the Greeley-Loveland Canal. Once in Greeley, the water is distributed using a series of lateral and farm ditches. Greeley's non-potable system includes minor amounts of ground water that are used for irrigation. Greeley currently has an available non-potable supply of about 2,350 AF (Greeley 2004c).

Reuse

Greeley uses reusable effluent from the Greeley Loveland System (Greeley Loveland Irrigation Company, Seven Lakes, and Lake Loveland) and Windy Gap Project water when available to meet return flow obligations and augmentation requirements. Only a portion of Greeley Loveland System water is available for reuse and the amount can vary annually with return flow requirements as determined in Water Court decrees. Reusable water and return flow obligations (RFOs) are not included in the Greeley Loveland System supply in Table F-1 or the requirements in Table F-5. Effluent from the treatment and use of Windy Gap water also provides a source of reuse water when available. Greeley estimates that it will be able to reuse up to 80 percent of Windy Gap water if firmed to meet existing and future RFOs (Koch 2005).

Water Demand

Like its water supply system, Greeley's configuration of water deliveries including agreements with entities outside its service area, is complicated but consistent with its role as a regional water provider. Greeley provides wholesale water to the Town of Evans, a Kodak plant, part of the Town of Windsor, part of the Town of Milliken, and Garden City. These agreements follow a general pattern in which those consuming entities must provide Greeley with raw water and associated water rights, whereupon Greeley treats and delivers potable water to the respective customers at master meters. The water demands associated with these customers are excluded from consideration in the EIS because Greeley is not responsible for providing these entities with raw water or new water resources. These wholesale customers together required about 4,400 AF in the year 2003 (City of Greeley 2004c).

Greeley continues to serve other customers outside the City in the Greeley service area pursuant to historical agreements. These include the transmission line customers and certain agricultural customers, which together number about 950 and who required 242 MG of water or 740 AF in year 2002 (City of Greeley 2004c). Water use for these customers outside the Greeley service area has averaged 801 AF from 1993 through 2002 and is likely to remain stable in the future, except for variations due to weather.

The City of Greeley has grown from a rural community of 20,400 in 1950 to the second largest city in northern Colorado, with a population of 83,000 in 2003. The population doubled from 1960 to 1980. Table F-2 depicts Greeley's historical growth since 1990. These figures include University of Northern Colorado students and changes in city boundaries since 1990.

Population growth from 1970 to 1990 averaged 2.24 percent per year. Population growth during the 1990s was approximately 2.5 percent per year.

Table F-2. Population Growth and Annual Growth Rate for the City of Greeley, 1990 to 2003.

		Growth Rate
1990	60,536	0.53%
1991	59,977	-0.92%
1992	61,162	1.98%
1993	63,286	3.47%
1994	64,092	1.27%
1995	65,563	2.30%
1996	67,164	2.44%
1997	69,727	3.82%
1998	72,252	3.62%
1999	74,296	2.83%
2000	76,930	3.55%
2001	78,384	1.89%
2002	81,000	3.34%
2003	83,000	2.47%

Source: City of Greeley 2020 Comprehensive Plan 2000; Colorado Department of Local Affairs 2004.

Historical Water Use

The City of Greeley provides water through both a potable and non-potable water system, each of which is described below.

Historical Potable Use

Table F-3 provides a breakdown of potable water deliveries to Greeley water customers inside the City for the past 10 years.

The comprehensive water conservation strategies undertaken by Greeley during this time period, including universal metering, served to reduce the increases in use that would have occurred from the City's growth. Total potable water use has increased from 4,312 in 1993 to 6,184 in 2002 with annual figures determined by growth and fluctuations in weather. Residential water use, including single family and multifamily customers, accounted for an average of 60 percent of total potable use during this period. Commercial water use, which includes the University of Northern Colorado demands, averaged 23 percent of total use during this period. In addition, the largest single Greeley customer is Swift and Company, formerly known as Monfort and Con Agra, which consumed an average of more than 1,000 MG from 1993 to 2002, accounted for an average of 17 percent of total inside city potable water use. Greeley also serves other large commercial and industrial water users, including a cogeneration plant and a dairy, along with the school district and the Northern Colorado Medical Center.

Table F-3. Potable Water Deliveries to Inside City of Greeley Customers, 1993 to 2002.

	MG			
1993	2,569	796	947	4,312
1994	3,613	1,017	1,048	5,678
1995	3,375	940	1,083	5,399
1996	3,824	1,086	1,048	5,958
1997	3,856	978	1,024	5,858
1998	4,170	1,185	1,041	6,395
1999	3,824	1,123	907	5,855
2000	4,600	1,238	1,118	6,957
2001	4,231	1,152	1,266	6,649
2002	4,166	1,102	916	6,184

[1] Residential includes single family, multifamily and a small number of residences on septic tanks.

[2] Commercial includes large commercial, such as UNC, city uses, a small number of businesses on septic tanks, parks, and potable water used at golf courses.

[3] Swift and Company was formerly known as Con Agra and Monfort.

[4] Total potable use excludes Kodak and a small number of residential and commercial customers outside the City, which Greeley must serve.

Source: City of Greeley 2004c; ERO Resources 2004.

Outside the City of Greeley, the Greeley Water Department provides water to a small number of residential, commercial and agricultural customers along its Bellvue transmission line, plus customers in a grid system southwest of the City. Water demand from these customers averaged 801 AF from 1993 to 2002 and this use is not expected to change significantly in the future (Harvey Economics 2004). In addition, the City of Greeley also provides water to Kodak, whose demands averaged 439 MG or 1350 AF during that period.

Three large Greeley customers, the University of Northern Colorado (UNC), Eastman Kodak Corporation (Kodak), and Swift and Company (Swift) provide their own water to the City of Greeley, which Greeley treats pursuant to contracts with each. Hence, these entities, like the wholesale contract customers previously discussed, are not relevant to consideration of future demands or any gpcd calculations.

The calculation of gpcd for the City of Greeley is complicated by the following considerations:

- Greeley serves wholesale customers, residences, small businesses, agricultural entities and a Kodak plant outside its service area.
- Unlike most other cities in northern Colorado, Greeley has a number of large commercial and industrial water users.

- Greeley has a tradition of relatively large lot sized homes. These large lots historically influence gpcd figures; however that influence has decreased in recent years as smaller lots have dominated new development.
- Greeley is farther out on the eastern plains than most other Project Participants in northern Colorado, causing larger amounts of irrigation demand due to the relatively hot, dry climate.

Historical consumption patterns were also influenced by the advent of metering for Greeley water customers. Greeley initiated its universal metering program in the late 1980s and was essentially complete by 1997. Metering appears to have had a dampening affect on water use patterns, expressed by such measures as gpcd (City of Greeley 2004b).

Table F-4 depicts historical trends in gpcd for the City of Greeley.

Table F-4. Potable Water Use per Capita for the City of Greeley.

	gpcd	
1993	183	157
1994	227	211
1995	187	195
1996	206	219
1997	194	203
1998	207	218
1999	175	197
2000	207	220
2001	180	204
2002	172	192

[1] Excludes wholesale accounts, UNC and Swift, along with residential and commercial customers outside Greeley city limits.

[2] Inside city single family residential use divided by population served by the City of Greeley.

Source: City of Greeley 2004c.

Total water use per capita, excluding wholesale accounts and those outside city limits, averaged 202 from 1993 to 2002. Single family residential water use per capita inside Greeley city limits averaged 194 between 1993 and 2002. Water use patterns indicate a flattening of demand due to universal metering (complete in 1997), routine water conservation efforts, and weather related effects, including drought restrictions.

Non-potable Water Use

Because of the various canals that have crisscrossed Greeley since its inception, the City has long used non-potable water used for irrigation purposes. Historically, non-potable water demands were about 1,500 AF per year, and were supplied out of the Greeley Loveland Irrigation Company canals and through the Greeley Irrigation Company system. The City became more aggressive about its non-potable water development in 1997, after seeing the cost effectiveness of such systems. In 2003, approximately 1,800 AF of non-potable water was delivered by the City of Greeley. Currently two golf courses, a number of parks, and some schools and subdivisions use non-potable water. UNC, AIMS Community College, and the Greeley Country Club have their own private, non-potable systems. Greeley actively encourages non-potable systems for new developments. Although Greeley significantly increased acreage under non-potable irrigation between 1997 and 2003, actual water use increases leveled off due to conservation efforts especially within the Greeley park system.

Total Historical Water Requirements

Table F-5 presents total water requirements for the City of Greeley, excluding wholesale water customers and industrial customers who provide their own water rights and water resources. Total water requirements have ranged from 14,782 in 1993 to 24,522 in 2000 and 22,939 in 2002.

Table F-5. Total Water Requirements for the City of Greeley 1993 to 2003.

	AF			
1993	10,326	1,500	11,826	14,782
1994	14,208	1,500	15,708	19,636
1995	13,245	1,500	14,745	18,431
1996	15,066	1,500	16,566	20,707
1997	14,835	1,550	16,385	20,481
1998	16,431	1,600	18,031	22,539
1999	15,184	1,650	16,834	21,043
2000	17,918	1,700	19,618	24,522
2001	16,518	1,750	18,268	22,835
2002	16,166	2,185	18,351	22,939
2003	13,259	1,775	15,034	18,792

[1] Including system losses.

Source: City of Greeley 2004c; Harvey Economics 2004.

Total water requirements account for conveyance, treatment and distribution losses of a total of 20 percent (conveyance and treatment composes an estimated 15 percent), but do not include a safety factor of 7,300 AF, which Greeley assumes for the year 2003 (City of Greeley 2004c; ERO Resources 2004). Greeley's justification for a safety factor is based upon these considerations:

- The junior nature of a majority of Greeley's water rights
- Increased water demands during hot and dry periods
- Uncertainty about the ability of Greeley's water supply models to predict real-world supply circumstances
- Water supply obligations on certain lands with insufficient water supply dedications to the City, which the City has not yet begun to serve

- Uncertainties related to system failures
- The overall complexity of the Greeley demand and supply system

Given these complexities and uncertainties, the need for a safety factor for the City of Greeley appears reasonable.

Water Demand Projections

The City of Greeley has expended considerable effort to project future water needs. The City prepared a comprehensive plan in 2000, a water demand study in 2002, and a water master plan in 2003.

Population Projections

The City of Greeley's water demand projections begin with population forecasts. The City of Greeley 2020 Comprehensive Plan established growth scenarios. Historical population growth of 2.5 percent per year was assumed for the City from 2003 through the year 2020 (City of Greeley 2000). Beyond the year 2020, the Water Master Plan assumed a two percent annual growth rate between 2020 and 2050 (City of Greeley 2003). Table F-6 depicts the City of Greeley's population projections.

Table F-6. Projected Population for the City of Greeley, 2005 through 2050.

	Population
2005	87,200
2010	98,700
2015	111,600
2020	126,300
2025	139,400
2030	154,000
2035	170,000
2040	187,700
2045	207,200
2050	228,800

Source: City of Greeley 2003; Harvey Economics 2004.

Greeley's population, according to these forecasts, will increase from 83,000 persons in 2003 to 126,300 in 2020, a 52 percent gain. By the year 2050, Greeley's population is projected to be 228,800, or 176 percent higher than the 2003 figure.

By comparison, the City of Greeley's percentage increase in population projections is in line with the average annual growth rate projected for Weld County by the Colorado State Demographer. Given the substantial growth projected by smaller communities in Weld County, it would appear that these population growth forecasts might somewhat aggressive. However, the City of Greeley spent considerable time studying its growth prospects in the comprehensive plan, and it contemplates a considerable expansion of the commercial base, as well as residential growth along US Highway 34 and west to Interstate 25. Given the growth that has occurred in other nearby communities, such as Windsor, this assumption is plausible. Further, Greeley's role as a regional center in northern Colorado should also enhance its growth prospects, as growth elsewhere in Weld and nearby counties occurs. Greeley's population projections are supportable for the purposes of this analysis and the EIS.

Greeley's Water Demand Projections

Greeley applied the population forecasts to projections of land use by type: high density residential; low density residential; commercial; employment districts; developed parks; and industrial. Greeley's consultants prepared single family, multifamily and commercial development projections on a market basis, consistent with the above population forecasts. Next, Greeley applied water use factors, i.e., AF per acre per year, to each of the different types of land uses. Given the densities and locations from the comprehensive plan, the water demands were projected for each type of land use and then aggregated to establish water use. Water demand projections and incremental changes between time periods are provided in Table F-7.

Table F-7. Future Water Requirements for the City of Greeley, 2005 to 2050.

	AF				
2005	3,600	500	4,100	4,800	27,700
2010	7,100	1,000	8,100	9,500	32,400
2015	11,100	1,600	12,700	14,900	37,800
2020	15,600	2,300	17,900	21,100	43,900
2025	19,000	2,800	21,800	25,600	48,500
2030	22,700	3,400	26,100	30,700	53,500
2035	26,800	4,000	30,800	36,200	59,000
2040	31,200	4,700	35,900	42,200	65,000
2045	36,000	5,400	41,400	48,700	71,500
2050	41,200	6,200	47,400	55,800	78,500

Note: Incremental needs represent changes compared with year 2002.

[1] Including system losses.

Source: City of Greeley 2004a; ERO Resources 2004.

The City of Greeley's projected demands include a 15 percent conveyance loss. Non-potable uses are projected to be 15 percent of potable uses. The 5 percent of combined treatment plant and distribution losses are included as well, as part of incremental potable demands at the treatment plant in the table above.

The study team believes that the water demand forecasting methodology utilized by the City of Greeley is reasonable, given the availability of data. The land use projections and designations represent the policy of the City of Greeley, but the absorption rate, or structures erected on the land, was based upon an expectation of future residential and commercial growth. Water use factors were based upon actual historical Greeley experience for different types of land uses.

To test the reasonableness of the projections, the study team applied historical average of 202 gpcd to projected population for comparison with the incremental potable demands at the treatment plant projections as derived by the City. Based upon the average gpcd recently experienced, 2020 water demand projections would be about 3 percent lower as compared with those produced by the City using a land use based approach. A similar comparison for the year 2050 indicates that the gpcd based approach would be roughly 22 percent lower than the projections used by Greeley. These differences might be explained by changing lot sizes, the growing proportion of commercial development, increasing income and the potential for new large water users. Further, the study team has chosen not to include the safety factor of 7,300 AF in calculating Greeley's future demands. Greeley's water demand projections without the safety factor have been applied in this analysis.

Water Conservation

The City of Greeley has an extensive water conservation program that was largely implemented during the last half of the 1990s. Table F-8 provides a list of the Greeley conservation programs in force at the beginning of 2004.

Beyond these programs, Greeley has spent $300,000 to install a central controls system to improve irrigation efficiency at its 35 parks. Greeley provides homeowner incentive programs for low-flow plumbing fixture retrofits and devices. The City is retrofitting municipal facilities with water conserving devices as old devices wear out. High water usage accounts are flagged and the customer is alerted to these situations for remedy, with city help. Billing has been changed from bimonthly to monthly readings to allow customers to more closely track their water use rates. Greeley requires proof of soil amendment at a rate of 4 cubic yards of amendments per one thousand square feet of turf before it will grant temporary (30 day) waivers from watering restrictions to customers attempting to establish new sod or seed lawns.

Greeley also is considering implementation of new water conservation measures in the future. First, the City is studying a water budget program that would estimate water requirements for individual customers and subject customers to inclining block rates to promote efficient water use. Secondly, Greeley is considering a commercial and industrial auditing program to evaluate individual businesses and recommend water reduction steps. Separate irrigation meters for new multifamily units and mandatory rain or wind shutoff devices on new sprinkler systems are also being contemplated.

Table F-8. City of Greeley Water Conservation Programs, 2004.

Program	Year Commenced	Program	Year Commenced
EDUCATION		**School Programs**	
Public Information		Children's Water Festival	1990
Bill inserts	1994	Conservation Fair	1995
Bus benches, billboards, etc.	1998	Waterwise Curriculum & water kits	1997
Events	1995	Stormwater awareness program	2002
Media briefings	1995		
News releases	1995	**Audits**	
Newsletter articles	1995	Residential sprinkler audits	2001
Newspaper advertising	1995	**Giveaways**	
TV and radio advertising	1995	Conserv. Kit - indoor	1997
Web page	1994	Conserv. Kit - outdoor	1997
Email newsletter	2004	Flow restrictors	1997
Targeted Outreach		Rain gauges	1997
Car washes	2002	Toilets	1999
UNC	2001	Water Budget	
Landscapers	2002		
Hotels/motels	2003	Landscape Standards	1999
Hotel/motel tent cards	2003	**Plumbing Standards**	1999
Homeowner associations	2002	**Wasting Water**	
Key accounts	2003	Wasting water code	1950
Weld County School District Six	2002	Wasting water enforcement	1997
Restaurants	2002		
Restaurant tent cards	2002	**Leak Detection**	1994
Commercial/Industrial Audits	2003	**Universal Metering**	1994
Adult Education		**Regional Involvement**	1996
Conservation Fair	1995	AWWA RMS Water Conservation Comm.	1997
Landscape Workshop	2000	AWWA RMS Youth Ed Comm	1997
Lawn watering guide	1995	Front Range Lawn Watering Group	2002
Research		Xeriscape Colorado	1997
BOR Xeriscape Study - YARDX Project	1996	**Water Emergency / Shortage Plan**	1998
Soil Amendment Study	2002	**Water Reuse**	
Xeriscape Demonstration Garden	1998	Greeley WPCF	1996
New Technology (ET Clocks, Irrigation)	2001		

Source: City of Greeley 2004c.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes, water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants, reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand as described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources or implementing additional water conservation measures.

Water Need

The City of Greeley currently has an adequate firm yield to meet existing water delivery requirements in dry years (Figure F-1). By about 2020, water demand is expected to exceed available firm water supplies. A water supply shortage of about 9,650 AF is anticipated by 2030 and a shortage of about 34,650 AF by 2050. Firming 44 units of Greeley's Windy Gap water would provide an annual yield of up to 4,400 AF, although preliminary model results indicate a firm yield closer to 2,900 AF. In the near term, the City needs the reusable effluent to meet return flow and augmentation obligations for existing operations, and improve flexibility in managing its water portfolio. A Windy Gap water supply of 4,400 AF would provide Greeley about 8 percent of the City's 2030 water supply requirement, or 6 percent of its 2050 water requirement, not including reuse of up to 80 percent of the Windy Gap firm yield (Figure F-2), not as a potable supply, because of the geographical and physical constraints, but as a supply to meet Greeley's RFOs. Conservation and other water supply sources also will be needed to meet the remainder of future water demands.

Figure F-1. Greeley's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

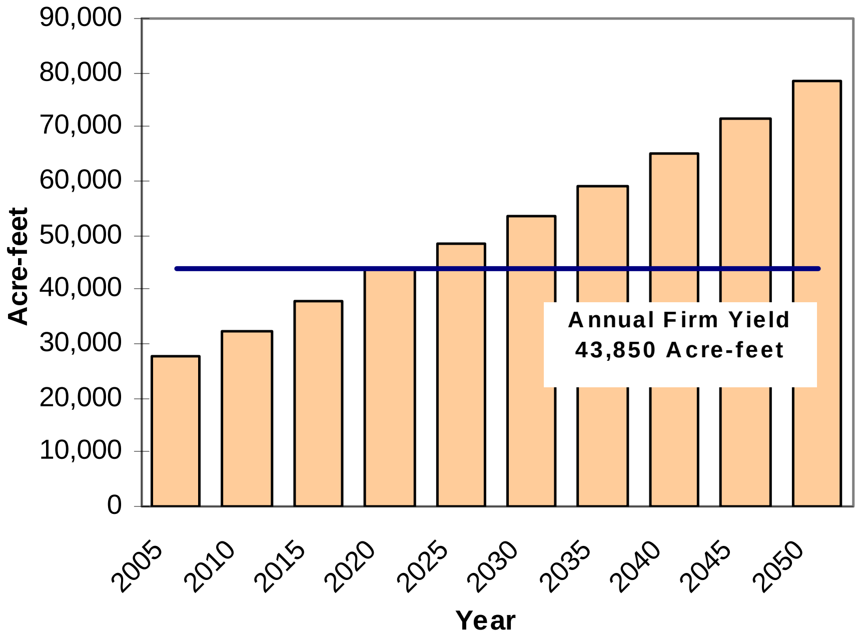
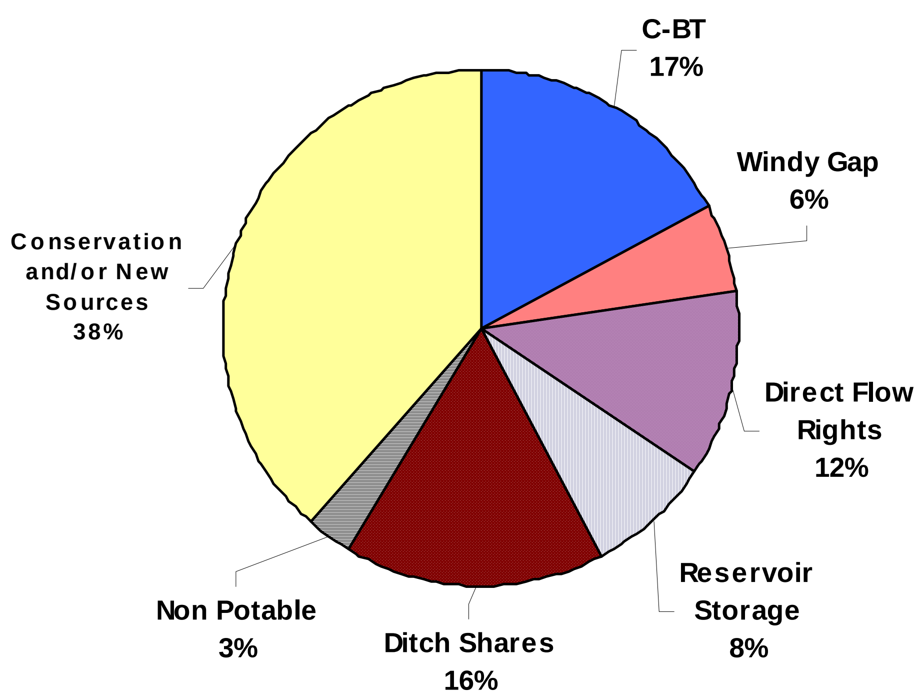


Figure F-2. Greeley's 2050 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

CITY OF LAFAYETTE

Introduction

The City of Lafayette is located just east of the City of Boulder in the eastern edge of Boulder County. Bordering communities include the cities of Louisville and Broomfield, and the towns of Superior and Erie. Lafayette began as an agricultural community in the late 1800s and later supported local coal mining activity. Like many communities within the rapidly growing US Highway 36 corridor, the City of Lafayette experienced significant growth in population over the last decade. The following discussion provides a summary of Lafayette's water supply and demand.

