CITY OF LONGMONT

RAW WATER MASTER PLAN UPDATE

- EXECUTIVE SUMMARY -

Prepared for:

CITY OF LONGMONT
1100 South Sherman Street
Longmont, Colorado 80501

Prepared by:

TETRA TECH RMC
1900 South Sunset Street, Suite 1-F
Longmont, Colorado 80501

Tetra Tech RMC Job No. 43-0033.242.00

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1.0 INTRODUCTION

In December 1990 Rocky Mountain Consultants, Inc. (RMC), now Tetra Tech RMC, completed a Raw Water Master Plan for the City of Longmont (Longmont). More than a decade has passed since then - a period of significant growth and changes including, among many other developments, completion of a pipeline to deliver C-BT water directly to Longmont year-round, significant recent progress toward developing terminal storage for the Windy Gap Project, and changes of water rights for Longmont's use. This Raw Water Master Plan update (RWMP) is intended to serve as a guide for the development of Longmont's raw water resources system through buildout of the Longmont Planning Area (LPA). Rather than recommend the pursuit of certain projects, the plan presents and analyzes alternative projects and provides guidelines for on-going further evaluation of those alternatives to determine whether they meet Longmont's goals for its water supply system. The goals and policies (collectively the Guiding Water Principles) formulated by the City staff and Water Board for this RWMP are listed in Table 1.

Table 1

City of Longmont Guiding Water Principles

	Statement of Goal	*Policy Statement*
Goal 1	The City will acquire and maintain a raw water supply sufficient to meet the water demands of the City at full build-out of the Longmont Planning Area during a drought with a 1 in 100 year recurrence interval.	The City will maintain diligence on conditional water supply projects. The City will continue to meet its Raw Water Quality of Life Benchmark. The City will continue to pursue efforts to maintain and improve the yields of its water rights and interests in regional water projects.
Goal 2	The City will maintain and enforce a Raw Water Requirement Policy that is consistent with other polices adopted by the city, and that support the attainment of the other goals stated in this document.	The City will continue to consistently apply the Raw Water Requirement Policy to all new development in the City. The City will continue to revise the Raw Water Policy as necessary to meet the water supply needs of the City
Goal 3	The City will acquire, develop, and beneficially use a water supply that consists of water rights in the South Platte and Colorado River basins.	The City's water supply will continue to be composed approximately one-third from the Colorado Big Thompson and Windy Gap projects with the balance from St. Vrain and Left Hand basin water rights.
Goal 4	The City will pursue policies that develop and maintain a high quality raw water supply for delivery to treatment facilities either directly or by exchange.	The City will place highest priority on development and maintenance of water originating in high mountain watersheds, and the storage of that water in mountain reservoirs. The City will integrate other sources of supply, giving highest priority to exchanges. The integration of such supplies into the treatment system will take place as demand requires and when technology of treatment evolves to allow for high quality potable water at reasonable treatment costs.
Goal 5	The City will pursue policies that promote the retention and preservation of water supplies that originate in the St Vrain Basin for use within the St. Vrain Valley.	The City will work cooperatively with the St. Vrain and Left Hand Water Conservancy District and local irrigation companies and water districts to develop and implement strategies that result in the preservation, retention, and use of native water supplies.

Table 1 (cont.)

City of Longmont Guiding Water Principles

	Statement of Goal	*Policy Statement*
Goal 6	The City will pursue policies that will protect and improve the quality of the water supplies in the St. Vrain Creek watershed.	The City will continue to develop and implement watershed protection programs, actively participate in implementing projects and programs that improve the water quality of storm water discharges, and discharges from the Wastewater Treatment Plant that are within the Total Maximum Daily Loading of the St. Vrain Creek.
Goal 7	The City will develop and implement a water conservation policy that strives to achieve a sustainable use of its water resources.	The City will strive to achieve water conservation that results in water demands at build out of the Longmont Planning Area that are 10 percent lower than current projections. The City will pursue water development that does not rely on the dry up of agricultural lands.
Goal 8	The City will pursue water policies and operations that minimize adverse environmental impacts.	The City will independently and in partnership with other agencies and organizations evaluate the environmental impacts of water development projects and operate the City's water resource facilities to minimize adverse environmental impacts while not unreasonably diminishing the yield of the City's water supplies.
Goal 9	The City will pursue water policies and operations that promote multiple uses of water.	The City will manage it's water resources with the primary goal of meeting the domestic water needs of its customers while also striving to provide for other water uses such as recreational, agricultural, and environmental.
Goal 10	The City will develop a strategy of flexibility in raw water supply that will enable it to respond to changes in supply and demand conditions.	The City will continue to acquire, develop and operate its water supply to provide for the necessary redundancy, flexibility and capacities to address potential changes in climate, system and operational failures, and changes in water demands while maintaining a reliable water supply.
Goal 11	The City will consider regional supply and treatment partnerships and agreements that complement and support other regional goals of the City and clearly benefit the citizens of Longmont.	The Longmont Municipal Charter, Section 11.1, allows the City to provide extraterritorial water service provided the agreements or contracts clearly benefit the inhabitants of the City.
Goal 12	The City will develop strategies to meet the above goals in the most economically beneficially manner for the citizens of Longmont.	The City will continue to evaluate the costs and benefits of all water development strategies and seek to meet the water needs of the community using favorable financing options, encouraging water conservation, efficient project designs, and partnering in regional water projects were appropriate.