Water Supply

The City of Lafayette's raw water supply is derived from shared ownership in several ditch and reservoir companies with diversions from Boulder Creek and South Boulder Creek (Table G-1). Over 80 percent of Lafayette's firm yield comes from four companies including the New Consolidated Lower Boulder Reservoir and Ditch Company, South Boulder and Bear Creek Ditch Company, Howard Ditch Company, and Dry Creek No. 2 Ditch Company. In addition, Lafayette recently joined the NCWCD and has acquired C-BT Project units.

Water supplies from South Boulder Creek are delivered to Baseline Reservoir and then to the Baseline Water Treatment Plant year round, as available. Water supply sources derived from Boulder Creek are taken to the Goosehaven Reservoir complex via the 75th Street pipeline and to Baseline Water Treatment Plant year round, as available. Lafayette can only take Windy Gap and C-BT Project water from spring to early fall when the Boulder Creek Supply Canal is running.

Transbasin Water

Colorado-Big Thompson Project

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002-2004 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Lafayette, like most water providers, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

Lafayette owns 143 units in the C-BT Project, which provides a firm yield of about 86 AF using a C-BT quota of 0.6 AF/unit. C-BT water is delivered to the City through its 75th Street Pipeline located immediately downstream of the Boulder Creek Supply Canal outlet into Boulder Creek.

Windy Gap Project

Lafayette is in the process of acquiring 8 units of Windy Gap water. They currently have an agreement in concept with Left Hand Water District for 1 unit of Windy Gap water and are discussing purchase of 7 additional units from other entities. Firmed Windy Gap water would provide Lafayette water to meet potable needs and effluent for reuse. Similar to C-BT water, Windy Gap water would be delivered to Lafayette via the 75th Street Pipeline. Windy Gap water would be used as a supplemental source of water for Lafayette when local supplies are not adequate due to low snow pack in Boulder Creek Basin.

Ditch Shares

Lafayette's ownership in nine mutual irrigation companies provides water from South Boulder Creek and Boulder Creek. Ditch that provide this source of water include Coal Ridge Ditch Company, Dry Creek Number 2 Ditch Company, South Boulder and Bear Creek Ditch Company, New Consolidated Lower Boulder Reservoir and Ditch Company, South Boulder Canyon Ditch Company, Davidson Ditch and Reservoir Company, Gooddhue Ditch and Reservoir Company, Howard Ditch Company, and Leyner-Cottonwood Consolidated Ditch Company. Ditches on South Boulder Creek provide Lafayette about 2,090 AF of firm yield and ditches on Boulder Creek provide 1,611 AF of firm yield annually.

Reservoir Storage

Lafayette's ownership in three reservoirs including Waneka Lake, Baseline Reservoir, and Goosehaven Reservoir provide raw storage and allow the City to manage its water supply. The firm yield from these reservoirs is 747 AF.

Water Reuse

Currently Lafayette receives beneficial use of wastewater by exchanging to the 75th Street Pipeline via Coal Creek downstream to the confluence of Coal Creek and Boulder Creek and back up to the point of diversion. This allows the water reclamation facility effluent owned by Lafayette to be traded for clean raw water. Currently these exchanges provide about 200 AF on average for reuse (Lafayette 2005a).

Lafayette is considering implementation of a reclaimed water system that could be used either to irrigate large landscaped areas or to store and release water during certain times of the year in exchange for clean raw water. This system would allow capture of water unavailable by constraints associated with the exchange of wastewater. Lafayette plans on fully utilizing all available effluent associated with Windy Gap water if firmed (Lafayette 2005a) which, accounting for consumptive use and losses, typically is about 80 percent depending on season of use and the reclaimed water system. Wastewater return flows from the use of Windy Gap water could be recaptured and used in the reuse system.

Table G-1. Inventory of Lafayette Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	143	86[1]
Windy Gap Project	8[2]	0
Ditch Shares		
South Boulder Creek	N.A.	2,090
Boulder Creek	N.A.	1,611
Reservoir Shares		
Waneka Mutual Reservoir, Baseline Reservoir, and Goosehaven Reservoir	N.A.	747
Total	—	**4,534**

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis.

[2] Lafayette is currently in the process of acquiring 8 Windy Gap units.

Source: Lafayette 2005b.

Water Demand

The City of Lafayette is responsible for providing water to residential, commercial, industrial, and irrigation users within the City's boundaries. In addition, the City also provides water to the East Boulder County and Baseline Water Districts to serve certain rural residential customers. As of 2004, Lafayette did not serve any large water users.

Historical Water Demands

Lafayette's current service area population is estimated at 25,518 persons. This total reflects a current population within the City of 24,637 people and an additional 359 residential taps outside the City's limits (City of Lafayette 2004a). Table G-2 provides historical population estimates, the total number of residential units, and average annual growth rates for each.

Table G-2. City of Lafayette Population and Residential Unit Change, 1979 through 2002.

			Residential Units	
				Annual Change
1979	8,591	N.A.	3,765	N.A.
1980	8,985	4.6%	4,086	8.5%
1981	9,786	8.9%	4,309	5.5%
1982	10,685	9.2%	4,666	8.3%
1983	11,751	10.0%	5,016	7.5%
1984	12,634	7.5%	5,492	9.5%
1985	13,323	5.5%	5,675	3.3%
1986	13,750	3.2%	5,789	2.0%
1987	13,995	1.8%	5,817	0.5%
1988	14,221	1.6%	5,823	0.1%
1989	14,405	1.3%	5,829	0.1%
1990	14,708	2.1%	5,848	0.3%
1991	14,894	1.3%	5,940	1.6%
1992	15,364	3.2%	6,062	2.1%
1993	15,766	2.6%	6,516	7.5%
1994	16,841	6.8%	6,838	4.9%
1995	17,616	4.6%	7,389	8.1%
1996	19,004	7.9%	7,745	4.8%
1997	19,768	4.0%	8,123	4.9%
1998	20,703	4.7%	8,814	8.5%
1999	22,034	6.4%	9,145	3.8%
2000	23,197	5.3%	9,115	-0.3%
2001	23,901	3.0%	9,392	3.0%
2002	24,213	1.3%	9,515	1.3%

[1] 1980, 1990 and 2000 correspond to Census estimates; all other years were estimated by the City of Lafayette.

Source: City of Lafayette 2004b.

Over this period, population grew at an average annual rate of 4.5 percent, whereas the growth rate for the total number of residential units was 4.1 percent. Annual growth rates for both population and the number of residential units have fluctuated. Significant growth, ranging from 8 to 10 percent per year, occurred during the early 1980s and mid 1990s, followed by periods of relatively slower growth.

In November of 1995, Lafayette imposed growth restrictions that limited the number of new residential dwelling permits to 200 per year. These restrictions were amended in 2000 to allow for an additional 50 affordable, permanently deed restricted units per year. Since 1995, the total number of new households has varied between 691 and 123. This variability reflects, on the high side, a backlog of projects that were planned prior to the restrictions and, on the low side, hesitation by developers to continue planning until the effects of the backlog were known (City of Lafayette 2004c).

Average housing unit size steadily grew between 1980 and 1990. Over this period the number of persons per household increased from 2.28 to 2.52 (City of Lafayette 2004d). Growth in the number of persons per household has since slowed. As of 2000, the number of persons per housing unit was 2.54. This likely reflects stabilization in the rate of development between single family and multifamily residences (City of Lafayette 2004e).

Potable Water Demands. Table G-3 provides a breakdown of historical potable water use by consumer type for the period 1994 to 2003.

Table G-3. Potable Water Use by Customer Type for the City of Lafayette, 1994 to 2003

								Annual Percent Change
1994	509	202	711	94	9	39	854	N.A.
1995	493	174	667	81	7	37	792	-7.3%
1996	565	180	745	100	7	48	900	13.7%
1997	628	170	798	103	9	53	962	6.9%
1998	742	183	925	126	13	80	1,144	18.8%
1999	679	201	881	133	15	77	1,106	-3.3%
2000	755	238	994	146	16	101	1,257	13.6%
2001	774	234	1,008	150	13	114	1,285	2.2%
2002	565	177	742	105	16	41	903	-29.7%
2003	685	188	872	148	18	94	1,133	25.5%

Source: City of Lafayette 2004f.

These figures reflect treated water deliveries to the end user for customers within and outside the City.[1] Residential users have historically accounted for the majority of total deliveries; however, analysis of use by customer type between 1994 and 2003 suggests that non-residential use has grown as percentage of total use. In 2003, residential use accounted for 77 percent of total deliveries, down from 83 percent in 1994. On average, residential users have accounted for 81 percent of annual use.

Total treated water deliveries increased by 33 percent between 1994 and 2003, or at an average annual rate of 4.5 percent. Deliveries decreased by nearly 30 percent between 2001 and 2002, indicating the City's ability to reduce demands during drought. Table G-4 provides total and residential gpcd for 1994 to 2003.

[1] In 2003, deliveries to customers within the East Boulder County and Baseline Water Districts accounted for only 2 percent of total deliveries or 22 MG.

Table G-4. Potable Water use per Capita for the City of Lafayette.

	gpcd	
1994	116	139
1995	104	123
1996	107	130
1997	111	133
1998	122	151
1999	109	137
2000	117	148
2001	116	147
2002	84	102
2003	97	126

Source: Figures are based on the data presented in Tables G-1 and G-2.

Total and residential per capita per day use has averaged 134 and 108 gallons respectively. Although consumption patterns were lower in 2002 and 2003, analysis of the data did not reveal any meaningful trends in per capita per day use.

Non-Potable Water Demands. The City of Lafayette supplies approximately 325 AF of non-potable water to meet the irrigation needs of the City's golf course and landscaping along Highway 287. The golf course receives approximately 300 AF of non-potable water annually. Non-potable supplies totaling 25 AF per year are used for irrigation purposes along Highway 287 (City of Lafayette 2004a). These supplies are delivered via pipeline and do not incur significant delivery losses (City of Lafayette 2004g).

Total Water Requirements. Table G-5 indicates total potable and non-potable water deliveries by the City of Lafayette.

Table G-5. Total Water Requirements for the City of Lafayette, 1994 to 2003.

	AF			
1994	2,620	0	2,620	2,830
1995	2,430	0	2,430	2,624
1996	2,763	0	2,763	2,984
1997	2,953	325	3,278	3,514
1998	3,510	325	3,835	4,115
1999	3,393	325	3,718	3,989
2000	3,856	325	4,181	4,489
2001	3,942	325	4,267	4,583
2002	2,770	325	3,095	3,317
2003	3,476	325	3,801	4,079

[1] Including system losses.

Source: City of Lafayette 2004f.

Total requirements reflect adjustments made to account for approximate system losses of 8 percent (Id). This includes average treatment and distribution losses of 1.5 and 6.5 percent, respectively (McLaughlin Rincon 2004). Over the period of record, total water requirements increased by 44 percent, or at an average annual rate of 4.1 percent.

Projected Water Requirements

McLaughlin Rincon Project Water Requirements

The City of Lafayette provided the study team with projected potable and non-potable water demands at buildout, which were prepared by McLaughlin Rincon. These buildout projections are found in the 2004 Water System Master Plan and were based on anticipated land use patterns within the City's urban growth boundaries (McLaughlin Rincon 2004). Land use projections are included in Table II-D of the Water System Master Plan.

Project Potable Demands. McLaughlin Rincon utilized 2001 plant production data to identify "average" year use data for each user type. Climatological data indicated that 2001 was near average and comprehensive use data was available (McLaughlin Water Engineers 2003). Table G-6 provides the per AF demand factors used to derive potable demands.

Table G-6. Lafayette Master Plan Demand Factors.

		AF/Dwelling Unit
Parks	3.00	
Single Family Residence	—	0.50
Multifamily Residence	—	0.25
Office	1.04	—
Institutional/Public	1.03	—
Retail	1.61	—
Industrial	0.40	—

Source: McLaughlin Rincon 2004.

To arrive at projected potable demands, the number of new acres by type of use or number of dwelling units was multiplied by the demand factors presented in Table G-6. Total projected potable deliveries at buildout were estimated to be 6,950 AF.[2]

The study team evaluated the methodology utilized by McLaughlin Rincon and found that the methods used to project potable water demands at buildout were reasonable given the availability of data.

Projected Non-Potable Demands. Non-potable demands were also projected in the McLaughlin Rincon study.[3] The study identified six areas (329 acres of irrigable land) as likely future candidates to be served by non-potable supplies. Based on an application

[2] This reflects an adjustment of 6.5 percent to account for delivery losses between the plant and end user.

[3] "These requirements have not been included in the potable water needs" (McLaughlin Rincon 2004).

rate of 3 AF per acre per year, total projected non-potable demands were estimated at 986 AF per year.

The study team evaluated the methodology utilized by McLaughlin Rincon and found that while the methods used to calculate non-potable water demands were generally sound given the scope of the Water Master Plan, consultation with Lafayette suggested a need to revise these for the purposes of this study (City of Lafayette 2004g).

The City indicated that these figures represented an upper bound on non-potable demand dependent on the future costs associated with, among other things, the development of potable and non-potable supplies. Based on discussions with Doug Short, City of Lafayette Public Works Director, the study team adjusted projected non-potable demands to reflect the mid-way point of current non-potable use and the upper bound provided by McLaughlin Rincon, or a total of 658 AF per year.[4] The remaining 328 AF of demand that must be met were added to potable demands.

Adjusted projected total water deliveries for the City of Lafayette at buildout are 8,033 AF, including 7,375 AF of potable use and 658 AF of non-potable use (McLaughlin Rincon 2004).

Study Team Demand Projections

To arrive at annual projections between now and buildout, the study team first estimated the total housing units at buildout. Based on projected land use patterns, buildout will result in an additional 4,540 residential units. Assuming 2.54 persons per housing unit, total population at buildout will be approximately 36,200 people.[5]

The City of Lafayette provided the study team with dwelling unit forecasts based on an assumed 200 new units per year, as defined by the limits of Lafayette's growth restrictions (City of Lafayette 2004b). These projections seem reasonable given recent trends and the City's growth restrictions. Assuming 2.54 persons per housing unit, population growth within the City of Lafayette is projected to grow by 508 persons per year. By comparison, the City of Lafayette has grown by an average of 792 persons per year since 1990. Table G-7 provides the population and dwelling unit forecasts used to project Lafayette's future water demands.

[4] The resulting total is also consistent with the City's response to the Windy Gap Questionnaire.

[5] The land use plans used to determine the number of new residential units were based on development as of January 2002. To arrive at buildout population, the projected total number of new people was added to 2002 total population.

Table G-7. Population and Dwelling Unit Forecasts for the City of Lafayette, 2005 to 2050.

			Annual Growth Rate
2005	10,100	25,700	N.A.
2010	11,100	28,200	1.9%
2015	12,100	30,700	1.7%
2020	13,100	33,300	1.6%
2025	14,100	35,800	1.5%
2030	14,200	36,200	0.2%
2035	14,200	36,200	0.0%
2040	14,200	36,200	0.0%
2045	14,200	36,200	0.0%
2050	14,200	36,200	0.0%

Source: City of Lafayette year 2004b; Harvey Economics 2004.

Based on the assumed rate of growth, the City of Lafayette will reach buildout by 2026. To project use between 2003 and 2026, water demands were assumed to grow at a rate consistent with population growth. Table G-8 provides projected potable and non-potable demands for the City of Lafayette through 2050. An additional 8 percent was added to all potable demands to account for treatment and distribution losses.

Table G-8. Water Demand Projections for the City of Lafayette, 2005 to 2050.

	AF			
2005	3,800	350	4,200	4,500
2010	4,700	430	5,100	5,500
2015	5,500	500	6,000	6,500
2020	6,400	570	7,000	7,500
2025	7,300	650	7,900	8,500
2030	7,400	660	8,000	8,600
2035	7,400	660	8,000	8,600
2040	7,400	660	8,000	**8,600**
2045	7,400	660	8,000	8,600
2050	7,400	660	8,000	8,600

[1] Including system losses.

Source: Harvey Economics 2004.

Conservation

The City of Lafayette has implemented several measures to encourage conservation throughout its system. In 1999, the City began an extensive water transmission and refurbishment program to minimize system losses. System losses have since fallen by nearly 15 percent (City of Lafayette 2004g).

The City currently prices water according to an aggressive increasing block rate structure. In 2003, Lafayette implemented a program to increase water rates by 41 percent through 2006 or 9 percent per year.

Lafayette also takes an active role in educating water users. The City regularly provides free education materials via the web, monthly newsletters, governmental access television, and how-to seminars. In addition, Lafayette recently partnered with the Center for Resource Conservation to hold free xeriscape seminars. This partnership also included 130 irrigation audits for Participants. Xeriscape seminars and irrigation audits are an on-going part of Lafayette's conservation program.

Future conservation plans by the City include the possible addition of a 5th tier to its rate structure and the permanent banning of outside watering between 10 A.M. and 6 P.M.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for water reuse. Transbasin diversions and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands and reuse can contribute to meeting demands.

The existing firm supply (including reuse water, where available) and projected future demand as described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Need

The City of Lafayette is approaching a near-term shortage in available firm water supplies. Water available to meet dry year demands is expected to exceed supplies within the next few years. Water demands are projected to peak at buildout in about 2026, at which this time a water supply shortage of about 4,100 AF is anticipated (Figure G-1). Firming 8 units of Lafayette's Windy Gap water would provide a firm annual yield of about 800 AF and reusable effluent that can be used for non-potable irrigation requirements. A firm Windy Gap water supply would provide Lafayette about 9 percent of the City's 2050 water supply requirement, not counting reuse of about 80 percent of Windy Gap effluent (Figure G-2). Water conservation and other sources of water supply will be needed to meet the remainder of future water demands.

Figure G-1. Lafayette's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

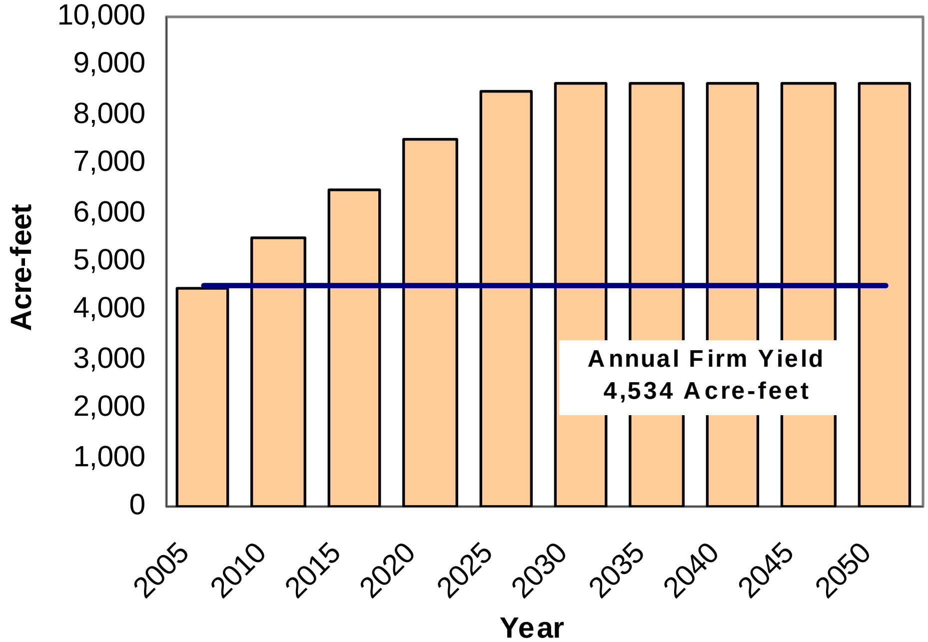
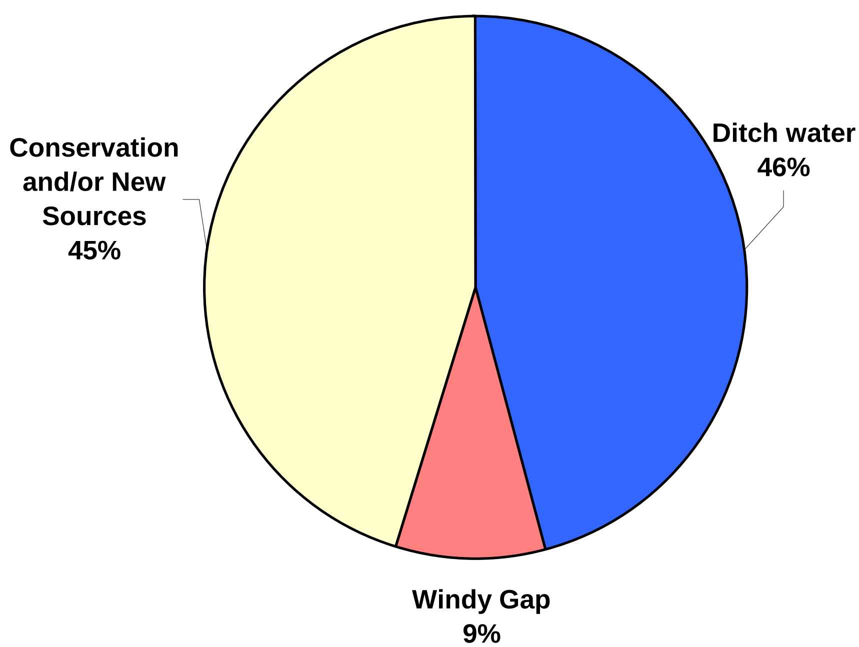


Figure G-2. Lafayette's 2050 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND SUMMARY

LITTLE THOMPSON WATER DISTRICT

Located in Berthoud, Colorado, the Little Thompson Water District (LTWD) provides treated water to about 7,000 homes and businesses in Northern Colorado. LTWD is a special government water district with customers in Larimer, Weld and Boulder counties. The 300-square-mile LTWD service area is generally bounded by the City of Loveland on the north, Longs Peak Water District on the south, the City of Greeley, the South Platte River and the St. Vrain River on the east, and the foothills on the west. It expanded to include the former Arkins Water Association in 1999 and the Town of Mead in 2001 and 2002.

Water Supply

Currently, the LTWD relies primarily on C-BT water to meet its municipal and commercial water requirements. The LTWD also owns a 0.22 cfs direct flow right in Buckhorn Creek and a few select ditch rights; however, these water supplies do not provide an annual firm yield (Table H-1).

Table H-1. Inventory of Little Thompson Water District Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project[1]		
Variable units	4,219 units	2,532
Fixed units	4,964 units	2,978
Total	9,183 units	5,510
Windy Gap Project	12 units	0
Direct Flow Rights		
Buckhorn Creek	0.22 cfs	0
Reservoir Storage		
Dry Creek Reservoir (50%)	4,400 AF	0
Ditch Shares		
Consolidated Home Supply	24	0
Big T Ditch and Manufacturing	0.33	0
Highland Ditch	2	0
Supply Ditch	9.5	0
Total		**5,510**

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis.

Transbasin Water

Colorado-Big Thompson Project

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002-2004 when the C-BT Project was limited by the physical supply of water that it could actually deliver. The LTWD, like most water providers, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

The LTWD owns 9,183 units in the C-BT Project, which provides a firm yield of about 5,510 AF using a C-BT quota of 0.6 AF/unit. Water is delivered from Carter Lake through the Southern Water Supply Pipeline (SWSP) to the Carter Lake Filter Plant and then delivered to customers.

Windy Gap Project

The LTWD is in the process of acquiring 12 units of Windy Gap water from the City of Greeley. Firmed Windy Gap water would provide LTWD water primarily for residential use associated with the planned St. Vrain Lakes Development. Effluent from Windy Gap water would be used in a reuse program to meet outside irrigation needs. Similar to C-BT water, Windy Gap water would be delivered to LTWD via the existing SWSP.

Direct Flow Rights

The LTWD own a 0.22 cfs direct flow right in Buckhorn Creek, but this junior right does not provide a firm annual yield.

Ditch Shares

The LTWD owns shares in four water ditches (Table H-1). The water is leased out to agricultural irrigators and does not provide a firm water supply for municipal use.

Reservoir Storage

LTWD currently has no water reservoir storage and relies on existing C-BT reservoirs for raw water storage. The LTWD and Central Weld County Water District are jointly planning construction of Dry Creek Reservoir, which is scheduled for completion in 2006. Dry Creek Reservoir will allow LTWD to store a portion of its C-BT water to improve its daily operational flexibility for treatment, as well as drought protection. Additional storage will improve reliability should problems at the Carter Lake outlet occur. The new reservoir will have a storage capacity of about 8,800 AF (Anglund, pers. comm. 2004).

Water Reuse

The LTWD does not currently have a reuse program or a source of water available for reuse. If Windy Gap water is firmed, the LTWD is planning to capture all of the available effluent from the first use of Windy Gap water from the wastewater treatment plant and estimates that about 80 percent of the Windy Gap water would be available for reuse (LTWD 2005). This water would be stored in ponds and delivered to raw water irrigation systems primarily within the St. Vrain Lakes Development and possibly elsewhere within the District.

Water Demand

The LTWD provides treated water to nearly 20,000 persons in its service area, which lies within Larimer, Weld, and Boulder Counties (NCWCD 2003). The District also provides treated water as a wholesale distributor to the North Carter Lake Water District, Long Peaks Water District, Town of Berthoud, and the City of Loveland. Because the LTWD is not responsible for providing the raw water for these deliveries to other customers, these deliveries were not included in the demand evaluation (NCWCD 2004). All supplies are treated and delivered via the Carter Lake Filter Plant.

Historical Water Demands

The LTWD currently provides water service to about 7,000 taps. Table H-2 provides the total number of taps by tap size and population estimates for the period 1991 to 2003.

Table H-2. Number of Taps and Population for LTWD, 1991 to 2003.

	Number of Taps						Estimated Population Served
	-						
1991	3,708	7	29	16	9	3,769	10,800
1992	3,806	7	30	16	10	3,869	11,080
1993	3,976	7	31	16	10	4,040	11,580
1994	4,165	7	31	16	10	4,229	12,130
1995	4,371	7	33	16	10	4,437	12,730
1996	4,550	7	35	16	10	4,618	13,250
1997	4,765	8	35	16	10	4,834	13,880
1998	4,942	8	35	16	10	5,011	14,390
1999	5,515	8	36	16	10	5,585	16,060
2000	5,769	8	35	17	10	5,839	16,800
2001	5,885	8	35	17	10	5,955	17,130
2002	6,529	10	37	20	11	6,607	19,010
2003	6,711	10	44	20	11	6,796	19,540

Source: LTWD Files obtained October 2004; Harvey Economics 2004.

Population estimates were derived using a 2000 breakdown of customer classes by tap size and persons per household reported by the Census for 2000.

Between 1991 and 2003, the total number of taps increased by 3,027, or at an average rate of 5 percent. In 1999 and 2002, the District assumed the role of primary water service provider for the Arkins Water Association and the Town of Mead. It is the District's belief that the absorption of these two service areas is not consistent with normal District growth (LTWD 2004a). Ignoring these two years, the District grew by 1,801 taps, or at an average annual rate of 3.9 percent. Almost all of the residential customers are found among the 5/8-inch tap sizes, and these have accounted for the bulk of the growth since 1990. In addition to its wholesale customers previously identified, the LTWD also serves large water users. An estimated eight to ten large agricultural and dairy users are among the larger tap sizes (LTWD 2004b). These larger tap counts have increased only slightly since 1990.

Water use. Table H-3 provides a breakdown of total water use and per tap use by tap size for 1991 to 2003. Over this period, the total number of taps grew at an average annual rate of 5 percent, with the majority of this growth occurring in the 5/8-inch category. This class of customers primarily includes residential users (LTWD 2004c).

Table H-3. Total Water Use, Millions of Gallons, and per Tap Use by Tap Size for the LTWD, 1991 to 2003.

											Total	
												Use per Tap
1991	697	0.19	9	1.29	46	1.59	87	5.43	43	4.79	882	0.23
1992	701	0.18	9	1.34	51	1.71	102	6.73	50	5.04	914	0.24
1993	729	0.18	10	1.49	48	1.54	98	6.13	53	5.29	938	0.23
1994	865	0.21	5	0.64	52	1.67	112	7.01	49	4.85	1,082	0.26
1995	779	0.18	6	0.81	45	1.35	105	6.55	45	4.47	979	0.22
1996	927	0.20	7	0.94	53	1.50	113	7.07	48	4.81	1,147	0.25
1997	876	0.18	2	0.28	62	1.77	116	7.23	48	4.82	1,104	0.23
1998	1,096	0.22	3	0.37	59	1.67	128	7.99	54	5.38	1,340	0.27
1999	995	0.18	3	0.41	55	1.53	119	7.43	55	5.45	1,226	0.22
2000	1,375	0.24	3	0.43	65	1.86	123	7.23	73	7.27	1,639	0.28
2001	1,312	0.22	3	0.38	66	1.90	134	7.89	69	6.90	1,585	0.27
2002	1,235	0.19	3	0.35	66	1.79	118	5.88	65	5.93	1,488	0.23
2003	1,002	0.15	4	0.45	55	1.25	106	5.29	61	5.55	1,228	0.18

Source: Files obtained from LTWD October 2004; Harvey Economics 2004.

While there has been variability in annual deliveries, total use increased by 39 percent from 1991 to 2003. This growth was largely driven by residential use in the smaller tap sizes. Further, water used per tap in smaller tap sizes corresponds to a shift in the types of residential customers serviced by the LTWD. During this time, large-lot use grew by more than 60 percent, while annual deliveries to small users fell by nearly 30 percent

(LTWD 2004c). This is consistent with the trend toward suburban type dwelling units and away from small homes and lots, common to rural areas.

Feed lot water use has also fallen substantially in recent years. This downward trend is consistent with the District's belief that many of its large agricultural and dairy customers have left, or are beginning to leave, the District (LTWD 2004b).

Identifying trends in per tap use is unclear due to the drought experienced in 2002 and 2003, except for the slight upward trend in per tap use among 5/8 inch taps for residential customers, previously discussed. Also, use per tap among customers using 3/4-inch taps dropped substantially in 1996 because of significant reduction in deliveries made to a single large commercial user (Id). Table H-4 provides residential and total gpcd for the LTWD.

Table H-4. Potable Water Use per Capita for the LTWD.

Year		Total
	gpcd	
1991	169	224
1992	174	225
1993	168	223
1994	167	219
1995	187	239
1996	160	209
1997	182	233
1998	159	210
1999	179	229
2000	155	200
2001	211	262
2002	181	228
2003	166	209

Source: LTWD Files obtained October 2004; Harvey Economics 2004.

Residential and total gpcd averaged 174 and 224 gallons respectively, between 1991 and 2003. This difference is explained by the presence of dairies and other agricultural users in the LTWD service area. It is believed that residential per capita use does not reflect increasing use per residential tap, because of increasing persons per housing unit. In addition, LTWD acquired the Arkins Water Association in 1999 and began serving the Town of Mead in 2001 and 2002, which temporarily required per capita use.

Table H-5 indicates total deliveries made by the LTWD. Total water requirements account for system wide losses. System wide losses incurred during treatment and delivery have historically averaged around 8 percent (LTWD 2004b).

Table H-5. Total Water Requirements for the LTWD, 1990 to 2003.

			Total Water Requirements[1]
			AF
1990	852	2,614	2,820
1991	882	2,708	2,920
1992	914	2,805	3,030
1993	938	2,878	3,110
1994	1,082	3,319	3,580
1995	979	3,004	3,240
1996	1,147	3,521	3,800
1997	1,104	3,389	3,660
1998	1,340	4,110	4,440
1999	1,226	3,762	4,060
2000	1,639	5,030	5,430
2001	1,585	4,863	5,250
2002	1,488	4,565	4,930
2003	1,228	3,769	4,070

[1] Including system losses.

Source: Harvey Economics 2004.

Between 1990 and 2000, the historical peak for LTWD, total deliveries increased by 2,610 AF, or 93 percent. This ignores 2002 and 2003, which were excluded due to the effects of drought and related conservation efforts on consumer demand.

Projected Water Requirements

The LTWD provided the study team with demand projections through 2050. These forecasts were included in the District's Water Resource Master Plan (LTWD 2004d). The District first converted all tap sizes to a 5/8-inch tap equivalent, using AWWA standards. To project future demands, the District analyzed historical trends in the number of tap equivalents. Based on historical growth, the total number of equivalent taps was assumed to grow by 3.5 percent per year. To arrive at projected demands, the District assumed that each equivalent tap would result in 0.63 AF of additional demand per year.

The study team reviewed the methods used by the District and concluded that improvements in the demand forecasting approach were warranted for the purposes of this study. First, the District's actual experience in tap equivalency does not mirror the AWWA standards. Second, recent trends in specific sized tap numbers and use per tap are not captured with the tap equivalency approach. Importantly, the detailed records provided by the District made tap conversion unnecessary and allowed the study team to incorporate anticipated changes in the customer base by tap size into the projections.

Growth rates for each tap size were based on historical averages and information provided by the District. The 5/8 inch taps were projected using an average annual increase of 3.5 percent between 2003 and 2015, 3 percent between 2016 and 2025, and 2.5 percent between 2026 and 2050.[1] This pattern of growth was determined based on an analysis of historical growth within the District and growth projections for the northern Front Range prepared by the Colorado Demography Office. Average annual changes in the number of taps were assumed for all the other tap sizes. Table H-6 presents tap projections for the LTWD through 2050.

Table H-6. Projected Number of Taps by Size for the LTWD, 2005 to 2050.

							Total
2005	7,200	11	46	20	10	1	7,300
2010	8,500	12	51	21	11	1	8,600
2020	11,800	14	61	22	12	1	11,900
2030	15,400	17	71	23	13	1	15,500
2040	19,700	19	81	24	14	1	19,800
2050	25,300	22	91	25	15	1	25,500

Note: These projections are not specific to any development, but are demand driven and pertain to active taps in all developments served by LTWD.

Source: Harvey Economics 2004.

Between 2005 and 2050, the total number of taps is projected to increase by 18,200, or at an average annual rate of 2.8 percent, driven by growth in the number of 5/8-inch taps.

Projected demands were calculated by multiplying per tap use by the total number of taps. For all tap sizes, average annual use per tap over the previous five years prior to 2003 was used to project demand.

LTWD and St. Vrain Lakes Development are currently negotiating a water supply agreement that would provide service to residential and commercial customers within a subdivision containing nearly 4,000 lots. It is the District's belief that this growth would occur outside of, and in addition to, the normal growth rate of 3.5 percent.[2] The District, in conjunction with St. Vrain Lakes Development, provided the study team with annual projected water requirements for the development based on detailed current development plans and historical patterns of use. The study team reviewed the methods and assumptions used by LTWD and found them acceptable.

Table H-7 presents total projected water requirements for the period 2005 to 2050. These figures have been adjusted upward to account for treatment system losses of 8 percent.

[1] Interview with Erik Anglund, Water Resource Engineer, LTWD, September 2004.

[2] Personal email communication with Erik Anglund, LTWD, November 2004.

Table H-7. Total Water Requirements for the LTWD, 2005 to 2050.

	l Water Deliveries		Total Water Requirements[1]	
				Including St. Vrain Lakes Development
2005	1,800	5,600	6,000	6,000
2010	2,100	6,500	7,000	8,100
2015	2,500	7,500	8,200	10,300
2020	2,800	8,600	9,400	11,800
2025	3,200	9,900	10,700	13,200
2030	3,600	11,100	12,100	14,500
2035	4,100	12,400	13,500	15,900
2040	4,500	14,000	15,200	17,600
2045	5,100	15,700	17,000	19,400
2050	5,700	17,600	19,100	21,600

[1] Including system losses.

Source: Harvey Economics 2004.

Including the St. Vrain Lakes Development, the study team projections in 2020 are 1,300 AF, or 5 percent, higher than the projections provided by LTWD. The study team, after assessing the considerable growth projected for the District, has adopted the set of projections that exclude the St. Vrain Lakes Development even though the Firming Project is the primary source of water for this development. This is explained by the fact that the demand projections are driven by expectations of people moving into the District, not developers' plans alone. If people are moving into the St. Vrain Lakes Development, then they will not be moving into competing development lots in the District. This approach offers a conservative perspective on the absorption rate and the fact that growth is likely to slow in later years as the population base increases.

It is worth noting that in its current role, LTWD cannot control, nor direct, the growth that occurs within its service boundaries. While the District assists developers in identifying and securing potential sources of supply, the developers themselves are responsible for securing the raw water necessary to meet the demands of their development.

Based on a comparison of projected demands with current supplies, it is evident that the Windy Gap Firming Project will provide only a small portion of the total LTWD water supply necessary. In addition to its participation in the Windy Gap Firming Project, the LTWD has taken an active role in promoting the development of dual-use systems. This includes systems that are capable of utilizing re-use water when available.

Conservation

LTWD has introduced several measures to encourage conservation among its customers. Full monthly water metering and pressure regulation in the system and at each individual customer's tap provide the District with a means of tracking water usage and potential leaks and losses within the system. The District also operates a telemetry

SCADA system for remote system management and analysis of abnormal operating conditions (Anglund, pers. comm. 2004). The following is a list of additional conservation measures utilized by the Districts, as of 2004 (NCWCD 2003; LTWD 1997):

- Conservation tips via newsletters and the District website;
- An increasing block rate structure;
- A collection of xeriscape related educational materials at the Berthoud Public Library, established through a grant from the Colorado Water Conservation Board in 1997; and
- Several current developments utilize dual use systems. Developers are encouraged to incorporate dual-use systems into future developments.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand as described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Needs

The LTWD's current water needs are met by C-BT Project water. Water demand could exceed available firm water supplies by about 2005, which would affect the ability of the District to meet dry year water needs depending on C-BT deliveries. LTWD's projected 2030 water requirements exceed available firm supplies by about 6,600 to 8,600 AF depending on the St. Vrain Lakes Development (Figure H-1). By 2050 demand is estimated to exceed current firm water supplies by about 13,600 AF excluding the St. Vrain Lakes Development. Firming LTWD's Windy Gap water would provide a firm annual yield of about 1,200 AF for potable needs plus about 80 percent would be available as reusable effluent to meet a portion of non-potable demands. A firm Windy Gap water supply would provide the LTWD about 6 percent of the District's 2050 water supply requirement (Figure H-2). Water conservation and other sources of water supply also will be needed to meet all of the estimated future water demands.

Figure H-1. LTWD's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

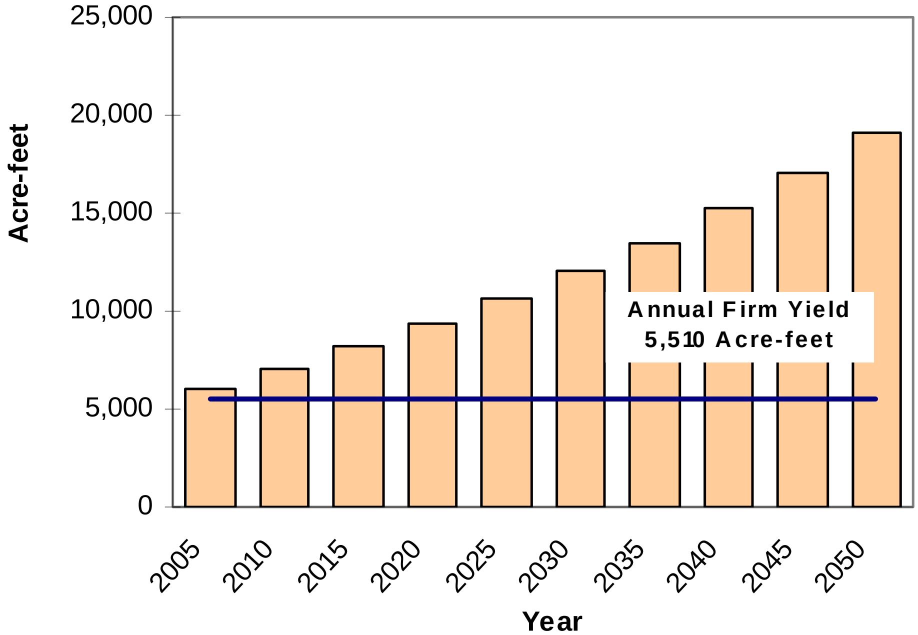
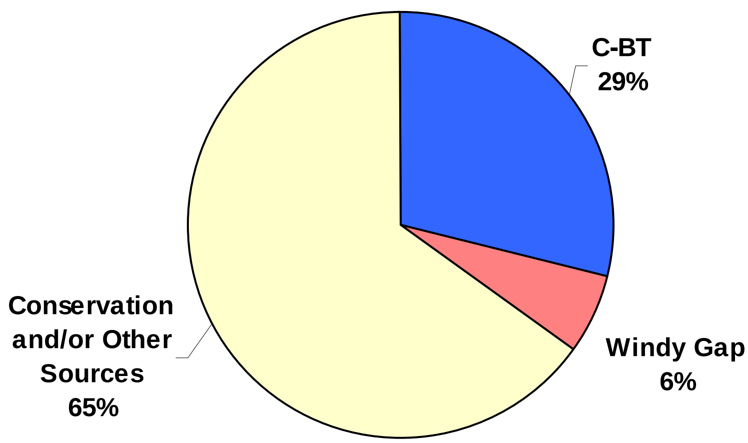


Figure H-2. LTWD's 2050 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

CITY OF LONGMONT

Introduction

The City of Longmont is the second largest and fastest growing city in Boulder County. Longmont is located about 16 miles northwest of the City of Boulder. The City was founded in 1871 and was named after the nearby Longs Peak. Like most of the Colorado Front Range, Longmont has experienced steady growth over the past 20 years. The following discussion provides a summary of Longmont's water supply and demand.

Water Supply

Longmont's raw water sources come from the St. Vrain Creek basin (including Left Hand Creek, a tributary to St. Vrain Creek), and from the Colorado River Basin. St. Vrain basin water resources include Ralph Price Reservoir, the North Pipeline on North St. Vrain Creek, and the South Pipeline on South St. Vrain Creek. Other St. Vrain basin resources include ownership in mutual and private ditch and reservoir companies that divert from St. Vrain Creek east of Lyons, Colorado. Colorado River basin resources consist of water available for delivery to Longmont from two trans-mountain diversion systems, the C-BT and the Windy Gap Project (Longmont 2004a).

Transbasin Water

Colorado-Big Thompson Project

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002-2004 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Longmont, like most municipalities, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

The City of Longmont owns 12,360 units in the C-BT Project and has a long-term lease and exchange agreement for 5,000 units. C-BT Project water provides a firm annual yield of about 10,416 AF using a C-BT quota of 0.6 AF/unit (Table I-1). C-BT water represents about 34 percent of Longmont's existing raw water supply. C-BT water is delivered from Carter Lake to Longmont via the Southern Water Supply Pipeline (SWSP) and the St. Vrain Supply Canal to Longmont's water treatment facilities.

Table I-1. Inventory of Longmont Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
Windy Gap Project	80 units	0
C-BT Project	17,360 units	10,416 [1]
Upper Baldwin Replacement Water	36.5 shares	343
Direct Flow Rights		
Pipelines (North and South)	100%	905
1929 Transfers	100%	1,584
Transferred Upper and Lower Basin Direct Flow Rights	795.6	11,367
Reservoir Storage		
Municipal storage	16,197 AF	3,698
Reservoir exchange plan	100%	1,450
Irrigation reservoirs	8,500 AF	1,200
Total	—	**30,963**

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis. Longmont's C-BT units include a long-term lease and exchange for 5,000 units.

Source: Longmont 2004a, 2004b; Tetra Tech 2004b.

Upper Baldwin Gulch Replacement Water

Longmont receives about 343 AF per year from shares in Upper Baldwin replacement water from the Colorado River basin.

Windy Gap Project

The City of Longmont owns 80 units of Windy Gap water. Yield from 5 units of this water are currently leased to the Town of Erie. Windy Gap does not provide a firm annual yield because water rights are junior and there is insufficient storage to capture water during wet years. Windy Gap water from the Colorado River basin is delivered to the City from Carter Lake via the SWSP and the St. Vrain Supply Canal to water treatment facilities. When available, Windy Gap water provides a source of raw water for municipal and industrial use and because Windy Gap water is reusable, the effluent from Windy Gap first use can be used to meet return flow obligations and various exchange program requirements.

Direct Flow Rights

Longmont's direct flow rights, or native supply, are diverted from St. Vrain Creek near the City's west water treatment plants near Lyons. These rights include direct flow decrees, a 1929 transfer of irrigation water rights, transferred interest in various ditches and storage reservoirs, and other miscellaneous basin rights. Many of Longmont's municipal rights are converted irrigation rights. Longmont currently has changes pending for rights from seven ditches, which are expected to be finalized by the end of 2004. Other direct flow rights include reuse sources associated with the transfer of irrigation shares in local area ditch and reservoir companies.

Reservoir Storage

Primary Municipal Storage Reservoirs

Longmont's primary water storage reservoirs are Ralph Price Reservoir (Button Rock Dam) on North St. Vrain Creek, and Union Reservoir located east of Longmont. Union Reservoir is part of Longmont's reservoir exchange program, which also includes Clover Basin, Independent, McIntosh, Oligarchy No. 1, and Pleasant Valley. Longmont has a reservoir exchange program and irrigation reservoirs in addition to these storage rights. Longmont has changes pending for irrigation reservoir storage rights (see below) for conversion from irrigation to municipal use. Other municipal storage includes McCall Reservoir. This reservoir is exchanged for direct flow water for delivery to the treatment plant and delivered via ditch to parks in Longmont.

Ralph Price Reservoir. This reservoir on North St. Vrain Creek provides 16,000 AF of storage. Longmont owns 100 percent of both current storage and future storage from potential enlargement activities. The decree to enlarge this reservoir already exists, although enlargements to a capacity of greater than 32,551 AF would require transfer of other water rights to the Ralph Price Reservoir or obtaining new water rights.