1.1 Background

The purpose of the 2003 Raw Water Master Plan update (RWMP) is to re-examine Longmont's raw water supplies and demands, updating them from the 1990 work, and to make recommendations for the continued development of the raw water system. Since considerable growth has taken place subsequent to the 1990 RWMP being completed and since Longmont is quickly approaching the build-out of the Longmont Planning Area (LPA), this RWMP is proposed to examine how Longmont's system can be expanded to meet the demands of the City through build-out of the LPA.

Certain assumptions were made in the conduct of this RWMP, including the current LPA as the limit for future development, no increase in the density of existing development, no new significant industrial users, no significant changes in the regulatory or physical climate affecting the yield of Longmont's water rights, and others. Key assumptions include:

1. **LPA Basis for Plan:** The current LPA, as amended by the 2003 proposed amendments to the Longmont Comprehensive Plan, is used for the limit of future development. Provision of service will primarily occur only in the LPA service area. Longmont will continue to apply the Raw Water Requirement Policy to all new development and annexations in the LPA. As that policy is applied, the current ratio of non-historic water vs. cash-in-lieu will remain the same.

2. **Development Rate:** Development through buildout of the LPA will occur as planned for in the 2003 Comprehensive Plan.

3. **In-fill:** In-fill of undeveloped lands similar to existing development only, i.e. no increase in the density of existing development and no re-development of existing property.

4. **Water Consumption Rate:** Future customers will use water at a demand ratio that is similar to the existing customers at the time of this update.

5. **Industrial users:** No new significant industrial users, not previously identified, will be added to the system. For those users that may create a demand greater than 3 acre-feet per acre, the Raw Water Requirement Policy will be applied to obtain the additional supply needed.

6. **Transbasin Water:** No significant change in C-BT or Windy Gap system operation, yield or allocation of water will occur.

7. **Regulatory Climate and Laws:** No significant changes in the regulatory climate that might affect the yield of the water rights in Longmont's portfolio, or might affect operation of new or existing raw water storage facilities will occur. Also, no significant changes in federal laws, administration of current laws or federal requirements for environmental releases of water.

8. **Climatic Change:** There will be no significant climatic change that might adversely affect supplies or demands.

9. **Operational Criteria:** The analysis of Longmont's water supply system and its ability for meeting future demands was completed using a typical operation of the water rights portfolio and raw water facilities. It was also assumed that a reasonably perfected daily application of water rights in priority would occur at all times.

10. **SEO administration:** No significant revisions to administration policy by the State Engineers Office.

11. **Non-Potable Water:** No new consumptive uses of water for non-potable purposes such as in-stream flows, recreational uses, bulk system interconnects, etc. will occur that are not achievable through operational flexibility.

1.2 System Description

Longmont's sources of raw water 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 resources include ownership in many mutual and private ditch and reservoir companies. Colorado River basin resources consist of ownership in two trans-mountain diversion systems, the Colorado-Big Thompson (C-BT) Project, and the Windy Gap Project. A complete listing of Longmont's current portfolio of water rights as of March 2002 is included in the RWMP at Table 4.1.

In order to utilize the water rights described above, Longmont has developed a system of storage, diversion, conveyance and treatment facilities. Storage reservoirs include Ralph Price Reservoir, Pleasant Valley Reservoir (a/k/a Terry Lake), McCall Lake, Oligarchy Reservoir No. 1 (a/k/a Burch Lake), Clover Basin Reservoir, and Union Reservoir. Diversion and conveyance facilities include the North and South Pipelines, diversion structures at the St. Vrain Supply Canal, Supply Ditch, Highland Ditch, Rough & Ready Ditch, Palmerton Ditch and Oligarchy Ditch headgates on St. Vrain Creek, and the C-BT and Highland Ditch pipelines. Water treatment plants include the North and South plants near Lyons, the Wade Gaddis plant near Hygiene, Colorado, and a planned new water treatment plant to be located north of St. Vrain Creek in Dowe Flats on land recently acquired from Cemex.