Union Reservoir. Longmont owns 85 percent of the storage rights in Union Reservoir, which has a current quota capacity of 10,000 AF and an active capacity of 12,000 AF. Proposed reservoir enlargements would provide an additional 20,000 AF of storage, or a total of 32,000 AF of storage. The increased capacity in the reservoir would provide Longmont with additional water storage capacity, more water exchange possibilities, and storage space for reuse water. In 1986, Longmont applied for and subsequently received a conditional decree for the enlargement of Union Reservoir. The current proposal to enlarge Union Reservoir also includes a pipeline to pump raw water for direct use in parks and golf courses, exchanges with area ditches, and to a new water treatment plant near Dowe Flats.

Other Municipal Storage Reservoirs

Liberty Reservoir. Longmont also holds a conditional storage decree for Liberty Reservoir in the amount 1,515 AF. This reservoir will be used for storage of storm drainage and wastewater treatment plant effluent flows.

Other Reservoirs in the Reservoir Exchange Plan

Clover Basin Reservoir. Clover Basin is primarily used to deliver raw water to parks and schools along Dry Creek immediately downstream of the reservoir.

Independent Reservoir. Independent Reservoir is used primarily to affect an exchange of direct flow water with the Longmont Supply Ditch. The exchanged water is then delivered to water treatment plants.

Lake McIntosh Reservoir. Longmont's interest in Lake McIntosh Reservoir is used primarily for delivery of raw water for irrigation of parks and school facilities served by the Oligarchy Ditch.

Oligarchy No. 1. Reservoir. The Oligarchy Number 1 Reservoir is located adjacent to the City of Longmont's Wade Gaddis Water Treatment Plant. Longmont's interest in the reservoir is used for forebay storage, raw water storage, and as an equalization facility for the water treatment plant.

Pleasant Valley Reservoir. Pleasant Valley Reservoir is used in an exchange plan where this senior storage right is delivered to water treatment plants for direct use, and the reservoir is filled using more junior storage rights and other water resources the City controls.

Irrigation Reservoirs

Bluebird, Pear, and Sandbeach Reservoirs. Longmont also owns storage rights in Bluebird, Pear, and Sandbeach Reservoirs, which are commonly known as the High Mountain Dams. The storage reservoirs for these decrees were located in Rocky Mountain National Park and were sold to the U.S. Department of the Interior so that the sites could be reclaimed. The storage decrees are currently being transferred to Ralph Price and Pleasant Valley Reservoirs to firm the water supply in these facilities.

Ground Water

Longmont also has an existing well used as a circulation pump for the water treatment plant and conditional filings for several new well. Ground water does not currently provide any water supply to the City.

Water Reuse

Longmont obtains reuse water from municipal water that is decreed for reuse and Windy Gap water when available. Longmont's water reuse plans utilize the water in the natural stream course after treatment and return to the St. Vrain Creek. The reuse plans are based upon meeting return flow obligations in the creek, exchanging water with other water rights owners, and leasing this water to downstream water users. Longmont has been able to nearly fully utilize its reusable effluent because it has storage both above and below its system, which allows storage of excess reusable effluent credit for use in drought years. The 15-year average of reuse water available for use by Longmont is about 1,000 AF (City of Longmont 2005). If Windy Gap water is firmed, Longmont estimates about 62 percent could be reused to meet non-potable demands (City of Longmont 2005).

Water Demands

The City of Longmont supplies potable water inside its city limits, outside the city limits to a limited degree, and to non-potable customers. Each of these sources of demand is addressed below. In addition, Longmont treats water for the Town of Lyons, amounting to 2 MG per day on average, but this water is supplied by Lyons and is therefore not included in the historical demands or projections.

Historical Water Use

Longmont's population has grown from about 43,000 in 1980 to an estimated 77,300 in 2002. The population increased by about 9,000 persons between 1980 and 1990, and by about 20,000 persons between 1990 and 2000. Between 1990 and 2000, the increase was about 39 percent for an average annual rate of 3.4 percent (U.S. Bureau of the Census selected years; Longmont Community Profile 2003).

Treated Water Deliveries

Treated water deliveries in Longmont increased from about 3,800 MG in 1984 to 4,900 MG by 2003. Table I-2 provides historical treated water use for selected years in millions of gallons.

Table I-2. Treated Water Use by Customer Type for the City Longmont, 1984 to 2003.

	MG						
1984	834	621	N.A.	N.A.	2,313	80	3,848
1990	1,516	699	N.A.	N.A.	1,614	80	3,909
1995	1,698	1,018	N.A.	N.A.	1,113	80	3,909
1996	1,890	1,052	N.A.	215	1,037	80	4,273
1997	1,948	1,057	N.A.	286	871	80	4,243
1998	2,286	1,101	N.A.	304	866	80	4,637
1999	2,178	1,146	N.A.	218	742	80	4,364
2000	2,695	1,345	N.A.	167	1,077	80	5,364
2001	2,640	1,296	120	279	827	80	5,243
2002	2,620	1,234	156	290	834	80	5,212
2003	2,602	1,150	209	235	633	80	4,909

Source: Customer billing data from Lynn Wegley, City of Longmont, August 2004; City of Longmont worksheets, December 2004.

In 1984, about 60 percent of Longmont's treated water deliveries, amounting to 9,700 customers, were unmetered. Through a persistent metering program, the City has reduced unmetered water sales to 2,300 customers and 633 MG in 2003, or 13 percent of total treated water deliveries.

Single family metered residential use accounts for about 80 percent of total metered residential water use inside the city, on average. Residential water use, which includes single family and multifamily customers, accounted for 62 percent of total inside city water deliveries in 2003; this proportion has remained fairly stable since 1990.

Commercial and industrial water use grew substantially between 1990 and 1995, but has grown more slowly from 1995 through 2003. Among the commercial and industrial water users in Longmont, three individual companies represent approximately one-third of use from that sector. ConAgra, Amgen and Royal Crest Dairy are the three large industrial water users and their use has been relatively steady in recent years (City of Longmont 2004c).

Longmont provides water service to about 1,000 people outside its city limits along with some commercial and industrial users. The total outside city water sales amount to roughly 80 MG to 100 MG per year, or about two percent of total water sales to end users. In total, Longmont's outside city water sales have declined since the 1980s but have been relatively stable since the mid 1990s.

Table I-3 presents Longmont's water demand expressed in total gpcd from 1990 through 2003.

Table I-3. Potable Water Use per Capita for the City of Longmont.

	gpcd	
1990	200	N.A.
1991	203	N.A.
1992	207	N.A.
1993	201	N.A.
1994	213	195
1995	183	166
1996	197	181
1997	190	174
1998	199	183
1999	180	165
2000	197	184
2001	186	173
2002	182	169
2003	171	158

Residential water use measured in gpcd consumption has fluctuated mostly with the weather and water restrictions. Drought restriction in recent years has also influenced residential water use. Longmont's water use has averaged about 190 gpcd from 1994 to 2003, including commercial and industrial users. Excluding the three largest industrial demands (27 percent of total water demand) reduces the average total water use to about 175 gpcd.

Non-Potable Water Demands

Non-potable water demand includes:

- Parks, golf courses and recreation;
- School district irrigation;

- Return flow obligations; and
- Special contract obligations.

These historical demands are summarized in Table I-4.

Table I-4. Longmont Non-Potable Demands, 1990 through 2003.

	AF				
1990	2,160	920	586	408	4,074
1991	2,171	920	604	408	4,103
1992	2,029	906	664	408	4,007
1993	2,046	906	666	408	4,026
1994	1,633	906	672	408	3,619
1995	1,454	906	740	408	3,508
1996	1,232	906	722	408	3,268
1997	1,183	906	1,122	408	3,618
1998	897	906	1,141	408	3,352
1999	1,183	946	1,182	408	3,718
2000	1,432	970	1,243	408	4,052
2001	1,550	970	1,265	408	4,192
2002	1,882	760	1,393	408	4,443
2003	1,565	461	1,418	408	3,852

Source: City of Longmont worksheet, December 2004.

Return flow obligations to downstream users are mostly met by the Longmont wastewater plant discharges; the remaining return flow obligations represent a demand on Longmont's water supplies. In addition, Longmont has contractual obligations for raw water deliveries with the Town of Lyons and certain farmers that it agreed to as part of the Ralph Price Reservoir development process (City of Longmont 2004e).

Total non-potable demands have grown from 4,074 AF in 1990 to 4,443 AF in 2002, the peak year of demand. The irrigation demands for city parks and other recreation plus the return flow obligations make up the bulk of these demands.

Total Historical Water Use

In 2003, total Longmont water demand from all sources amounted to 20,900 AF. The City of Longmont's water requirements include treated water deliveries plus a 7 percent distribution loss and a 5 percent loss from the treatment plant back to the point of diversion (City of Longmont 2004a). Non-potable demands are added to this amount to derive total water requirements. Longmont's water requirements have increased by 25 percent since 1990. Historical treated water demands and total Longmont water requirements are indicated in Table I-5.

Table I-5. Total Historical Water Requirements for the City of Longmont, 1990 to 2003.

					Total Water Requirements [1]
				AF	
1990	3,909	1,328	5,237	16,071	17,653
1991	4,000	1,337	5,337	16,379	17,998
1992	4,182	1,306	5,488	16,841	18,534
1993	4,212	1,312	5,524	16,953	18,657
1994	4,485	1,179	5,664	17,383	19,198
1995	3,909	1,143	5,052	15,505	17,087
1996	4,273	1,065	5,338	16,381	18,110
1997	4,243	1,179	5,422	16,638	18,355
1998	4,637	1,092	5,729	17,581	19,457
1999	4,364	1,212	5,575	17,110	18,876
2000	5,364	1,320	6,684	20,513	22,684
2001	5,243	1,366	6,609	20,281	22,403
2002	5,212	1,448	6,660	20,439	22,548
2003	4,909	1,255	6,164	18,918	20,904

[1] Including system losses.

Projected Water Requirements

The City of Longmont provided the study team with projections of water demand through buildout. These water demand projections were developed by Tetra Tech RMC and published in its Raw Water Master Plan Update, dated January 2004. These water demand projections included residential projections reflecting a population cap of 104,000 people by the year 2025, compared with about 77,000 people in the year 2002 (Tetra Tech 2004b). Tetra Tech projected residential water demand based upon historical water use, i.e., gpcd, applied to the population projections (Tetra Tech 2004c). Commercial and industrial water demand was projected based upon projected growth of Longmont's commercial and industrial base and assumed water demand for the three large customers, ConAgra, Amgen and Royal Crest Dairy. Including projected water demand from parks and the wastewater treatment plant and system losses, total projected water requirements according to the Longmont Raw Water Master Plan, show an increase to 23,900 AF by 2015, 31,300 AF by 2030, and 35,500 AF by buildout (Table I-6).

The study team has evaluated the demand forecasting methodology utilized by the City of Longmont. We find that the methods for projection are generally sound given the available data. Historical gpcd have been stable in recent years and represent a useful assumption to apply to population projections. The study team also believes that commercial and industrial demand should be projected separately based upon reasonable expectations about growth in that sector and that these three largest customers should be projected separately as well.

The City of Longmont's 2004 Raw Water Master Plan Update recommends that demand projections be revised once the comprehensive plan information is available. Now that the revised comprehensive plan information is available, the study team has applied that new information, using the Tetra Tech approach, to update the City of Longmont water demand projections.

The latest update to the City of Longmont Raw Water Master Plan, when coupled with non-potable demand projections, provides total raw water requirements that increase from approximately 25,900 AF in 2005 to 38,100 by the year 2030 and 42,300 AF at buildout. The increase in water use from 2005 to 2030 is about 47 percent or an average annual rate of 1.6 percent. This compares to an average annual growth rate of 1.7 percent from 1990 through 2003 for Longmont treated water deliveries. This projection is in line with recent population projections in the City's Comprehensive Plan. The study team considers these projections reasonable.

Of the three large industrial users, ConAgra and Royal Crest Dairy expect relatively constant water use in the future. Amgen anticipates substantial increases in water use; we have assumed Amgen's water use to increase four-fold over the next 30 years, based upon information from the company (City of Longmont 2004c). Outside city water use is expected to continue at the fairly stable rate it has established over the past five years. Unmetered water use is expected to be fully converted to metered water use by the end of 2005.

Longmont's non-potable water demands are also expected to increase in future years. Parks and recreation related demands are projected on the basis of the City's most recent comprehensive plan in terms of acreage. Non-potable demand from the schools is expected to increase, in keeping with the schools' plans for a new baseball park, middle school development and various elementary schools in the future. Non-potable school district demands are expected to increase from a total of 1,000 AF per year to 1,200 AF per year at buildout. Demand for return flow can be derived from assumptions about additional ditch water diversions according to contract.

Table I-6 includes City of Longmont water demand projections through buildout, which is projected to occur in 2048.

Table I-6. Water Demand Projections for City of Longmont, 2004 through Buildout.

	AF			
2004	14,900	16,800	4,600	21,400
2005	18,300	20,600	5,300	25,900
2006	18,600	20,900	5,300	26,200
2007	18,800	21,300	5,400	26,700
2008	19,100	21,600	5,400	27,000
2009	19,400	21,900	5,400	27,300
2010	19,700	22,200	5,900	**28,100**
2011	20,000	22,600	5,900	28,500
2012	20,300	22,900	5,900	28,800
2013	20,600	23,200	6,000	29,200
2014	20,800	23,500	6,000	29,500
2015	21,100	23,900	6,400	30,300
2016	21,500	24,200	6,500	30,700
2017	21,800	24,600	6,500	31,100
2018	22,100	25,000	6,500	31,500
2019	22,500	25,400	6,500	31,900
2020	22,800	25,700	6,800	32,500
2025	25,800	29,100	6,800	35,900
2030	27,700	31,300	6,800	38,100
2048	31,400	35,500	6,800	42,300

[1] Including system losses.

Water Conservation

The City of Longmont has implemented a range of conservation measures in the past and more conservation measures are contemplated in the future to reduce demand. In 1989, the City enacted an increasing block rate structure with a 30 percent overall rate increase. Normalizing for weather variations, residential gpcd has been relatively stable for the past ten years.

In 1996, Longmont developed a water conservation master plan to "promote water conservation by example, education, incentive, and innovation, as a responsible approach to present and future management of a valuable resource." The Plan includes best management practices (BMPs) including:

- Implementing block pricing for residential water customers
- Increasing rates for unmetered use
- Basing commercial/industrial rates on the cost of service

- Converting residential services to meters
- Showing comparative usage on monthly utility bills
- Retrofitting City buildings with low water use plumbing fixtures
- Selecting appropriate plant materials using xeriscape principles
- Retro-fitting irrigation systems to central control
- Monitoring the irrigation systems for leakage
- Acting as a resource for disseminating water conservation information
- Conducting an annual water festival
- Providing a xeriscape demonstration garden, xeriscape information and seminars
- Requiring low water use fixtures in new construction
- Creating the Drought Response Plan and enacting water waste ordinances
- Acting as a resource to commercial/industrial water users for water conservation information

Additional conservation measures are being developed and implemented by the City of Longmont. The city will require a soil amendment on all new lawns to conserve water. Landscaping standards are also moving away from blue grass for arterial landscaping. Longmont has also recently implemented a washer and toilet rebate program for frontloaded, efficient washers and low-flow toilets. Longmont is also revising its landscaping standards to encourage xeriscaping.

Overall water savings of 18 to 20 percent might be achieved through implementation of the above BMPs. Longmont utility officials estimate that past conservation measures have already saved about 10 percent and these savings are factored into the water demand projections. Hence, a savings of an additional 10 percent is envisioned with new conservation measures (City of Longmont 2004a). This additional 10 percent savings is not reflected in the demand projections, since it represents an additional future resource. The City will continue to monitor water conservation savings and demand requirements in the future.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with implementing additional water conservation measures.

Water Need

Longmont's current water needs are met by C-BT, direct flow rights, and reservoir storage. Water demand is expected to exceed available firm water supplies by about 2017, which would affect the ability of the City to meet dry year water needs depending on C-BT deliveries (Figure I-1). A firm water supply shortage of about 7,100 AF is projected by 2030 and about 11,300 AF by 2050. Firming Longmont's Windy Gap water supply would provide about 5,125 AF of water based on the City's storage request and preliminary modeling, or about 12 percent of the City's 2050 firm water supply (Figure I-2). Current reuse supplies may provide about 1,000 AF on average and reuse of about 62 percent of Windy Gap water would also contribute to meeting future non-potable water demand. Water conservation and other sources of water supply also will be needed to meet all of the estimated future water demands.

Figure I-1. Longmont's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

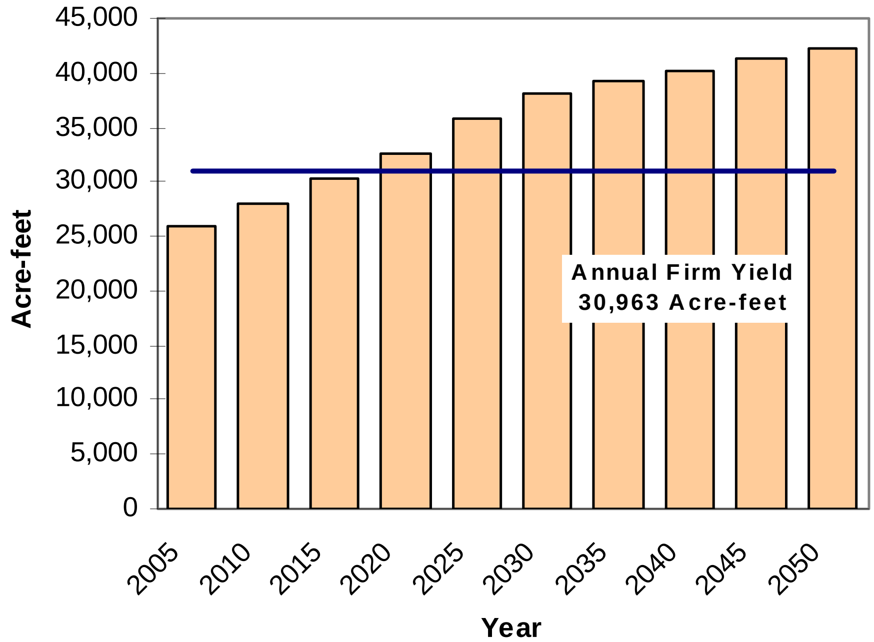
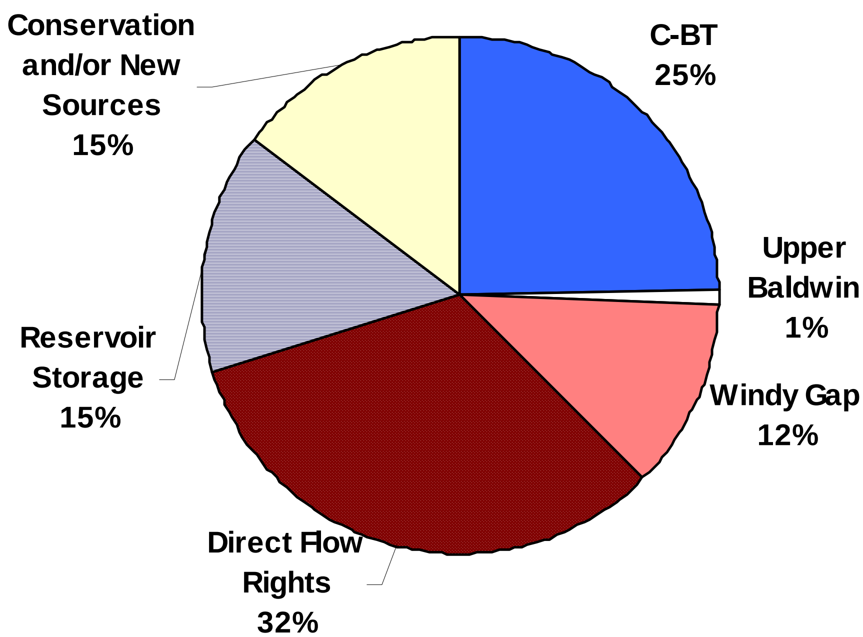


Figure I-2. Longmont's 2050 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

CITY OF LOUISVILLE

Introduction

The City of Louisville is located in Boulder County about 6 miles east of the City of Boulder and 25 miles northwest of Denver. The City was founded in 1878 in response to the emerging coal mine industry in the area. Today Louisville supports a residential community and associated commercial and industrial businesses. Louisville city limits cover an area of about 8.6 square miles including 1,700 acres of designated open space owned by the City or owned in conjunction with other bordering municipalities (ERO 2004a). The following discussion provides a summary of Louisville's water supply and demand.

Water Supply

Louisville's main sources of water supply include direct flow rights from South Boulder Creek and C-BT water (Table J-1). Louisville has two water treatment plants (north and south) as well as a wastewater treatment plant just east of town. South Boulder Creek and Marshall Lake water are delivered by a combination of the Community Ditch, Louisville Lateral and pipelines from South Boulder Creek to both water treatment plants. Windy Gap and C-BT water are transported via the Southern Water Supply Pipeline (SWSP) to the North Water Treatment Plant. Currently the only physical limitation in Louisville's system is its capacity in the SWSP pipeline, which is 7.2 cfs (Boyle Engineers 2003).

Transbasin Supplies

Colorado-Big Thompson

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Louisville, like most municipalities, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

Table J-1. Inventory of Louisville Water Supply.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	1,937 units	1,162[1]
Windy Gap Project	9 units	0
Direct Flow Rights		
Direct transfers via Community Ditch and Louisville Pipeline from South Boulder Creek	N.A.	3,201
Reservoir Storage		
Louisville Reservoir	210 AF	0
Harper Reservoir	610 AF	0
Marshall Reservoir (FRICO)	350 shares	700
Marshall Reservoir (SBCC)	26 shares	0
Total		5,063[2]

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis.

The City of Louisville's owns 1,937 units in the C-BT Project, which provides a firm yield of about 1,162 AF using a C-BT quota of 0.6 AF/unit. C-BT water represents about 22 percent of Louisville's existing raw water supply. C-BT water is delivered from Carter Lake to Louisville via the Southern Water Supply Pipeline (SWSP).

Windy Gap

Windy Gap Project water provides an additional source of transbasin water. The City of Louisville currently owns 9 units of Windy Gap water, which is delivered through the SWSP—the same as C-BT water. Windy Gap has not provided a firm supply of water on which Louisville can rely on to meet its water requirements.

Direct Flow Rights

Louisville's raw water supply system is built on a foundation of direct diversion and storage rights on South Boulder Creek. Direct flow rights are diverted primarily from South Boulder Creek at the Louisville Pipeline and/or Community Ditch headgates near Eldorado Springs and conveyed through the City's system for treatment at its two water treatment plants (Boyle Engineers 2003).

Reservoir Storage

Louisville has water storage in several reservoirs including about 600 AF in Harper Lake and 210 AF in Louisville Reservoir. The City owns 25 percent of the shares in Farmers Reservoir and Irrigation Company (FRICO) Marshall Division, which provides firm annual yield of 700 AF of water. The City also owns 70 percent of the storage capacity in Marshall Lake belonging to the South Boulder & Coal Creek Irrigating Ditch Company (390 AF out of a total 600 AF of available storage). The City has a secondary use agreement with the FRICO. This agreement allows Louisville's use of any remaining water storage space after the needs of other shareholders are met. Overall, there is limited water storage capacity in the Louisville system (ERO 2004a).

Reuse

Reuse water is used by Louisville to reduce demand on the potable water system's raw water supply during the summer months when water demand is highest. Overall, about 25 percent of Louisville's native supply can be reused. Louisville recently installed a water reuse pipeline that can supply about 500,000 gallons/day from the wastewater treatment plant to the Coal Creek Golf Course. Reuse water is also used at the Louisville Sports Complex and Miners Field and will be used at numerous parks located along the pipeline route (City of Louisville 2004a). Currently about 300 AF of water is available for non-potable reuse (Louisville 2005). In the future, up to about 900 af/year of native water primarily from South Boulder Creek could be available for reuse incrementally over time (ERO 2004a). Louisville estimates about 45 percent of Windy Gap water could be reused for irrigation (Louisville 2005).

Water Demand

The City of Louisville is responsible for providing water to residential, commercial, industrial, and irrigation users within the City's boundaries. The City also provides water to several residential and one commercial customer just outside the city limits. Louisville's largest water user is StorageTek, which used 340 AF of water in 1997. StorageTek has recently reduced water demands due to operational changes; the company required 67 AF of water in 2003.

Historical Water Demands

The City of Louisville's 2003 population was estimated at 18,387 persons. Table J-2 provides historical population estimates and numbers of water taps by customer type with annual growth rates for population and total water taps.

Population grew 49 percent, or at an average annual rate of 3.1 percent, from 1990 through 2003. The average annual growth rate for the total number of residential water taps was just 0.2 percent from 1998 through 2003, and commercial water taps increased at an average annual rate of 7.1 percent in the same period. Annual growth rates for both population and water taps have fluctuated. Population grew most significantly in the early and mid-1990s, while residential water taps have remained almost stagnant since 1998. Commercial growth has been considerable since 1998.

Residential growth in Louisville has slowed dramatically since the mid-1990s as the city approaches residential buildout. Currently, the City of Louisville is fully annexed, and any future growth would be more or less limited to residential/commercial infill development. The commercial sector will generate the majority of future growth in water taps and usage in the City of Louisville (City of Louisville 2004c).

Table J-2. City of Louisville Population and Water Taps, 1990 to 2003.

							Total In-City Taps
1990	12,361	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1991	13,575	9.8%	N.A.	N.A.	N.A.	N.A.	N.A.
1992	14,732	8.5%	N.A.	N.A.	N.A.	N.A.	N.A.
1993	15,887	7.8%	N.A.	N.A.	N.A.	N.A.	N.A.
1994	16,943	6.6%	N.A.	N.A.	N.A.	N.A.	N.A.
1995	17,538	3.5%	N.A.	N.A.	N.A.	N.A.	N.A.
1996	17,947	2.3%	N.A.	N.A.	N.A.	N.A.	N.A.
1997	18,147	1.1%	N.A.	N.A.	N.A.	N.A.	N.A.
1998	18,177	0.2%	5,979	219	74	62	6,334
1999	18,062	-0.6%	6,044	297	91	94	6,526
2000	18,937	4.8%	6,044	297	91	94	6,526
2001	18,950	0.1%	6,044	297	91	94	6,526
2002	18,681	-1.4%	6,044	297	91	94	6,526
2003	18,387	-1.6%	6,039	309	93	88	6,529

[1] Residential Taps include single-family and multi-family units.

[2] Other Taps include irrigation taps and other misc. taps.

Source: U.S. Census Bureau 2004; City of Louisville 2004b.

Potable Water Demands

Table J-3 provides a breakdown of historical potable water use by consumer type for the City of Louisville from 1998 through 2003.

Table J-3. Potable Water Use by Customer Type for the City of Louisville, 1998 to 2003.

						Annual Percent Growth
1998	798	277	70	72	1,217	N.A.
1999	763	275	64	73	1,175	-3.4%
2000	855	310	74	93	1,332	13.3%
2001	814	278	64	101	1,257	-5.6%
2002	643	190	23	49	906	-27.9%
2003	692	235	41	85	1,053	16.2%

Source: City of Louisville 2004c.

These figures reflect potable water deliveries to the end user for the customers the City serves. Annual fluctuations are largely attributable to weather. Total potable water deliveries decreased by 14 percent between 1998 and 2003, due primarily to drought-related water restrictions in response to a severe shortage in the last two years. Deliveries decreased by 28 percent between 2001 and 2002, indicating the City's ability to reduce demands during drought. Total potable deliveries reached a peak of 1,330 MG in year 2000. Residential users have historically accounted for the majority of total deliveries at 66 percent; commercial users accounted for an average of 23 percent of total potable water use. Single-family residential use accounts for an average of about 90 percent of residential use and 60 percent of overall, in-city use. The proportions of use accounted for by each customer type remained relatively constant from 1998 through 2003.

Table J-4 provides total and residential gallons per capita and per tap per day for 1998 through 2003, as measured at the tap.

Table J-4. Potable Water Use per Capita and per Tap for the City of Louisville.

					Total Use per Total Tap
			Gallons per Tap per Day		
1998	120	183	336	3,467	526
1999	116	178	317	2,538	493
2000	124	193	358	2,856	559
2001	118	182	339	2,568	528
2002	94	133	266	1,756	380
2003	103	157	287	2,086	442

Source: Figures are based on the data presented in Tables J-2 and J-3.

From 1998 through 2003, residential water use averaged 112 gpcd. Total water use per capita per day averaged 171 gallons. Single family residential water use per single family residential tap averaged 317 gallons per tap per day from 1998 through 2003, whereas commercial water use per commercial tap averaged 2,545 gallons per tap per day. Total water use per tap for all taps averaged 488 gallons per tap per day. Although water usage patterns were lower in 2002 and 2003 in the City of Louisville, average water use measurements appear to more accurately reflect historical and future water usage patterns.

Non-potable Water Demands

In 2004, the City of Louisville supplied approximately 216 AF of non-potable or wastewater treatment effluent reuse to meet irrigation needs at various city locations. The City's Golf Course used 182 AF, or 58 MG, including 135 AF of non-potable and 48 AF of wastewater treatment effluent reuse. An additional 34 AF of wastewater treatment effluent reuse water was used to irrigate the city's ball fields. These supplies are delivered via pipeline and incur only negligible delivery losses. The City supplied the golf course with non-potable irrigation water from 1998 through 2003. Louisville anticipates providing non-potable reuse water to irrigate additional parks and ball fields starting in 2005, bringing the total deliveries of effluent reuse water to 300 AF (ERO 2004).

Total Water Requirements

Table J-5 indicates the City of Louisville's total potable and non-potable water deliveries from 1998 through 2003.

Table J-5. Total Water Requirements for the City of Louisville, 1998 to 2003.

					Total Water Requirements[1]
				AF	
1998	1,217	68	1,285	3,944	5,360
1999	1,175	68	1,244	3,816	5,248
2000	1,332	68	1,400	4,296	6,030
2001	1,257	68	1,326	4,068	5,672
2002	906	53	959	2,943	4,235
2003	1,053	62	1,115	3,421	4,560

[1] Including system losses.

Source: City of Louisville 2004c.

Total requirements reflect water treatment plant production data adjusted to account for 15 percent losses from points of diversion to the treatment plant (City of Louisville 2005). Losses from treatment plant to tap for potable deliveries averaged 14 percent. Total water requirements reached their peak in 2000 when more than 6,000 AF of water was diverted for Louisville customers. From 1998 through 2003, total water requirements decreased by 15 percent, due primarily to drought-related water restrictions.

Projected Water Requirements

City of Louisville's Projected Water Requirements

Prepared by the City's water resource engineer, the City of Louisville provided the study team with projected potable and non-potable water demands at buildout. These buildout projections are found in the City of Louisville Raw Water Master Plan Update and were based on previously anticipated land use and water use patterns within the City's planning area. In 2004 the City initiated a city wide Comprehensive Planning review (Id). The review is incorporating important assumptions about residential and commercial growth into the buildout projection for the City. This projection assumes 1,650 new housing units at buildout in addition to the City's current 7,400. The projection also assumes 6.24 million more square feet of commercial and industrial space at buildout in addition to the City's current 8.6 million square feet. Finally, the projection assumes 187 acres of additional parks and open space (City of Louisville 2004d). Assumptions about future development and water use on Storage-Tek lands have been incorporated into potable and non-potable projections. The study team adopted these same assumptions about growth at buildout. The City will update the buildout total raw water demand at the completion of the review.

Study Team Demand Projections

To arrive at projections of the City of Louisville's future water use, the study team first estimated population and commercial square footage from 2005 through 2050. Based on discussions with the City, the study team assumed a one percent growth rate in population and a 1.5 percent growth rate in commercial square footage through buildout (City of Louisville 2004e; Leland Consultants 2004). The City anticipates that commercial square footage will remain stable for the next two years before ensuing with the 1.5 percent growth rate. Projections of population and commercial square footage are provided in Table J-6.

Table J-6. Population and Commercial Space Projections for the City of Louisville, 2005 through 2050.

		Nonresidential Square Footage (millions)
2005	18,700	9
2010	19,600	9
2015	20,600	10
2020	21,700	11
2025	23,000	12
2030	23,000	12
2035	23,000	13
2040	23,000	14
2045	23,000	15
2050	23,000	15

Source: City of Louisville 2004e; Harvey Economics 2004.

Based on the assumed rate of growth, the City of Louisville will reach residential buildout by 2025 and commercial buildout by 2045. To project water use between 2003 and 2050, the study team began by applying the average residential water use per capita per day of 110 gallons to projected population to forecast residential water demands. The team then applied the average water use per commercial square foot per day of 0.08 gallons to projected commercial square footage to forecast commercial water demands (City of Louisville 2004c, 2004e). Finally, the study team assumed that city and irrigation demands would increase with population at one percent annually, while non-potable demands for the golf course, parks and ball fields would increase with commercial development at 1.5 percent annually. Table J-7 provides projected potable and non-potable demands for the City of Louisville through 2050.

Table J-7. Water Demand Projections for the City of Louisville, 2005 to 2050.

	-						-	**Annual Percent Change**
2005	2,300	720	390	3,400	300	3,700	5,000	N.A.
2010	2,400	780	410	3,600	320	3,900	5,300	1.2%
2015	2,500	840	440	3,800	350	4,100	5,600	1.1%
2020	2,700	900	460	4,100	380	4,400	6,000	1.4%
2025	2,800	970	480	4,300	400	4,700	**6,300**	1.0%
2030	2,800	1,050	510	4,400	440	4,800	6,500	0.6%
2035	2,800	1,130	530	4,500	470	4,900	6,700	0.6%
2040	2,800	1,220	560	4,600	500	5,100	6,900	0.6%
2045	2,800	1,250	560	4,600	500	5,100	6,900	0.0%
2050	2,800	1,250	560	4,600	500	5,100	6,900	0.0%

[1] Including system losses.

Source: Harvey Economics 2004.

An additional 14 percent was added to potable demands to account for distribution system and treatment plant losses, and an additional 15 percent was added to all potable and non-potable demands to account for losses from point of diversion to treatment plant. Total water requirements are anticipated to increase by 38 percent from 2003 through 2050, or at an average annual rate of 0.7 percent.

Conservation

The City of Louisville has implemented a number of measures to encourage conservation throughout its system (ERO 2004a). These measures include:

- Leak detection and testing and replacement of faulty meters;
- Rebates for low-flow toilets, drip irrigation systems, water efficient clothes washers and controlled sprinkler systems;
- An inclining block water rate structure with a charge for excess water use;
- Totally metered water usage;
- A reuse system for non-potable treated wastewater; and
- Educational materials in water bills and on the City's website.

In response to the 2002/2003 drought, the City imposed watering restrictions from April 2002 through April 2003, which have since been lifted. The City has adopted a Drought Management Plan, which guides the implementation of measures when conditions point towards a shortage in supply, including; watering restrictions, tiered surcharges, and public education. Drought restrictions are distinguished from on-going conservation measures which are the emphasis in this analysis. The City is not actively pursuing any additional permanent conservation measures at this time.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand as described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project may contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Need

The City of Louisville water needs are currently met by direct flow rights, C-BT Project water, and reservoir storage. Water demand is expected to exceed available firm water supplies by about 2006, which would affect the ability of the City to meet dry year water needs depending on C-BT deliveries (Figure J-1). The City of Louisville is estimated to reach residential buildout by 2025 and commercial buildout by 2045. In 2050 a firm water supply shortage of about 1,800 AF is anticipated. Firming the Windy Gap water supply would provide Louisville up to 900 AF of water or about 13 percent of the City's 2050 water supply (Figure J-2). In addition, reuse of about 45 percent of Windy Gap effluent would contribute to meeting future non-potable water demand, as would the potential to reuse increasing amounts of native water up to 900 AF. Although Louisville's future non-potable water supply appears to be adequate to meet those needs, the City will need to develop additional firm water supplies to meet potable demand. Water conservation and other sources of water supply in addition to firming Windy Gap water also will be needed to meet future water demands.

Figure J-1. Louisville's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

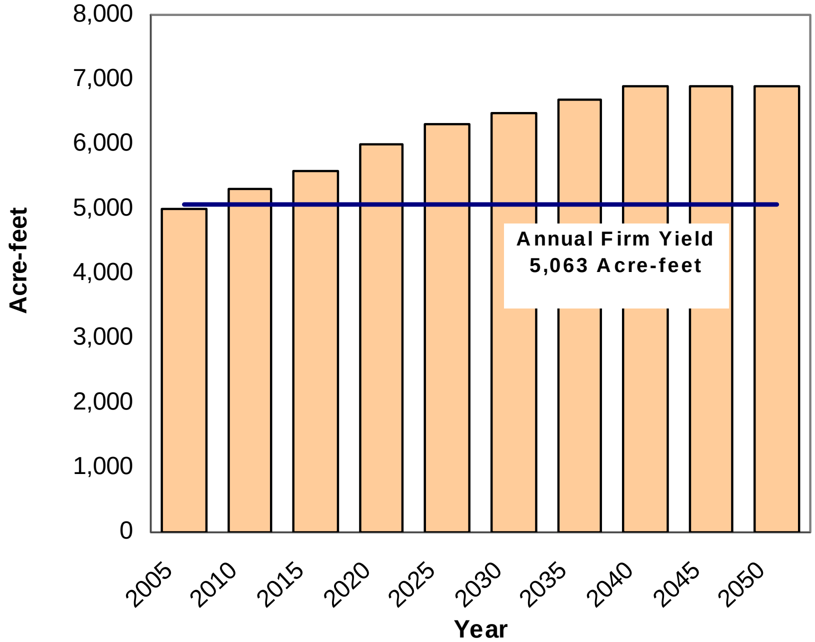
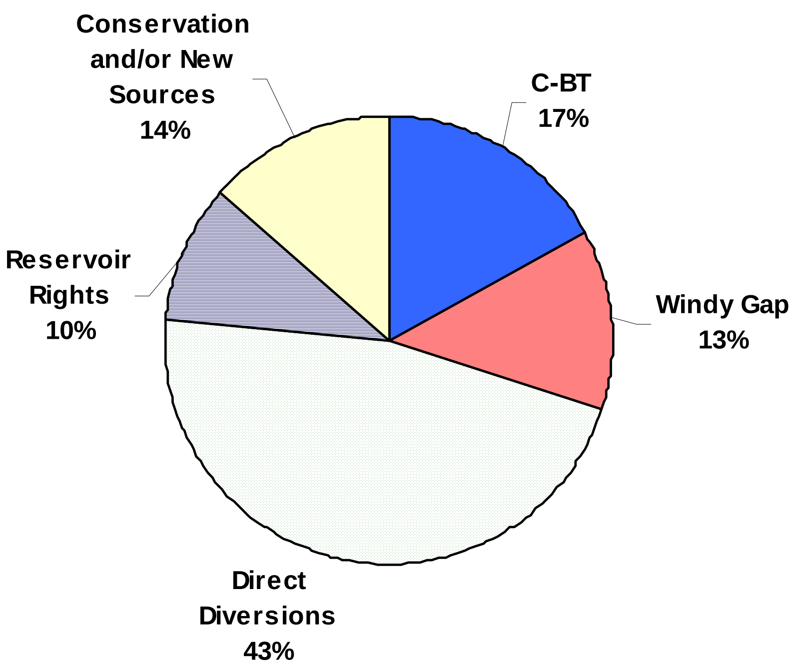


Figure F-2. Louisville's 2050 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

CITY OF LOVELAND

Introduction

The City of Loveland is located 50 miles north of Denver in southeastern Larimer County. Loveland's city limits encompass about 23.5 square miles. The City has experienced rapid population growth between 1990 and 2003, with a population increase of over 50 percent during this period. The following discussion provides a summary of Longmont's water supply and demand.

Water Supply

The City of Loveland has two categories of water supply — transbasin supplies and transferred native ditch water rights (Table K-1). Transbasin supplies consist of C-BT and Windy Gap water. Transferred native ditch rights are diverted directly from the Big Thompson River and consist of Early Transfers, 82CW202A ("202A") Transfers, Rist & Goss Transfers, and Pending Transfers (2002CW392). Some of the water attributable to Loveland's C-BT, 202A Transfers, and Pending Transfers are used for non-potable irrigation of many City-owned parks and golf courses if not diverted at Loveland's water treatment plant.

Transbasin Water

Colorado-Big Thompson Project

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002-2004 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Longmont, like most municipalities, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

Loveland's 10,538 units of C-BT water account for the largest portion of its water supply. Loveland's C-BT water yields about 6,232 AF of firm annual yield based a yield of 0.6 AF/unit.

Table K-1. Inventory of Loveland Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	10,538 units	6,232[1]
Windy Gap Project	40 units	0
Eureka Ditch	100%	180
Early Transfers		
Portion of No. 1 Priority on Big Thompson River	3.44 cfs	3,060
Big Thompson Ditch & Mfg. Co.	2.0 shares	
202A Transfers and Rist & Goss Transfers [2]		
Barnes Ditch	1,306.8 in.	2,450
Big Thompson Ditch & Mfg. Co.	2.6 shares	
Buckingham (George Rist)	6.1 shares	
Chubbuck Ditch	596.6 inches	
Louden Ditch Company	191.5 shares	
South Side Ditch	57.5 shares	
Rist & Goss Ditch	6.41 cfs	
Reservoir Storage		
Green Ridge Glade Reservoir	6,836 AF storage capacity	4,900
Total raw water available for delivery to WTP		16,822
Pending Transfers / Non-potable Water Supply		
Barnes Ditch	22.12 shares	970
Big Thompson D&M	0.888 shares	
Buckingham (George Rist)	87.25 shares	
Chubbuck Ditch	432.02 in.	
Louden Ditch Company	27.722 shares	
South Side Ditch	8.5 shares	
Total		**17,792**

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis.

[2] Historical diversions adjusted for contract/private rights.

Windy Gap

Loveland owns 40 units of Windy Gap water. Windy Gap water does not currently provide a firm water supply to the City (1988 and 2003 were the only years that Loveland received significant supplies of Windy Gap water). When available, Loveland uses Windy Gap water to supplement water supplies needed to meet its overall water demand. In the future, Loveland will need Windy Gap water to meet increased water demand and to develop year-round reusable effluent at the Wastewater Treatment Plant (City of Loveland 2004a).

Eureka Ditch

In 1941, the City of Loveland acquired ownership of the Eureka Ditch, a high mountain ditch that had been used to deliver water from the western slope to the Big Thompson River through Rocky Mountain National Park. The City, the National Park Service, the United States Bureau of Reclamation, and the Northern Colorado Water Conservancy District negotiated a deal under which the City abandoned the ditch in 1995 and the NCWCD provided the City with 180 AF of firm yield from the C-BT Project. This water was made available to Loveland starting in November 1996.

Early Transfers

In the course of its development, Loveland has acquired shares in various irrigation companies that supply irrigation water in and around the Loveland area. These shares typically were associated with land parcels that were developed for residential, commercial or other uses. Loveland's early transfers of irrigation water rights included 3.44 cfs of the No. 1 Big Thompson River priority in the 1880s and two shares (6.00 cfs) of the Big Thompson Ditch and Manufacturing Company in the late 1920s. Loveland uses its early transfers first to meet potable demand. This water consists of direct flow diversions from the Big Thompson River and is not decreed to allow storage. This water provides 3,060 AF of firm yield annually and is available throughout the year (City of Loveland 2004a).

"202A" Transfers and Rist & Goss Transfer

Following the early transfers, the City continued to acquire ditch shares as it grew. Portions of these shares were used informally for a number of years until an application was filed in Case No. 82CW202(A) ("202A") in 1982 to transfer a large block of shares in several different companies to municipal use by the City. The 202A decree was entered by the Water Court in 1986. Since that time the City has made several additional irrigation water rights transfers under the terms and conditions of the 202A decree. These are collectively referred to as the 202A Transfers and include Loveland's share ownership in the Barnes Ditch, Big Thompson Ditch and Manufacturing Company Buckingham (George Rist) Ditch, Chubbuck Ditch, Louden Ditch, and South Side Ditch. Loveland also transferred the water rights associated with the Rist and Goss Ditch in two separate proceedings. Collectively the 202A Ditch Rights (and the Rist & Goss Ditch) account for about 2,450 AF of firm yield. This water is available for delivery to the water treatment plant and meeting potable water demands.

Reservoir Storage

The expansion of Green Ridge Glade Reservoir was completed in 2004. This reservoir has a storage capacity of 6,836 AF and will be used primarily to firm native ditch water rights to provide water on a year-round basis. The reservoir may have limited reserve capacity for storing Windy Gap or C-BT water. The yield of this reservoir has been simulated as part of an outside modeling effort; the firm annual yield of the reservoir was estimated as 4,900 AF per year (Spronk Engineering 2005).

Pending Transfers

Loveland also owns additional native ditch shares that are pending transfer in Water Court. This water is currently used to meet non-potable demands including irrigation of City parks and golf courses. Transfer of this water for treatment and potable use may occur in the future following approval in Water Court. The firm annual yield following transfer for potable use is unknown at this time, but based on yields from previous water transfers it is estimated that 970 AF would be available to meet potable demands.

Other Water Sources

In addition to its native Big Thompson River water rights and transmountain supplies, Loveland can divert additional water by exchange or during free river conditions. These sources are not considered reliable, especially in a firm yield scenario, for purposes of this analysis.

Water Reuse

The City of Loveland does not have a reuse plant and does not have plans to construct a reuse plant in the near future. However the City has recently been able to reuse native water on a limited basis via exchanges from its waste water treatment plant outfall to various points of diversion along the Big Thompson River (Loveland 2005). Effluent releases to the Big Thompson River are used for replacement of evaporative depletions from off-channel ponds at City parks and golf courses. The City also leases some of its reusable effluent to outside-City interests.

If firmed, Windy Gap water would provide an additional reliable source of water for reuse following initial potable use in the municipal system. The City is currently evaluating how Windy Gap reuse would be used, but anticipates some level of use for augmentation, irrigation, and leasing (Loveland 2005). Increased demand for reusable effluent could potentially accelerate Loveland's need for Windy Gap water.