1.3 Drought Planning

With the 1990 Raw Water Master Plan, Longmont established the 1-in-100 year drought as the basis for planning the development of its water supply. The Water Resources Quality of Life Benchmark also incorporates this drought as the hydrologic basis for evaluation of the municipal water supply. Other Front Range area municipalities were contacted and generally report using the 1-in-100 year, the 1-in-50 year drought, or the historical 1950's drought (estimated by Tetra Tech RMC to be a 1-in-50 year drought) for planning purposes.

The 1-in-100 year drought used for Longmont's water supply planning is simulated by combining historical dry years. The result is a drought that is seven years in length and consists of the years 1953, 1954, 1955, 1974, 1968, 1967 and 1929 in that order. Table 2 shows the annual virgin flow of St. Vrain Creek at Lyons and percentage of the average annual virgin flow for each year of the simulated 1-in-100 year drought based on an average annual virgin flow of 122,800 acre-feet (1896 through 2002).

Table 2

Simulated 1-in-100 Year Drought

Drought Year	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Historic Year	1953	1954	1955	1974	1968	1967	1929
Virgin Flow (ac-ft)	91,700	47,200	71,000	92,300	95,900	105,700	120,800
Percent of Average	75%	38%	58%	75%	78%	86%	98%

1.3.1 2000 to 2002 Drought

The 2002 water year (October 2001 through September 2002) was the single worst drought year recorded in the St. Vrain Basin and throughout most if not all of the drainages in the State. The virgin flow of St. Vrain Creek was only 45,000 acre-feet or not quite 37 percent of the 1896 through 2002 average of 122,800 acre-feet. Gage flows for May, June, July and September 2002 were the lowest ever recorded. The recent drought actually began with the 2000 water year and so had a duration of three years. Various climatological experts have estimated that statewide the 2002 runoff was on the order of a 1-in-300 year (or maybe even greater) event. This means that the probability of occurrence of this type event in any one year would be much less than one percent. Individual basins may have experience more or less severe conditions.

While 2002 was an extraordinarily dry year, Longmont's water supply system performed very well. If the drought had continued, or if it had begun with more severe years than 2000 and 2001, Longmont's water supply capability would have been put to a much tougher test. The 100-year drought used in the 1990 RWMP and in this update contains a three year period (1953, 1954 and 1955) which in total was much more severe than the three years of recent experience. Of those years, 1954 was also an extremely dry year, with a virgin flow estimated at 47,200 acre-feet, or only five percent better than 2002. Thus the design drought includes a year nearly comparable to 2002. It is still appropriate that the seven year long, 1-in-100 year drought be used as the basis for evaluating Longmont's water supply capability.

2.0 RAW WATER DEMAND DEVELOPMENT

2.1 Population Growth Projection

The 1990 Raw Water Master Plan was based on a projection of population growth developed for the 1989 Treated Water Master Plan. The 1989 Treated Water Master Plan projected populations of 68,600 at 2000, 84,900 at 2010 and an ultimate buildout service population[1] of 120,900 projected to occur between 2010 and 2045 depending on the rate of growth. The table below compares the actual and 1989 projected service populations through 2000.

Table 3

Comparison of 1989 TWMP Projected Service Populations To Actual

Year	*1990*	*1995*	*2000*	*2005*	*2010*
1989 Projection	54,500	61,200	68,600	74,000	84,900
Actual	52,385	58,030	74,150	n/a	n/a

The February, 2000 update of Longmont's Treated Water Master Plan (2000 TWMP) presented a revised population projection based on historical growth data and a consideration of the amount of remaining undeveloped land within the LPA available for residential habitation versus non-

[1] Service population includes residents in the City of Longmont municipal boundary plus additional population served outside that boundary.

residential development. Table 4 shows the 2000 TWMP population projection through buildout expected to be at 2048. Though the 2005 population is greater than in the 1989 Treated Water Master Plan, the 2010 through buildout populations are smaller. This reflects the recent high growth rate, and the limited amount of undeveloped land in the LPA.