Water Demand

In 2003, the City of Loveland had a population inside its city limits of 58,170 (City of Loveland 2004b). The City of Loveland Water Utility serves most of the population within the City of Loveland plus additional customers within its Growth Management Area (GMA). Other water providers deliver water to some areas within the city limits. Loveland's estimated water utility service population is currently 63,583 according to figures from the City's Utility Billing division. As of 2003, the City of Loveland comprised about 86 percent of the GMA, while the Loveland Water Department served about 93 percent of that same area. Historical population growth for the City of Loveland (Table K-2) has been substantial since 1990.

Table K-2. City of Loveland Population, 1990 to 2003.

					Rate of Growth
1990	37,360	N.A.	1997	45,100	3.6%
1991	37,670	0.8%	1998	46,710	3.6%
1992	38,230	1.5%	1999	48,390	3.6%
1993	39,110	2.3%	2000	50,610	4.6%
1994	40,340	3.1%	2001	52,830	4.4%
1995	41,990	4.1%	2002	55,580	5.2%
1996	43,520	3.6%	2003	58,170	4.7%

Source: City of Loveland 2004a.

Between the census years of 1990 and 2000, the City of Loveland grew by more than one-third. From 1990 through 2003, Loveland gained more than 20,800 persons, or more than a 50 percent increase. This extraordinary level of growth was concentrated within the last 5 years.

Historical Water Demands

The City of Loveland potable water demand includes residential and non-residential water use inside and outside the City, ranch water picked up by water haulers, construction water delivered through fire hydrants, and wholesale water marketed to the Little Thompson Water District, Fort Collins-Loveland Water District, and the City of Greeley. Focusing on water deliveries to end users, Table K-3 provides a breakdown of historical water use by consumer type.

Total potable water sales to Loveland service area end users increased by 1,060 MG between 1990 and 2002, or about 50 percent. About 80 percent of Loveland's total water deliveries were dedicated to residential use over this time period.

Commercial water use accounted for 15 percent of water use, while the remainder was accounted for by industrial, city, ranch water, hydrants and wholesale water deliveries. Almost all of the increase in Loveland Water Utility deliveries occurred among the residential sector; non-residential water use has fluctuated in a narrow range largely attributable to weather influences in the period 1990 to 2003. The Loveland Water Utility identified only one large industrial user, Praxair. Praxair's water use was about 35 MG in 2003 and has not changed much in recent years, nor is it likely to do so in the future (Smith and Rheam 2004). Large commercial water users provide services and retail products to Loveland area residents and businesses.

Table K-3. Potable Water Use by Customer Type in the City of Loveland Water Service Area, 1990 to 2003.

	MG						
1990	1,674	508	N.A.	N.A.	N.A.	N.A.	2,181
1991	1,723	526	N.A.	N.A.	N.A.	10	2,260
1992	1,775	484	N.A.	N.A.	N.A.	130	2,389
1993	1,776	468	N.A.	N.A.	N.A.	138	2,382
1994	1,941	499	N.A.	N.A.	N.A.	269	2,710
1995	1,835	493	N.A.	N.A.	5	200	2,533
1996	2,054	536	N.A.	N.A.	4	328	2,922
1997	1,944	511	39	N.A.	1	276	2,770
1998	2,271	530	56	N.A.	6	231	3,095
1999	2,134	492	45	4	9	225	2,909
2000	2,668	564	63	6	8	468	3,777
2001	2,655	507	56	7	39	404	3,667
2002	2,673	469	37	6	36	20	3,241
2003	2,367	384	48	N.A.	91	7	2,898

Source: Various documents obtained from the City of Loveland Department of Water and Power, July through September 2004.

Table K-4 provides potable gpcd historical data for residential and total use, respectively. Residential gpcd have fluctuated within a narrow range from 1990 to 2003, with an average over that period of 117 gpcd. Total gpcd have also fluctuated within a generally narrow range, with an average of 172 gpcd.

Non-Potable Use

In addition to potable water use, the City of Loveland irrigates most parks and all three municipal golf courses with non-potable water. Non-potable water is also used for augmentation purposes to replace evaporative depletions at gravel pits and irrigation storage ponds. Total non-potable water use fluctuates with weather but has recently averaged around 850 AF annually.

Table K-4. Potable Water Demand per Loveland Service Area Resident for Residential and Total Water Needs, 1990 through 2003.

				gpcd	
1990	113	160	1997	109	168
1991	116	164	1998	123	182
1992	117	171	1999	112	165
1993	115	167	2000	133	204
1994	122	184	2001	127	190
1995	111	165	2002	122	160
1996	119	184	2003	103	136

Source: City of Loveland 2004b.

Total Water Requirements

Table K-5 indicates total potable and non-potable water deliveries by the City of Loveland Water Department plus total raw water requirements, including an 18 percent loss for conveyance, water treatment and distribution shrinkage.

Total water requirements, including potable and non-potable demand and system losses, increased from 9,200 AF to 13,167 AF between 1990 and 2002. This extraordinary 43 percent gain reflects the rapid growth that Loveland has experienced in recent years.

Table K-5. Total Water Requirements for the City of Loveland 1990 to 2003.

Year			Year		Total Water Requirements[1]
	AF			AF	
1990	7,544	9,200	1997	9,351	11,404
1991	7,785	9,494	1998	10,347	12,618
1992	8,181	9,976	1999	9,776	11,922
1993	8,161	9,952	2000	12,441	15,172
1994	9,166	11,178	2001	12,104	14,761
1995	8,624	10,517	2002	10,797	13,167
1996	9,817	11,972	2003	9,743	11,882

[1] Including system losses.

Source: City of Loveland 2004b.

Projected Water Requirements

The study team obtained the water demand projections and methodology followed by the Department of Water and Power, City of Loveland and then revisited these forecasts using a different methodology.

Water Demand Projections Provided by the City of Loveland

The City of Loveland projects water demand to increase from 13,220 AF in 2005 to 29,630 AF at buildout (City of Loveland 2004b). According to the City's Long Range Planning Division, the Loveland GMA is expected to reach a buildout population of 145,000 persons at approximately the year 2042. The Loveland Water Utility, which only serves a portion of the GMA, estimates its ultimate water utility service population to be about 127,000 persons.

The water demand forecasting methodology utilized by Loveland is relatively straightforward. Department of Water and Power staff applied the annual increase in population growth for the City of Loveland, as projected by the Loveland Long Range Planning Division, to year 2002 per capita water demands, i.e., each year, the projected annual increase in population is applied to 2002 per capita water demands and added to the previous year's projected water demand until buildout is reached in the year 2042. This method has a number of potential disadvantages:

- It is uncertain how representative year 2002 water demands actually were because of the drought conditions.
- This method assumes that all Loveland water demand varies directly with a change in population. Since 1990, almost all of the increase in water use has come from the residential sector, but the non-residential water use shows no discernible growth trends.
- Population projections from the Loveland Long Range Planning Division must be evaluated for reasonableness as part of the Windy Gap Firming Gap Purpose and Need Evaluation.

In light of these issues, with the concurrence of the City of Loveland Department of Water and Power staff, the study team independently developed water demand projections for comparison with the City's figures.

Study Team Projections

The study team evaluated the population forecasts for the City of Loveland, as provided by the Long Range Planning Division. Projections indicate an annual growth rate that varies each year, but within a range of 1.74 percent to 2.66 percent, after 2004. This rate of population change is well below the historical growth rate experienced from 1990 to 2003, and compares well with Larimer County growth projections, which range from 1.3 percent to 2.3 percent from 2000 to year 2030 (State of Colorado 2004). The employment projections made by the Long Range Planning Division also vary annually, and range between 1.3 and 2.6 percent from 2005 to 2030. These numbers compare favorably with Larimer County employment projections, which range from 1.3 to 2.2 percent during the same time period (The Center for Business and Economic Forecasting Inc. 2003). Therefore, the Loveland Long Range Planning Division's population and employment projections for the City were determined to be reasonable and were adopted for the water demand projections.

The study embarked upon the following steps to develop water demand projections:

1. City population projections were converted to Loveland Water Utility service area population projections, using the historical ratio of service area population to city population of 1.08.
2. Service area population projections, with a buildout of 127,000 persons, were applied to the average gpcd since 1990 of 117, to produce residential water sales projections.
3. Employment projections provided by the Loveland Long Range Planning Division for the GMA were used to estimate service area employment projections, utilizing the historical ratio of 0.93 for the service area to GMA population.
4. The projected service area employment was applied to an assumed non-residential consumption of 49 gallons per employee per day, the average since 1999. These non-residential water sales projections for the service area included commercial, industrial, and city water demands.
5. Wholesale water demands, ranch water demands, and construction water demands were assumed to be constant in the future, reflecting recent trends and expectations from the Department of Water and Power (City of Loveland 2004b).
6. Service area residential water projections, non-residential water projections, ranch water projections, hydrant water projections and wholesale water projections were combined to derive total potable water deliveries. To this sum, non-potable water demands of 850 acre-feet in 2003 linearly increasing to 1,700 acre-feet by 2040 were added.
7. System losses of 18 percent were applied to total water deliveries to estimate future water requirements for the City of Loveland.

Table K-6 summarizes the Loveland water demand projections as developed by the study team. The ultimate water demand for the Loveland Water Utility is estimated to be 28,300 AF by the year 2050.

City of Loveland Water and Power Department Staff revisited their water demand projections in the fall of 2004 and presented new figures at a Loveland utilities Commission meeting on September 15, 2004 (City of Loveland 2004d). Staff presented two demand projections approaches, one based on land use and the other on population projections. These water demand projections produced ultimate demand estimates of 28,886 acre-feet and 26,503 acre-feet, respectively. The Commission adopted an ultimate water demand projection for Loveland of 30,000 acre-feet, rounding up from the two staff estimates. These figures tend to corroborate the projections independently derived by the study team and used in this analysis.

Table K-6. Loveland Water Demand Projections, 2005 through 2050.

Year							Total Water Requirements[2]
						AF	
2005	2,800	600	100	3,600	290	11,800	14,400
2010	3,100	700	100	3,900	330	13,000	15,900
2015	3,500	800	100	4,400	370	14,600	17,800
2020	4,000	800	100	4,900	400	16,400	20,000
2025	4,500	900	100	5,600	440	18,500	22,500
2030	5,000	1,000	100	6,100	480	20,300	24,700
2035	5,400	1,100	100	6,600	520	21,900	26,800
2040	5,400	1,200	100	6,700	550	22,400	27,300
2045	5,400	1,300	100	6,900	550	22,800	27,800
2050	5,400	1,500	100	7,000	550	23,200	28,300

[1] Ranch water is assumed to be 6 MG. Rental hydrants are assumed to be 91 MG, and wholesale is assumed to be 7 MG.

[2] Total requirements assumed 18 percent loss from all sources.

Source: Harvey Economics 2004.

Conservation

The City of Loveland began officially serving customers in 1888. Wise use of water has been an important factor as well as providing high quality water at a fair price. The Water Utility uses a number of tools in promoting the wise use of water, as described below.

Water Restrictions

Six years after the Water Utility was established, lawn watering regulations appeared on the books. In 1893, the town fathers passed an ordinance dividing the town into two sections: one area watering from 5 am to 1 pm and the other area watering from 1 pm to 9 pm. This was in effect from April to September each year. The City imposed more formal watering restrictions on its customers during the summer of 1970. The restrictions were in response to moderating the water treatment plant capacity, not in response to inadequate water supplies. Until 1981, water restrictions let customers water only every two or three days per week. The installation of water meters and the expansion of the water treatment plant allowed the restrictions to be lifted (City of Loveland 1989). In 2002, water restrictions were implemented as a risk-averse option to a limited water supply; however, they were lifted once water supply conditions improved.

Water Meters

In July 1979, the Loveland City Council approved an ordinance requiring water meters for all new construction and for existing homes when ownership changed hands. Before that time, the City only required meters for commercial accounts within the City and for all accounts served outside the City limits. Less than a year later in June 1980, the Council passed another ordinance requiring meters for all water customers.

By 1981, the City was completely metered at a cost of over $3 million. The average annual water usage declined by 20 percent. Before metering, the water treatment plant's maximum day demand was 22 MG per day. After metering, the maximum day demand was 16.7 MG per day (City of Loveland 1989).

Water Rates

In 1887, the Water Utility established a flat rate, based on the type of dwelling and number fixtures. Customers paid the yearly fee in advance. Until 1968, water rates were based on a flat fee determined by fixture count. But keeping track of the number of bathrooms and toilet fixtures in homes was difficult; therefore, in July 1968, the City developed a flat rate charge per family based upon average water usage. Lot size determined the rate for lawn sprinkling. Since 1981, the monthly billing has reflected actual water use with the installation of meters. In 1989, the City Council approved a series of rate increases that specified water rates from 1990 to 1997. The revenue from these rate increases allowed Loveland to purchase additional C-BT units and cash fund the recent Green Ridge Glade Reservoir expansion. Currently, Loveland has a uniform rate structure with rates 33 percent lower in 2003 than they were in 2001.

Water Conservation Plan

In May 1996, the City of Loveland prepared a water conservation plan outlining 16 conservation measures it wanted to initiate by 2001 (City of Loveland 1996); since that time, Loveland has implemented a host of water conservation programs:

- The City widely promotes the importance of water conservation with information to its customers to enhance efficient water use patterns.
- The City distributes publications through the Loveland Public Library, the Utility Billing Office, and the Utility Service Center.
- The utility provides customers with dye tablets to test for toilet leaks.
- Working with the Parks Division, Loveland Water Department has updated the Jeff Peterson Xeriscape Garden.
- The Loveland Water Utility promotes the sale of water conservation kits for $5.
- The utility has included water conservation kits and information on its web site.
- The utility plays water conservation videos on the local access channel 16.
- The Loveland Water and Power Department sends postcards to all customers informing them of the water supply management program.
- Conservation information is advertised in the local newspaper.
- Three xeriscape seminars are conducted annually by a landscape architect as a community service.
- In 2004, the utility also embarked upon the sale of hose meters, the installation of a "Please Conserve Water" banner over US Highway 34,

inclusion of a water conservation message in utility bills, and development of a do-it-yourself irrigation audit document.

- The Loveland utility also has an active leak detection program, regularly replacing aging infrastructure to reduce system loss.

Current Status

Total water use was reduced about 13 percent from 2001 through 2003, but much of this savings is believed to be attributable to temporary drought related efforts. Initial per capita consumption rates have been relatively low, compared to the national average. This trend started once customers' water use became metered and continues today. Any savings from these already low consumption rates would be difficult to perceive, another reason why the City chose not to rely on water restrictions to reduce the already lower demand during a 1-in-100 year drought event.

Anticipated Water Need

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants, reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Need

Loveland's current water needs are met by C-BT, direct flow rights, irrigation transfers, and the recently completed Green Ridge Glade Reservoir. Water demand is expected to exceed available firm water supplies by about 2015, which would affect the ability of the City to meet dry year water needs depending on C-BT deliveries. A firm water supply shortage of about 6,900 AF in 2030 and about 10,500 AF in 2050 is anticipated, if the Loveland Water Utility relies only on existing usable supplies. Firming the Windy Gap water supply would provide Loveland about 4,000 AF of water, or about 14 percent of the City's 2050 water supply. A firm Windy Gap water supply would also provide a source reusable effluent and the City is evaluating options for potential use of this water. Loveland will continue to pursue other water supply sources and ongoing conservation measures so supplies are developed ahead of the demand.

Figure K-1. Loveland's 2005 Annual Firm Yield vs. Total Projected Water Requirements.

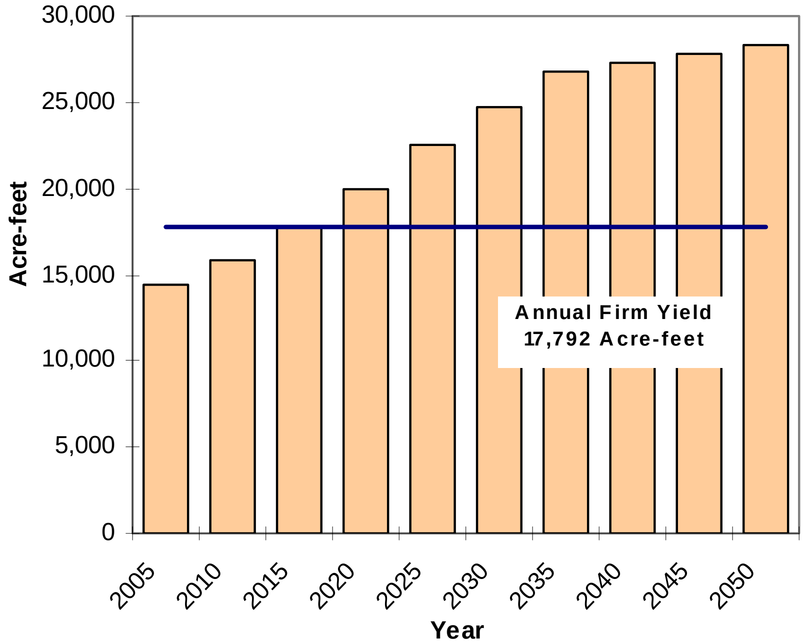
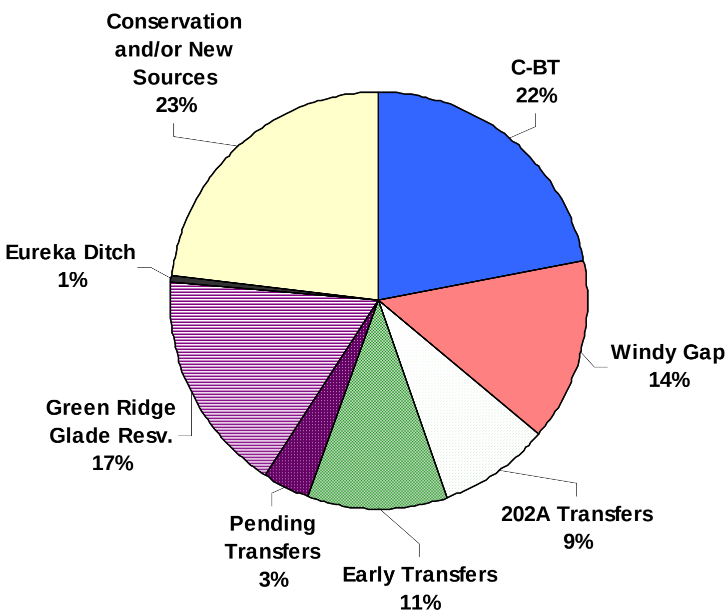


Figure K-2. Loveland's 2050 Projected Firm Water Supply Sources.



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WATER SUPPLY AND DEMAND

MIDDLE PARK WATER CONSERVANCY DISTRICT

Introduction

The Middle Park Water Conservancy District (MPWCD) was formed in 1950 as a direct result of the development of the C-BT Project. The MPWCD serves as a representative of water interests in Grand and Summit Counties and administers distribution of water from several projects to a variety of water users including municipal, private, and water and sanitation districts. MPWCD currently allocates water supplies from the Windy Gap Project and Wolford Mountain Reservoir.

Water Supply

MPWCD's water supply consists of 3,000 AF of Windy Gap water and 3,000 AF of Wolford Mountain Reservoir water (Table L-1). MPWCD also owns conditional water rights at several locations, but there are no immediate plans for development of these water rights.

Table L-1. Inventory of MPWCD Supplies.

		Firm Annual Yield (AF)
Windy Gap Project	3,000 AF	0
Wolford Mountain Reservoir	3,000 AF	0
Total		0

Windy Gap

Pursuant to the Agreement Concerning the Windy Gap Project and Azure Reservoir and Power Project, dated April 30, 1980, and the Supplement to Agreement of April 30, 1980, dated March 29, 1985, the MPWCD receives 3,000 AF of water produced each year from the Windy Gap Project for use within MPWCD. These agreements require that the Subdistrict dedicate and set aside annually, but non-cumulatively, at no cost to MPWCD, the first 3,000 AF of water in Granby Reservoir that is produced each water year from Subdistrict water supplies, for beneficial use without waste, either directly or by exchange or substitution, in MPWCD. The direct beneficial uses do not include instream uses or industrial uses. Any water so stored in Granby Reservoir shall be the last of any Subdistrict water to be spilled from Granby Reservoir if such spill is required.

If MPWCD's Windy Gap water is not used in a given year, it cannot be carried over for the following year. Consequently, any water that is not used reverts back to the Northern Colorado Water Conservancy District (NCWCD). However, MPWCD has transferred or exchanged the water when storage was available elsewhere, such as Wolford Mountain Reservoir.

The MPWCD's inability to firm Windy Gap Project water yield is similar to other Windy Gap Firming Project Participants. During dry years, no Windy Gap water is pumped and during wet years, there may not be enough storage in Lake Granby for Windy Gap water. Thus, MPWCD cannot rely on Windy Gap water each year. Firming annual storage of its 3,000 AF of Windy Gap water would provide MPWCD a reliable water supply to assist in meeting the current and future demands of entities in the MPWCD that contract for Windy Gap water.

Water Reuse

MPWCD water users do not reuse Windy Gap water.

Wolford Mountain Reservoir

MPWCD participated and cooperated in the development of Wolford Reservoir in the Muddy Creek basin north of Kremmling. In a 1992 agreement with the Colorado River Water Conservation District (CRWCD), the MPWCD receives 3,000 AF of storage in Wolford Mountain Reservoir in return for MPWCD's conveyance of its Troublesome Project to the CRWCD. MPWCD allocates water to Wolford Mountain's 28 contractees similar to Windy Gap water. In 2004, Wolford Mountain Reservoir contract holders ordered about 44 AF of water (Bishop-Brogden Associates 2004a).

Water Demands

The Middle Park Water Conservancy District is a wholesale water supplier for 67 water providers and users in Grand and Summit Counties. These entities have a contract with MPWCD to use Windy Gap water, as requested and as available, on an annual basis. The water providers, also known as contractees, include towns, suburban water districts, rural water districts, agricultural water users, consumers and ski areas. Together, the contractees account for 80 percent of the residents of Grand and Summit Counties (Bishop-Brogden 2004a, 2004c). The largest contractees own about two-thirds of the water served by MPWCD and include:

- Grand County Water and Sanitation District
- Town of Granby
- Town of Silverthorne
- Town of Kremmling
- Snake River Water District
- Winter Park Water and Sanitation District
- Town of Frisco
- Town of Fraser
- Three Lakes Water and Sanitation District
- Summit County
- Town of Breckenridge

Smaller contract holders include subdivisions, homeowner associations, and private individual homeowners. A complete list of MPWCD Windy Gap Project contractees is included at the end of this document.

Historical Water Demands

The MPWCD contractees utilize MPWCD waters for augmentation purposes in conjunction with other supplies. Some of the larger contract holders of MPWCD Windy Gap water rely on a variety of other primary sources of water to meet their total demand including surface water diversion, ditches, exchange agreements, and alluvial ground water. In addition, the MPWCD utilizes its water supply for exchanges, trades and other agreements with other Colorado water providers, such as Denver Water. Currently MPWCD Windy Gap water provides supplemental water to contract entities and only a portion of each individual entity's water supply. However, MPWCD water is the sole source of water for a number of small private augmentation water users, such as subdivisions and private landowners. Also, because Windy Gap water is used primarily to augment ground water pumping or stream diversions only the consumptive use is replaced by releases from Lake Granby, thus maximizing the use of available Windy Gap water. None of the MPWCD allocation of Windy Gap water is directly used by contract allottees (ERO 2004).

Given the nature of MPWCD water use, no records are available as to water demands by type of customer or by year. What is known is that the contractees to MPWCD request each year waters from the District to utilize in their own way. The allotments cost the contractees $115 per acre-foot annually, escalated by the rate of inflation from 2001 to the present, and out into the future (MPWCD 2001). This suggests that the entities requesting water are utilizing that water in a beneficial manner. In 2004, MPWCD contractees requested 2,680 AF of the 3,000 AF of Windy Gap water supplies (MPWCD 2004a). Actual delivery of Windy Gap water to the MPWCD has ranged from 0 AF to 624___ AF. Windy Gap waters from the MPWCD are utilized to the extent that these waters are available and can be used by the allottee, as of 2004.

Water Demand Projections

The MPWCD does not prepare its own water demand projections. The District's role is simply to respond to the needs of its contractees to the limit of its water supplies. To evaluate the future water demand or allotment needs for MPWCD, the study team has examined overall future water resource requirements for Grand and Summit Counties as an indication of contractees' demands.

Published in 2003, Hydrosphere Resource Consultants prepared the Upper Colorado River Basin Study (UPCO), which, among other things, provided water demand projections for the Colorado River headwater counties, Grand and Summit (Hydrosphere Resource Consultants 2003). The consultant surveyed almost all the water providers in Grand and Summit Counties, along with major water users, such as ski areas. From this study, current and future water demand projections were presented in the report, as identified in Table L-2.

Table L-2. UPCO Study Water Demand Projections for Grand and Summit Counties.

	AF	
Grand County	3,132	14,167
Summit County	8,027	17,871
Total	**11,159**	**32,038**

Source: Hydrosphere Resource Consultants 2003.

Based upon surveys of individual water providers, these water demand projections suggest that MPWCD will face a considerable increase in future water demands for its resources as these water providers seek to meet future needs.

To evaluate the timing of those needs, the study team examined various changes to the drivers of water demand as a function of time out into the future. Residential, commercial, agricultural and snowmaking water uses were examined for Summit and Grand Counties.

Residential Water Use. Population projections in Table L-3 for Summit and Grand Counties provide an indication of residential water demand.

Table L-3. Year-Round Population Projections for Summit and Grand Counties, 2000 to 2030.

		Grand County Population
2000	25,700	12,900
2005	28,200	14,300
2010	32,400	16,700
2015	36,700	19,600
2020	41,400	22,500
2025	46,000	25,700
2030	50,400	28,800

Source: DOLA 2004a.

By 2030, Summit County year-round population is projected to increase by 96 percent over the year 2000; Grand County year-round population is expected to increase by 123 percent over that same period. These figures do not include seasonal residents or visitors to either county.

Residential water demands will be driven in the future by increases in the number of housing units. In the year 2000, there were an estimated 24,200 housing units in Summit County and 10,900 housing units in Grand County. These housing units include permanent year-round homes, apartments, and seasonal or second homes. Regardless, all of these housing units must be supplied with water when needed. If the number of total housing units of all types grows in line with population growth, 23,230 new housing units will be needed in Summit County and 13,400 new housing units will be required in Grand County by the year 2030. Assuming an average of 657 gallons per housing unit per day at peak usage, total peak day use would be 24.1 MG per day (Bishop-Brogden Associates, Inc. 2004c). If year-round use is half peak daily use, a total of 13,500 AF of new water demand from the residential sector would be forthcoming for Summit and Grand Counties together by the year 2030.

Commercial Water Demands. New water demands must also be met from growth in the commercial sectors within Summit and Grand Counties. Employment projections for both counties are provided in Table L-4.

Table L-4. Summit and Grand Counties Average Annual Employment Projections, 2000 to 2030.

		Grand County Employment
2000	21,700	8,300
2005	21,800	9,300
2010	28,200	11,900
2015	34,300	14,100
2020	40,100	16,300
2025	45,400	18,200
2030	51,600	20,300

Source: DOLA 2004b.

Summit County employment is expected to increase by 138 percent or 29,900 employees, between the year 2000 and 2030. Grand County employment is expected to increase by 144 percent, or 12,000 employees, during that same period.

Commercial water demand projections for these two counties can be estimated based upon employment growth and an assumed 80 gallons per day per employee for water use (Bishop-Brogden Associates, Inc. 2004c). Total new water demand from the commercial sector in Summit and Grand Counties is projected to be 3,750 AF between the years 2000 and 2030.

Livestock Watering. Cattle, calves and other livestock will need watering in the rural areas of Grand and Summit Counties in the future. The study team examined historical trends for the number of cattle and calves on farms since 1992 and found a decline in the number of cattle and calves. On the basis of this trend, no new water demands for the agricultural sector in Grand and Summit Counties is assumed for this study (USDA National Agricultural Statistics Service 2004).

Snowmaking. As of 2004, there were four ski areas in Summit County – Arapahoe Basin, Breckenridge, Keystone, and Copper – and two ski areas in Grand County – Winter Park/Mary Jane and Sol Vista (Colorado Ski Country USA 2004a). Together these ski areas represent over 10,000 acres of skiable terrain, and these operations provide snowmaking to a combined 2,468 acres as of 2004 (Colorado Ski Country USA 2004a). An average of 1 AF per acre per year is required for snowmaking (Bishop-Brogden Associates, Inc. 2004c). The study team was unable to obtain reliable projections of snowmaking terrain for the Summit and Grand Counties ski areas, although past experience suggests that both skiable terrain and the proportion of a ski area subject to snowmaking have both increased over time. Even so, past trends in skier visits for these ski areas do not suggest an upward trend, and so projections of any increases in snowmaking demand were not made as part of this study (Colorado Ski Country USA 2004b).

Conservation. The larger 67 water providers in Summit and Grand Counties are required to have water conservation plans in response to state regulations applicable in 1996. Given the transient nature of the populations in these counties, water conservation represents special challenges. Once meeting initial demands, the headwater counties in the Colorado River Basin offer a high proportion of return flows that rejoin the stream system for downstream users.

The study team contacted seven of the larger water providers in Summit and Grand Counties, which are also allottees to the MPWCD, regarding their conservation programs and practices. Interviews were completed with six of the seven Participants contacted; the Town of Granby elected not to respond to this inquiry. The water suppliers that did respond to the survey indicated a wide range of water conservation programs and practices as of November 2004 (Harvey Economics 2004):

Town of Winter Park – Winter Park is 100 percent metered. This community has a public information program consisting of regular newsletters and water conservation reminders enclosed with water bills. Winter Park has a leak detection program and restricts outdoor water use under drought conditions.

Grand County Water and Sanitation District – Grand County's customers are also 100 percent metered. The County has a leak detection program and water restrictions that mirror those of Denver Water. Grand County has a low flow plumbing fixture requirement and an inclining block rate schedule. This water provider also advertises in a local newspaper to promote conservation efforts. In the future, Grand County hopes to work with other water providers to decrease irrigation and landscaping in future developments.

Town of Breckenridge – Breckenridge is fully metered and has an inclining rate block structure with an excess use fee. The Town has an active leak protection program that entails a full system survey every three years and has saved about 10 percent of total water use. Low flow plumbing devices are required in new construction and replacement plumbing fixtures. The town adopted an ordinance requiring separate tap fees, metering, rates and billing of irrigated areas, both for new construction and existing irrigation meters. In addition, mandatory watering restrictions are imposed as needed and enforced by written warning, fines, and shut-off. To encourage conservation, the Town offers reduced tap fees for efficient water use designs for new commercial and industrial water customers. Public education efforts include information in the Town Bulletin, mailings, door hangers and conservation reminders in billings. Breckenridge plans to implement a xeriscaping program that will include incentives to developers.

Snake River Water District – This water district has a leak detection program, is fully metered and promotes water conservation through bill stuffers. Water restrictions can be implemented when needed.

Town of Fraser – Fraser has a biannual leak detection survey effort. Low flow plumbing fixtures are required in Fraser according to the National Plumbing Code. Two new large developments in the Town of Fraser allow no outside irrigation, and promote xeriscape as the only landscaping alternative. Fraser has a public education program including newsletters that promote water conservation. Fraser is in the process of completing its metering efforts, which should be completed by year-end 2005.

Town of Silverthorne – Silverthorne is 100 percent metered. The Town performs a leak detection survey twice a year. This community also has low flow plumbing requirements and landscape restrictions in newly developed areas. Silverthorne performs a public education effort promoting water conservation through billing inserts. Water restrictions are applied as needed.

Summary. Summit and Grand Counties are likely to experience substantial increases in water demand between the years 2000 and 2030, primarily from residential and commercial growth. Total potable demand is projected to increase by as much as 17,000 AF. This does not include potential losses that each Summit and Grand County water provider experiences from the point of diversion back to the tap. These new demand requirements also do not include any new snowmaking or agricultural demands and are therefore considered conservative.

Anticipated Water Needs

The MPWCD is anticipated to need additional reliable sources of water supply to meet both current demand and anticipated future demands. Currently almost 90 percent of the Windy Gap Project water is contracted for. While actual use has varied from year to year, the projected future increase in residential and commercial demand of about 17,000 AF by 2030 in this analysis indicate a substantial shortage. A firm Windy Gap water supply would provide the MPWCD with reliable annual supply of 3,000 AF of water, which is about 10 percent of the estimated demand in 2030. The contractees to MPWCD are responsible for providing their own supplies; some or all of these entities will need to secure additional water resources between 2004 and 2030.

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WINDY GAP PROJECT MPWCD CONTRACT ENTITIES (2004)

Ben and Sandy Schneller
Blue River Water District
Bob Cooks — previously: Leslie and Nancy Gwin
Bravo Developing Inc.
C.D. Peper (1/22/96)
Casey and Rhonda Farrell
Christine French
Columbine Lake Water District
Copper Mountain Consolidated Metropolitan District
DeLoach, Jimmy
Dillon Valley Water and Sanitation District
Dr. Boyace Holland
Elkhorn Ridge Homeowners Association
Frank and Rebecca Newcommer
Fred Garrett
Giberson
Granby Jones, Inc.
Grand County
Grand County Water and Sanitation District
Grand Lake Recreation District
Hidden River Ranch Homeowners Association, Inc. (Gile)
High Lonesome Trails Homeowners Association, Inc.
Jim and Karon Warner (Tibbetts)
John Thompson (Wiebe)
Kenneth A. and Kristina M. Arellano (Tibbetts)
King, Morris
Koenigs, Chris
Lakeridge Homeowners Association
Liberty National Bank and Trust Co. of Oklahoma
Marilyn K. Hauge
Mark Unicume
MDJ Holdings, LLC
Mesa Cortina Water and Sanitation District
Mountain Parks Concrete Inc.
North Shore Water and Sanitation District
Parsons, Beverly
Pinon Ridge Homeowners Association, Inc.
Ranch Creek Ranch Owners Association Inc.
Richard R. and Linda V. Kelley
Roger Pierce (Wiebe) (1/8/96)

Ron VanVleet and Claire Silk
Shorewood Owners Association
Snake River Water District
Spring Branch Augmentation Association (Atwater)
Spruce Valley Ranch Foundation
Summit County
Sunnyshore Park Well Group
Sunset Ridge Estates Homeowners Association
Sunyshore
Sydney and Ardith White (Marquez)
Thompson Properties (Hahn)
Three Lakes Water and Sanitation District
Town of Breckenridge
Town of Fraser
Town of Frisco
Town of Granby
Town of Kremmling
Town of Silverthorne
Whitfield
Winter Park Recreational Association
Winter Park Water and Sanitation District
Wynstra

WATER SUPPLY AND DEMAND

PLATTE RIVER POWER AUTHORITY

Introduction

Platte River Power Authority (Platte River) is a joint action governmental entity owned by the Municipalities of Estes Park, Fort Collins, Loveland, and Longmont. Platte River was established in 1973 to meet the wholesale electric energy requirements of these municipalities, and is governed by an eight-member board with two members from each of the four municipalities.

The Rawhide Energy Station (Rawhide) is owned and operated by Platte River and provides a net output of 270 megawatts from Rawhide Unit 1, a coal-fired generating unit completed in 1984. Four gas-fired simple cycle combustion turbine (CT) units, also located at Rawhide, provide peaking power and back up for other Platte River energy sources. The coal used at Rawhide is mined at the Powder River Basin in Wyoming. Currently, most of the 270 MW generated at Rawhide, along with other Platte River energy sources, are used to supply electric energy for Estes Park, Fort Collins, Longmont and Loveland. Other energy sources include an allocation of hydroelectric power from the Western Area Power Administration of the Department of Energy and 154 MW of coal-fired generation from an 18 percent ownership in the Craig Units 1 and 2, located near Craig, Colorado. Platte River also owns and operates wind generators located near Medicine Bow, Wyoming, which produce approximately 10 MW. A small amount of surplus power is sold under contract to Xcel. Non-firm power, when available, is marketed to Tri-State Generation and Transmission Association, Inc., Xcel, Pacificorp, the Western Area Power Administration and other electric utilities in the western power grid (ERO 2004).

Water use at Rawhide is mainly for two purposes: boiler water for the steam-driven turbine and cooling water for the steam used to generate electricity. Water is recycled and used again after condensation. Ultimately, all water at Rawhide is used to extinction; no water is discharged from the Rawhide Energy Station site.

Platte River needs both a firm reliable supply of water for its existing Rawhide facilities and the anticipated need for additional power generation in the next 10 to 15 years. The need for additional power generation is based on growth projections provided by each of the four owner Municipalities, as well as Platte River's independent load estimates (ERO 2004). A number of different potential generation projects with varying water supply requirements, many of which are not located at the Rawhide site are possible (Id.).

Platte River would take delivery of firmed Windy Gap water in the same manner it currently takes non-firm and "in lieu" deliveries of Windy Gap water. The firmed Windy Gap water would improve delivery of water to the City of Fort Collins for first use under the existing Reuse Agreement and this would, in turn, improve the subsequent delivery of effluent reuse return flow to Rawhide, as well as direct Windy Gap water deliveries from Horsetooth Reservoir to Rawhide for boiler and potable water use.

Water Supply

Platte River's raw water supply is based on Windy Gap water and a Reuse Agreement with Fort Collins and the Water Supply and Storage Company (WSSC) involving exchanges that include Windy Gap water. (Table M-1). Platte River direct flow rights, reservoir storage rights in Hamilton Reservoir, and a limited number of native ditch shares in Larimer County Canal No. 2 provide other minor sources of water (Platte River 2004).

Table M-1. Inventory of Platte River Water Supplies.

			Firm Annual Yield (AF)
Transbasin Sources			
Windy Gap Project	160		0
Provided to Fort Collins under the Reuse Agreement W-9322-78 (April 24, 1979)	N.A.	4,200[1]	0
Direct delivery of Windy Gap water from Horsetooth Reservoir	950 AF[2]	N.A.	0
Direct Flow Rights			
Poudre River Decrees	1.6 cfs and 15.19 cfs	N.A.	0
Reservoir Storage			
Hamilton Reservoir Storage Decree	16,308 AF	N.A.	N.A.
Ditch Shares			
Larimer County Canal No. 2	0.1393	N.A.	N.A.
Total	—	4,200[3]	0

[1] A portion of Platte River's Windy Gap water supply is provided through a Reuse Agreement (W-9322-78 [April 24, 1979]) with Fort Collins and WSSC, which provides up to 4,200 AF of reusable effluent for use by Platte River in exchange for 4,200 AF of Windy Gap. Platte River and Fort Collins are considering a transfer of some of the Windy Gap water provided to Fort Collins under the Reuse Agreement to the City of Fort Collins. If this transfer occurs, the Windy Gap water transferred to Fort Collins would still be used as it is currently used to meet the requirements of the Reuse Agreement.

[2] Platte River takes direct delivery of up to 950 AF of Windy Gap water via an existing 10-inch pipeline from Horsetooth Reservoir when water is available.

[3] Actual deliveries vary annually with the availability of Windy Gap water and opportunities for in-lieu borrowing of C-BT water.

Transbasin Water

Windy Gap

Windy Gap water is used as part of a Reuse Plan to meet Rawhide Unit 1's annual water requirements. Up to 4,200 AF of reusable effluent from the City of Fort Collins is delivered by the City for use at Rawhide under a Reuse Agreement with the City and WSSC. In return Platte River provides Fort Collins with an equivalent amount of Windy Gap water (Table M-1). The reusable effluent is delivered to the Hamilton Reservoir on-site at Rawhide via an existing 24-inch pipeline from Fort Collins' Drake Water Reclamation Facility. In addition, Platte River takes delivery of 950 AF of its Windy Gap water directly from Horsetooth Reservoir via an existing 10-inch pipeline when water is available (ERO 2004). Windy Gap water is taken as continuous flow throughout the year. The Water Reuse section provides more discussion of the Reuse Agreement.

Platte River owns 160 units of Windy Gap water. The delivery of 4,200 AF of Windy Gap water allows Platte River to meet its obligations under the Reuse Agreement, although in dry years or when no storage is available in the C-BT system for Windy Gap, insufficient Windy Gap water is available. In such years, the potential for exchanges under the Reuse Agreement and in-lieu borrowing of C-BT water is reduced. Platte River is requesting 13,000 AF of storage to firm 51.5 Windy Gap units for current use in power generation at Rawhide. Ultimately, Windy Gap water could also be used for future power generation at Rawhide or at other locations.

Direct Flow Rights

Platte River's Poudre River decrees have a junior water right and are only infrequently available during the spring runoff or in extremely wet years. Although the Poudre River decrees can provide an estimated 400 AF of water (non-firmed) in certain years, this water is not reliable.

Reservoir Storage

Treated sewage effluent received from Fort Collins is stored in Hamilton Reservoir for use in cooling at the Rawhide Energy Station. Platte River must treat the water prior to use to reduce phosphorus and adjust pH. Hamilton Reservoir provides a total of 16,308 AF of storage and no firm yield (Id.). Platte River is limited to a drawdown of approximately 2,450 AF on this reservoir. Any further drawdown causes problems with the circulating water pumps and with the cooling capacity of the reservoir. Platte River took this into account when sizing the 13,000 AF firming storage request.

Ditch Rights

Larimer County Canal No. 2 ditch rights provide a very limited backup water supply for Platte River needs and serves as an alternate source for well water used to irrigate Platte River's Headquarters Office Facility in Fort Collins. Larimer County Canal No. 2 usually yields around 5 AF of water each year (42.687 AF per share/0.1393 shares), but does not provide any firm yield.

Water Reuse

Platte River's water reuse program has two components: First, the majority of the water (4,200 AF) used for cooling is effluent supplied by Fort Collins under the Reuse Agreement. Second, Platte River continues to recycle and reuse this cooling water to extinction.

Under a Reuse Agreement, Fort Collins, WSSC, and Platte River use a series of exchanges in order to meet each entity's respective water needs. Windy Gap water is used to meet Platte River's exchange obligation under the Reuse Agreement. The Reuse Agreement with Fort Collins includes an exchange whereby, Platte River provides Fort Collins with 4,200 AF per year of Windy Gap water in exchange for 4,200 AF of reusable effluent from Fort Collins. In addition, Platte River retained the return flows from the 4,200 AF of Windy Gap (about 55-65%) provided to Fort Collins. If Platte River's Windy Gap water falls short in a given year due to drought or for any other reason, then Fort Collins contribution of reusable effluent and the Windy Gap return flows could be reduced if other satisfactory arrangements weren't made. The Reuse Agreement also calls for a series of exchanges between Fort Collins and WSSC for water released from Joe Wright Reservoir and Long Draw Reservoir to the Larimer County Canal and North Poudre Canal with accompanying credits for reusable water to Fort Collins. The City's use of the reusable water generates reusable effluent that is made available for Platte River's use.

In addition to the effluent received from the Drake Water Reclamation Facility, Platte River pumps 950 AF of Windy Gap water directly to the Rawhide site from the Soldier Canyon pump station at Horsetooth Reservoir. About 50 percent of this water goes to Hamilton Reservoir and is used for cooling and is recycled to extinction. The remainder of this 950 AF is used for plant service water and boiler water. This water is recycled and ultimately used to extinction.

Water Demands

Platte River's current operational water demand for the 270-megawatt Rawhide Unit 1 is about 4,520 AF per year. Rawhide Station includes a coal-fired facility, plus four gas-fired CT units to meet peak power needs and to provide backup and reserve power. Platte River's four owner Municipalities utilize most of the 270 megawatts of total Rawhide coal-fired capacity; the remainder is sold into the Western Power Grid.

Historical Water Use

Since the plant went into operation, it has used a relatively consistent amount of water in order to run at maximum efficiency. A total of about 4,200 AF of water is delivered to the Rawhide Energy Station annually. This includes 3,261 AF on average of effluent from the City of Fort Collins for use primarily for cooling and 950 AF of relatively cleaner water taken directly from Horsetooth Reservoir and used for boiler make-up water and potable water. Platte River has an additional need for 309 AF to meet well and ditch augmentation requirements and a long-term lease obligation with Larimer County. A total of about 4,200 AF of water is fully consumed each year (ERO 2004). Any surplus water available provides an operational reserve to meet fluctuations in water demand or if not required, the water is leased.

Future Water Demands

Future water demands will depend upon increased power requirements and related generating facility development to meet those electricity demands. Energy load projections for Platte River forecast a continued increase for demand for electric power within Platte River's owner Municipalities as these areas continue to grow. This will result in a need for additional power generation within the next 15 years. Platte River is currently evaluating options for this new generation. Water demands for Platte River's portion of the new power generation will be approximately the same proportion as that used for current coal-fired generation. A location for the future generation facility has not yet been determined. Platte River's Windy Gap water may be used to help meet the water requirements of such new generation. Future demand projections will be continually updated by Platte River to determine the timing of power generation needs and the associated water requirements. In sum, it is clear that in the future, Platte River's water needs will expand with its generation requirements, but given uncertainty about when, where, and how that generation will be provided, these future needs have not been quantified for the Windy Gap Firming Project.

It is important to note that these water requirements understate the net additional Platte River needs for water, given the uncertainty in annual water supplies. As described above in the Platte River water supply discussion, it is necessary to strategically plan for water supply needs each year, and the current approach is vulnerable to drought and other uncertainties. Existing supplies are not sufficiently reliable to ensure the continuous reliable operation of this capital-intensive plant, which is essential to the welfare of four northern Colorado cities served by Platte River. The firming of Windy Gap water supplies would assure the Rawhide's current water needs are fully met and that additional water is available for future requirements.

Conservation

Water conservation at Platte River's Rawhide site is essentially 100 percent because, through recycling, the plant water is used and reused again and again to extinction. Water recycling also occurs at the ash disposal ponds and at the phosphorus removal system. The Hamilton Reservoir Dam is regularly monitored to ensure that no unnecessary seepage occurs.