Table 4

2000 TWMP Population Projections through Buildout of the LPA

Year	*2000*	*2005*	*2010*	*2015*	*2020*	*2025*	*2028*	*2048*
Population	70,218	79,910	83,816	88,684	93,657	103,405	108,000	108,000

According to the 2000 census, completed after the 2000 TWMP, Longmont's population was 73,344 with an additional 801 population served outside of the city limits for a total service population of 74,145. The 2000 TWMP population projection was modified for the RWMP because of recent estimates of population growth, a revised estimate of City population at buildout of the LPA, and a revised estimate of water use at Amgen.

Following the 2000 census, the Longmont Planning Division has determined the year-end population for 2000 at 73,344 and has estimated the 2001 and 2002 year-end populations at 76,098 and 77,328 respectively. These populations are significantly higher than projected in the 2000 TWMP. This indicates that the populations shown in the 2000 TWMP may be reached sooner than projected.

For purposes of the RWMP a revised population projection is proposed. The revised projection uses the same population growth rates as in the 2000 TWMP but starts with a 2002 population of 77,328. The RWMP population projection also includes an estimated 1,000 customers served with treated water who are located outside the Longmont city limits. The revised RWMP population projection, which is shown in Table 5, is also based on a more recent projection of population at build-out of the LPA of 103,000. With the additional 1,000 population served outside of the City, the buildout service population is projected to be 104,000. Because of recent high growth and the reduced ultimate population it is estimated that the residential build-out will occur at approximately 2024, four years earlier than was projected in the 2000 TWMP.

Table 5

City of Longmont Revised RWMP Population Projection

Year	*2000*	*2005*	*2010*	*2015*	*2020*	*2025*	*2026*	*2048*
Population	74,150	84,140	88,050	92,970	97,890	104,000	104,000	104,000

2.2 Raw Water Demand Projection

It is anticipated that the revised Comprehensive Plan will show less undeveloped area in the Longmont Planning Area and in the Municipal Service Area than was the basis of the 2000 TWMP

water demand projection. We recommend that the water demand projections presented in this report be used for water supply planning purposes until the revised Comprehensive Plan is adopted and a detailed analysis of potential business development can be completed.

Future water use for the RWMP was determined based on Tables 3-4 and 3-5 of the 2000 TWMP, with some modifications, and then adjusted to account for the revised population projection described in Section 2.1 and a more recent projection prepared and provided by Amgen. Examination of Longmont water use records shows that treated water demands increase by an average of 5 percent (on an annual basis) during years in which summer time precipitation is low.

Table 6 shows the projected average annual treated water demand by category and the total raw water demand rounded to the nearest 10 acre-feet per year used for the RWMP. Table 7 shows a yearly estimate of service population, water treatment plant output and raw water diversions required for that demand. The raw water demand values shown in Table 7 are the average year demands, not dry year demands.

Table 6

RWMP Projected Treated and Dry Year Raw Water Demands
(acre-feet per year)

	Treated Water Demands							*Raw Water Demands*	
Year	*Single-Family*	*Multi-Family*	*Business*	*WWTP*	*Parks*	*Total (note 1)*	*Dry Year (note 2)*	*Total (note 3)*	*Dry Year Total (note 4)*
2010	11,880	2,970	5,890	110	340	21,190	22,250	22,310	23,420
2015	12,520	3,130	6,630	110	340	22,720	23,860	23,920	25,120
2020	13,210	3,300	7,570	110	340	24,520	25,750	25,810	27,110
2025	14,770	3,690	8,830	110	340	27,740	29,130	29,200	30,660
2030	15,000	3,750	10,620	110	340	29,810	31,300	31,380	32,950
2035	15,000	3,750	11,890	110	340	31,080	32,630	32,720	34,350
2040	15,000	3,750	12,850	110	340	32,040	33,640	33,730	35,410
2045	15,000	3,750	13,910	110	340	33,100	34,760	34,840	36,590
2048	15,000	3,750	14,600	110	340	33,800	35,490	35,580	37,360

Notes:

1 *Treated Water Demands - Total* is rounded from actual value, not sum of rounded values for categories shown in table

2 *Treated Water Demands - Dry Year* is *Treated Water Demands Total* times 1.05

3 *Raw Water Demand Total* is *Treated Water Demands Total* divided by 0.95

4 *Raw Water Demand Dry Year Total* is *Treated Water Demands Dry Year Total* divided by 0.95

Table 7

Adopted RWMP Treated and Raw Water Demands
For the Water Treatment Plants
(acre-feet per year)