Platte River is considering additional water conservation at Rawhide, although all of these measures might not be technically feasible. First, if the generating facility were able to improve its heat rate, this would mean greater generation with less resource requirements, including water. Platte River is exploring this possibility but it is uncertain at this point if it is practical. Platte River employs a performance engineer to oversee and manage improvements in energy usage and heat rate, and thereby reduce water usage at the Rawhide site. Finally, Platte River might consider a hydro-cooling tower, a combination of wet-dry cooling, or more CT generation at the plant site. The feasibility of any of these options is highly uncertain.

Anticipated Water Need

Platte River's ability to meet its existing water demand is subject to the availability of Windy Gap water and the continued operation of the Reuse Agreement and the associated exchanges with Fort Collins and WSSC. Operation of the Rawhide Energy Station requires a reliable annual supply of water. Although current supplies can provide up to 5,150 AF when Windy Gap water is available, actual deliveries vary annually and there is no firm yield from existing water supplies.

Platte River needs to firm at least 5,150 AF of water to meet existing average demand of 4,520 AF, including an operational reserve of 630 AF for the Rawhide plant to continue operation if, in a given year, water supplies are less than expected or water demands are greater than expected. There are numerous scenarios (i.e., drought) under which there is no assurance that Platte River's water supplies will be sufficient or available when needed. Without the firming of the Windy Gap units, the ongoing operation of the Rawhide Energy Station is vulnerable to curtailed operation. As a utility providing power to four northern Colorado cities, Platte River asserts correctly that this vulnerability of a multi-million dollar generating facility on which citizens depend for their daily welfare is unacceptable.

In conclusion, the firming of Platte River's Windy Gap units is justified to meet current demands. Water to meet future generation needs offers further justification

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WATER SUPPLY AND DEMAND

TOWN OF SUPERIOR

The Town of Superior is located in southeast Boulder County and northern Jefferson County and is considered part of the greater Denver Metropolitan Area. Adjacent communities include Louisville, Broomfield, and the City of Boulder. The Town of Superior borders the Rocky Flats Environmental Technology Site and SH 128 to the south, Boulder City and County Open Space to the west and northwest, US 36 to the east and northeast, and the City and County of Broomfield and Jefferson County to the southeast.

The Town of Superior was founded in 1896 with an economy based on coal mining and farming (Town of Superior 2001). The Town remained small until the early 1990's when the Rock Creek Ranch residential development began construction. The Town has grown rapidly during the past decade, but as of 2004, population growth has tapered as the areas zoned for residential development approach buildout. Future water needs are expected to occur primarily from commercial and retail development and community parks (ERO 2004).

The following discussion provides a summary of Superior's water supply and demand.

Water Supply

Currently, the Town of Superior relies primarily on C-BT water, Windy Gap water when available, and local ditch water to meet its municipal and commercial water requirements (Table N-1).

Transbasin Water

Colorado-Big Thompson Project

The Town of Superior owns 2,080 units of C-BT water, which is delivered via the Southern Water Supply Pipeline (SWSP) from Carter Lake. C-BT water is delivered to the 400 AF Terminal Reservoir prior to treatment and delivery in the Town's distribution system. Superior's share of the capacity in the SWSP is 6.0 cfs.

Annual deliveries of C-BT Project water vary from year to year depending on available water supplies, the needs of shareholders, and the annual quota established by the NCWCD Board of Directors. Historically, C-BT quotas have ranged between 0.5 and 1.0 AF per unit. However, quotas are adjusted to actually deliver more water in dry years. This is the opposite situation from most water rights in Colorado, because the C-BT Project was designed to provide supplemental water in dry years when native water supplies yield less water. Historically, the C-BT Project has delivered 1 AF in dry years and as little as 0.5 AF in wet years or in extremely dry years, such as the drought of 2002-2004 when the C-BT Project was limited by the physical supply of water that it could actually deliver. Superior, like most municipalities, has not assembled a water portfolio that would deliver a full supply of water in extreme drought years for economic reasons. Based on analysis of hydrology and C-BT operations through historical drought periods from 1950 to present, NCWCD has determined that the firm yield of the C-BT project is 0.6 AF per unit.

Table N-1. Inventory of Superior Water Supplies.

		Firm Annual Yield (AF)
Transbasin Sources		
C-BT Project	2,080 units	1,248[1]
Windy Gap Project[2]	22 units	0
Reservoir Storage		
Terminal Reservoir	400 AF	0
Marshall Lake	385 AF	0
Ditch Shares		
FRICO Ditch	54.47 units	202
South Boulder and Coal Creek Ditch	1 units	37
Goodhue Ditch	15 units	0
Ground Water		
Laramie-Fox Hill Aquifer	N.A.	57
Total[3]		**1,544**

[1] C-BT yield is variable from year to year. C-BT's long-term firm yield is assumed to be 0.6 AF/unit for purposes of this analysis.

[2] When available, a portion of Windy Gap Project yield is also reused for irrigation purposes. The reuse component is not included in this table.

[3] The firm yield for purposes of this analysis is 1,544 AF; however, Superior has maintained a sufficient water portfolio to meet all current demands. It uses increased quotas from is C-BT units in dry years and Windy Gap yields in wet years when C-BT quotas are lower. It also operates pursuant to the Integrated Operating Criteria, which allows Superior to collateralize Windy Gap water with C-BT water. In doing so, it has significant reuse water available for irrigation purposes. The Windy Gap Firming Project is essential to meet future demands. Upon completion of the Project, Superior will be able to use its C-BT units to meet future demands, rather than using them as collateral for Windy Gap units.

Windy Gap Project

Windy Gap Project water provides an additional source of transbasin water. The Town of Superior currently owns 22 units of Windy Gap water, but is in the process of selling 7 units to the City of Erie. Windy Gap water is delivered to Superior through the SWSP—the same as C-BT water. Windy Gap has not provided a firm supply of water on which Superior can rely to meet its water requirements without in lieu borrowing of C-BT water. Windy Gap deliveries have ranged from about 70 to 2,200 AF per year.

Ditch Shares

Superior owns 54.47 shares in the Farmer's Reservoir and Ditch Company (FRICO), one share in the South Boulder and Coal Creek Ditch Company and 15 shares in the Goodhue Ditch Company. Superior's share of FRICO water is delivered through the Community Ditch. These ditch shares are used solely as a non-potable water supply for irrigation of parks and open space except 7.96 FRICO shares and its one share in the

South Boulder and Coal Creek Ditch Company, which have been adjudicated for municipal use in addition to irrigation. The yield of the FRICO shares was adjudicated to provide 3.71 AF per share. The South Boulder and Coal Creek Ditch share was adjudicated to provide 37.5 AF per year. The shares yield more water in wet years.

Ground Water

Superior also owns water rights in the non-tributary Laramie-Fox Hills Aquifer underlying the Town. The yield from these wells has averaged 56.6 AF per year.

Reservoir Storage

Superior's only potable water storage facility is at Terminal Reservoir, which is used to store Windy Gap and C-BT water prior to treatment. By virtue of its ownership of FRICO shares, Superior also has a pro rata share of storage in Marshall Lake, which can be used to store ditch water for future use. FRICO water is also temporarily stored in several small ponds throughout Superior for use in irrigation.

Water Reuse and Irrigation

Currently, Superior has an extensive reuse and raw water irrigation program that allows for the reuse of about 32 percent of its Windy Gap water when it's available and when Superior provides C-BT water as collateral. Superior is currently not able to store effluent during the winter due to lack of storage space, so all available effluent is used during the summer. Reuse water and Superior's ditch shares are used to irrigate the Town's parks and greenways. When the Windy Gap water is firmed, Superior will no longer need to use its C-BT water to collateralize its Windy Gap units. Those C-BT units will be used to meet future demands.

Water Demands

Superior was historically a small community until development began in earnest in the 1990s. Surrounding the original town of small homes is a rapidly growing bedroom community for Boulder and other Front Range cities. The total planning area including the existing town limits and potential annexation areas is 2,736 acres or about 4.3 square miles (Town of Superior 2001).

Historical Water Demands

As of 2004, the Town of Superior's population was estimated at 11,000 (ERO 2004). Table N-2 provides historical population trends and the total number of water taps for the Town of Superior for those years in which such information is available.

As population growth commenced in the early 1990s, average annual growth became extraordinary, with an average population increase of 33 percent from 1990 through 2004. The town's population tripled in 1993. Since 2000, the average annual population growth has slowed in relative terms but still exceeds 5 percent on an annual basis. The growth in the number of water taps also slowed after the year 2000, but still grew more than 20 percent between the year 2000 and 2003.

Table N-2. Population and Water Taps for the Town of Superior, 1990 to 2004.

		Total Number of Water Taps
1990	250	N.A.
1991	308	N.A.
1992	313	N.A.
1993	1,180	N.A.
1994	1,960	N.A.
1995	2,300	N.A.
1996	3,689	N.A.
1997	5,417	N.A.
1998	6,332	N.A.
1999	7,870	N.A.
2000	9,011	2,800
2001	9,863	3,202
2002	9,963	3,408
2003	10,212	3,468
2004	11,000	N.A.

Source: DOLA 2004; Vranesh and Raisch 2004.

Potable Water Demands

Superior does not serve any other communities with water nor does it receive water from other communities. Table N-3 indicates total water consumption and production from Superior's water treatment plant, from 1995 through the year 2003.

Table N-3. Potable Water Deliveries and Treatment Plant Production for the Town of Superior, 1995 to 2003.

	MG	
1995	138	140
1996	209	214
1997	239	243
1998	344	351
1999	366	373
2000	430	439
2001	448	457
2002	466	475
2003	480	490

Source: Vranesh and Raisch 2004a.

Superior's total water deliveries more than tripled between 1995 and 2003, reaching a peak of 480 MG in 2003. Superior has a 2 percent system loss, on average, from the treatment plant outflow to the end-user (ERO 2004). Average annual growth in water deliveries was 33.5 percent from 1995 through 2003. A breakdown of water use by type of user was not available for Superior. The Town of Superior does not serve any large industrial customers as of 2004.

Table N-4 presents average gpcd and gallons per tap per day for the Town of Superior from 1995 through 2003.

Table N-4. Potable Water Use per Capita and per Tap for the Town of Superior.

		Gallons per Tap per Day
1995	164	N.A.
1996	156	N.A.
1997	121	N.A.
1998	149	N.A.
1999	127	N.A.
2000	131	421
2001	125	384
2002	128	374
2003	120	379

Source: DOLA 2004; Vranesh and Raisch 2004, 2004a.

From 1995 to 2003, Superior's total gpcd averaged 135. From the year 2000 through 2003 Superior's gallons per tap per day averaged 390.

Non Potable Demands

Non-potable waters, primarily re-use water supplies, are used extensively within the Town of Superior. Non-potable water is used for parks and common green areas for multi-family projects and certain commercial activities. The re-use water is supplemented by ditch water in the summer months. Non-potable demands increased from 130 MG, or 400 AF in 1996 to about 228 MG, or about 700 AF by the year 2003 (Town of Superior 2004).

Total Water Requirements

Table N-5 presents total water requirements from potable and non-potable customers for the Town of Superior from 1995 through 2003.

Table N-5. Total Water Requirements for the Town of Superior, 1995 through 2003.

					Total Water Requirements[1]
				AF	
1995	138	N.A.	138	424	446
1996	209	130	340	1,043	1,098
1997	239	111	349	1,071	1,127
1998	344	226	570	1,749	1,841
1999	366	182	548	1,682	1,770
2000	430	300	730	2,240	2,358
2001	448	228	676	2,075	2,184
2002	466	226	692	2,124	2,235
2003	480	225	705	2,163	2,277

[1] Including system losses.

Source: Vranesh and Raisch 2004a; Town of Superior 2004; ERO 2004.

Water deliveries are adjusted to total water requirements by accounting for a distribution loss of 2 percent and losses from the point of diversion to the treatment plant of an estimated 3 percent (ERO 2004). Total water requirements have increased from 1,127 AF in 1997 to 2,277 AF in 2003, an increase of 1,150 AF. The considerable increases in annual water requirements for the Town of Superior have slowed in recent years as population growth tapers off.

Projected Potable Water Requirements

The Town of Superior develops its own water demand projections, which are driven by increases in the number of dwelling units by type and projections of office and retail space for the town. To each of these projections, the Town of Superior applies a water usage rate to arrive at total water use by type of user. These totals are then aggregated to get annual projections (ERO 2004).

Population projections and buildout assumptions drive the water demand projections. The Town of Superior assumes that buildout will occur in the year 2014, when the population of the town reaches 15,400 persons. Compared with the 2004 population estimate of 11,000, the Town is expected to experience an average annual growth of 3.4 percent. This figure is very much reduced from historical population growth for the community, but more in-line with regional growth. The study team believes these population projections are reasonable as long as future development is constrained by the Town of Superior's boundaries and its land use plans and policies. If those should change, these projections could be low.

Office and retail growth is projected by the Town of Superior on the basis of population and expectations about future developments within the community. These projections are determined in large part on near term plans of developers and are considered reasonable for water demand forecasting in this instance.

The water use factors for single family, multifamily, office and retail uses are based on actual consumption experience of customers within the Town during 2002. This represents a reasonable basis for deriving such water factor assumptions and the study team adopts these use factors for the Town of Superior projections. Table N-6 depicts the Town of Superior's projected water use by type of user through the year 2014.

Table N-6. Projected Annual Change in Town of Superior Water Deliveries by Type of User, 2004 through 2014.

	AF				
2004	17	3	0	3	1,500
2005	25	5	1	11	1,523
2006	25	4	1	2	1,565
2007	25	13	2	5	1,642
2008	25	11	2	5	1,685
2009	0	7	2	4	1,697
2010	0	0	2	1	1,701
2011	0	0	2	2	1,706
2012	0	0	2	1	1,708
2013	0	0	2	0	1,710
2014	0	0	1	0	1,711

Source: Vranesh and Raisch 2004b.

Potable water deliveries are expected to increase by 211 AF from 2004 through 2014. Total potable water usage is projected to exceed 1,700 AF by the year 2014. This level of increase is considered by the study team to be reasonable, if not low. If average gpcd were applied to buildout population projections, future potable demand would exceed 2,300 AF.

Projected Non-Potable Demands

The Town of Superior plans on maximizing the use of non-potable water for outdoor uses in the future. This would include new public water uses and green spaces for multifamily, office or retail customers. Superior has a goal of using 100 percent of its reusable water. Irrigation of future parks is expected to rely upon reusable water. Total increases in non-potable use call for a doubling from 2004 level, or from 700 AF, to 1,400 AF at buildout (ERO 2004).

Total Projected Water Requirements

Table N-7 presents total projected water requirements for the Town of Superior through the buildout year 2014. Total water requirements are projected to increase from 2,340 AF in 2004 to 3,275 AF in 2014.

Table N-7. Total Water Requirements for the Town of Superior, 2004 to 2014.

	AF			
2004	1,523[2]	700	2,223	2,300
2005	1,565	770	2,335	2,500
2006	1,597	840	2,437	2,600
2007	1,642	910	2,552	2,700
2008	1,685	980	2,665	2,800
2009	1,697	1,050	2,747	2,900
2010	1,701	1,120	2,821	3,000
2011	1,706	1,190	2,896	3,000
2012	1,708	1,260	2,968	3,100
2013	1,710	1,330	3,040	3,200
2014	1,711	1,400	3,111	3,300

[1] Superior has maintained a sufficient water portfolio to meet demands to date. It maximizes increased quotas from its C-BT units in dry years, Windy Gap yields in wet years, and the carryover program for C-BT water. It currently provides reuse water on a reliable basis pursuant to the Integrated Operating Criteria by collateralizing Windy Gap water with its C-BT units. However, the Windy Gap Firming Project is essential to meet future demands. Total water requirements include system losses.

[2] Actual potable deliveries in 2004 were 1,400 AF and non-potable deliveries were 455 AF for a total of 1,855 AF due in part to above-average precipitation.

Source: ERO 2004; Vranesh and Raisch 2004a, 2004b.

Conservation

The Town of Superior has an inclining rate block rate structure oriented to water conservation. Superior also intends to use as much reuse water as it can. In addition to these two major conservation policies, Superior has instituted the following conservation measures:

- Lawn watering is restricted to between 10 P.M. and 6 A.M.
- New homes are required to have low flow toilets and washers.
- Superior's land use plans encourage high density and small lawns.
- Superior has a new and highly efficient water system with minimal leakage and loss.

Beyond these conservations policies and measures, Superior is not contemplating additional water conservation measures at this time.

Anticipated Water Needs

Assumptions

The evaluation of potential water needs is based on projections of the future water demands for each of the Participants and the existing or anticipated firm supply of water available. Estimates of the firm water supply, often referred to as the dry year yield, indicate the amount of water that is available during a defined period or condition. Often this encompasses a 50-year historical record that includes several dry years. For planning purposes water providers must consider the firm yields available to serve customers during periods of regularly occurring drought. In addition, because water yield from the various water supply sources can fluctuate substantially from year to year, water providers seek to secure water supplies or adequate storage to capture flows during wet years so as to meet their dry year water needs.

Despite the utility of the using firm yield for long-range planning, firm yield is difficult to estimate for several sources of water including C-BT Project water and water reuse. As previously described, C-BT water is a supplemental water supply, with quotas established annually depending on available supplies. Typically C-BT water deliveries are greater during dry years and are lower during wet years, under the assumption that C-BT unit holders need the supplemental water supplies more during dry years. For purposes of this analysis we have assumed a long-term dry year yield for the C-BT Project of 0.6 AF per year. However, except in exceptionally dry years, C-BT may deliver yields of up to 1.0 AF per unit. Thus in many dry years, Participants that own C-BT units may have available C-BT Project water greater than indicated by the assumed 0.6 AF per unit yield.

In addition, firm yield supplies also do not reflect the reuse component for some sources of supply. Transbasin diversions other than C-BT water and some other water sources can typically be captured and reused repeatedly until extinction. For most Participants reuse water is used to meet non-potable irrigation requirements or downstream obligations. Water for reuse depends on the availability of water for the first use. While Windy Gap water can be reused, if the supply is not firm, then neither is the reuse.

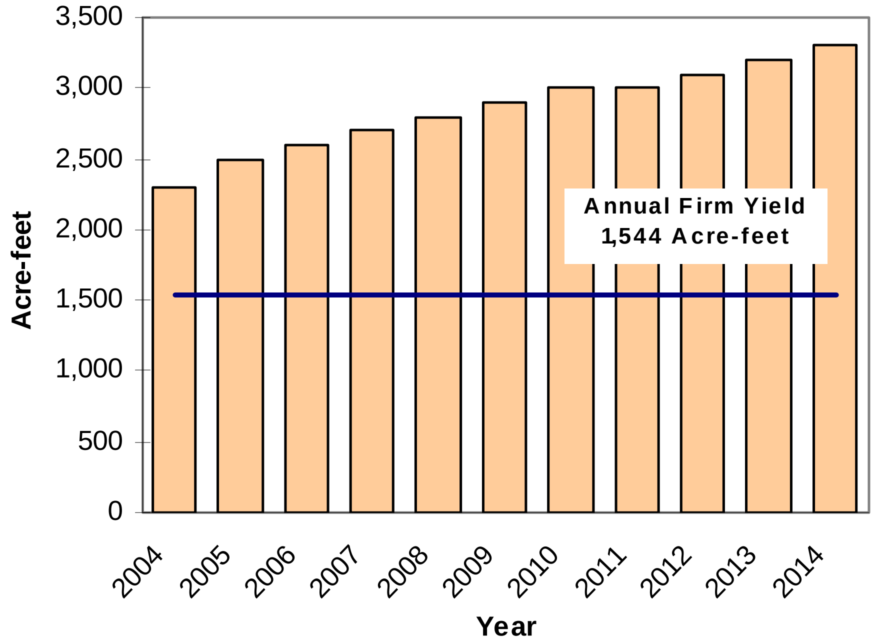
For some Participants, firm supply and demand projections indicate a near-term shortage. However, this shortage is based on dry year conditions and average yields may be adequate to meet current demands, particularly in consideration of available C-BT supplies and reuse water.

The existing firm supply (including the long-term yield for C-BT) and projected future demand as described in this analysis provide the best available estimate of anticipated shortages in firm yield. To the extent that there are shortages, Participants will need to acquire or develop other sources of water. Firming the yield of the Windy Gap Project would contribute to meeting projected water needs. The remaining water shortage could be met by developing additional water sources along with additional water conservation measures.

Water Needs

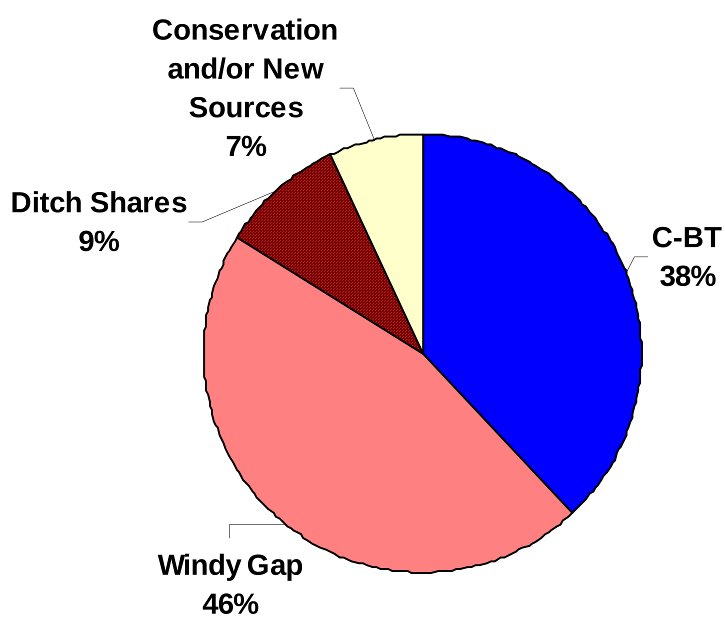
Potable demands are currently met by C-BT water and Windy Gap water when available. Non-potable supplies from the FRICO ditch and reuse of Windy Gap effluent have been used to meet irrigation requirements. By buildout in 2014, a firm water supply shortage of about 1,800 AF is anticipated if the Windy Gap Firming Project is not completed (Figure N-1). Firming Superior's Windy Gap water supply would provide 1,500 AF of water, or about 46 percent of the Town's 2014 water supply (Figure N-2). Reuse of about 32 percent of Windy Gap water would also contribute to meeting future non-potable water demand. Water conservation and other sources of water supply also will be needed to meet future water demands.

Figure N-1. Superior's 2005 Annual Firm Yield vs. Total Projected Water Requirements.[1]



[1] The Report does not include reuse water as a part of Superior's firm yield.

Figure N-2. Superior's 2014 Projected Firm Water Supply Sources.



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Vranesh and Raisch. 2004b. Vranesh and Raisch Letter Regarding: Town of Superior/Windy Gap Firming Project, from P. Zilis to E. Harvey, Nov. 2004. Attachment II.