Year	*Service Population*	*Total WTP Output*	*Total Raw Water Demand (note 1)*	*Year*	*Service Population*	*Total WTP Output*	*Total Raw Water Demand (note 1)*
2010	88,050	21,190	22,310	2030	104,000	29,810	31,380
2011	89,030	21,500	22,630	2031	104,000	30,065	31,650
2012	90,020	21,800	22,950	2032	104,000	30,320	31,920
2013	91,000	22,110	23,270	2033	104,000	30,570	32,180
2014	91,980	22,410	23,590	2034	104,000	30,830	32,450
2015	92,970	22,720	23,910	2035	104,000	31,080	32,720
2016	93,950	23,080	24,290	2036	104,000	31,270	32,920
2017	94,940	23,440	24,670	2037	104,000	31,470	33,120
2018	95,920	23,800	25,050	2038	104,000	31,660	33,330
2019	96,900	24,160	25,430	2039	104,000	31,850	33,530
2020	97,890	24,520	25,810	2040	104,000	32,040	33,730
2021	99,680	25,170	26,490	2041	104,000	32,260	33,950
2022	101,470	25,810	27,170	2042	104,000	32,470	34,180
2023	103,270	26,450	27,840	2043	104,000	32,680	34,400
2024	104,000	27,090	28,520	2044	104,000	32,890	34,620
2025	104,000	27,740	29,200	2045	104,000	33,100	34,850
2026	104,000	28,190	29,670	2046	104,000	33,330	35,090
2027	104,000	28,640	30,140	2047	104,000	33,570	35,330
2028	104,000	29,090	30,620	2048	104,000	33,800	35,570
2029	104,000	29,450	31,000				

Notes:

1 *Total Raw Water Demand* is *Total WTP Output* divided by 0.95

2 Raw water demands are average year demands. Drought modeling considers a five percent in increase in demand as a result of less than average precipitation. Modeling may also incorporate a demand reduction due to water use restrictions or other conservation techniques. A 10 percent reduction may be applied to the figures above during specific years of the 1-in-100 year drought as described in Section 2.2.

2.3 Raw Water Supply Agreements

In addition to its own demands, Longmont has agreements to supply raw water to others. A 2002 agreement with Public Service Company of Colorado (PSCo) provides that PSCo trades 2,000 to 3,500 C-BT units to Longmont in exchange for "*an equivalent amount of fully consumable water.*" Longmont is to provide this water at the Fort St. Vrain Generating Station near the confluence of St. Vrain Creek and the South Platte River. For purposes of this plan the demand at Fort St. Vrain is based on 3,500 units at the annually declared quota for each of the drought years, and at a constant amount each month.

Longmont has also performed an exchange for C-BT water with South Platte River ditch companies in the past. It is unknown whether or when the opportunity for such a trade might arise again, therefore, this analysis does not include this demand.

Finally, Longmont and PSCo have an exchange agreement whereby Longmont supplies water to the Fort St. Vrain Generating Station in exchange for the use of PSCo water rights decreed from St. Vrain Creek near Lyons. The exchange agreement provides for a one for one trade based on the average annual transferable yield of the four ditch rights. Though not yet decreed by the Water Court, based on RMC's analysis the total transferable yield is estimated to be approximately 528 acre-feet per year. For purposes of this RWMP the total PSCo demand is modeled as 528 acre-feet distributed over the May through September period according to the distribution of the average positive historical net stream depletions based on Tetra Tech RMC's analysis for the change of those water rights.

2.4 Raw Water Irrigation Demands

Two municipal golf courses and a number of Longmont's parks are irrigated with raw water using agricultural water rights. For purposes of this RWMP, it is assumed that the irrigation water normally provided for parks will continue to be used in the future. As new land within the LPA is annexed and developed for parks, it is assumed that a proportional amount of the historic water rights will be assigned to those lands. In general, we project that 10 percent of historic water rights to be acquired through the Raw Water Requirement Policy will be provided for irrigation use at parks.

3.0 WATER RIGHTS INVENTORY

Longmont's inventory of water rights has grown through construction of projects, purchase of water rights and through water acquired via the Raw Water Requirement Policy. Examples of construction include the North and South St. Vrain Creek Pipelines, McCall Lake, Ralph Price Reservoir and the Windy Gap Project. Purchases include shares in the Longmont Supply and Palmerton Ditches, Bluebird, Pear and Sandbeach Reservoirs, C-BT Project units, and a majority interest in Union Reservoir in 1986.

Longmont's Raw Water Requirement Policy specifies that new development transfer all historic irrigation water rights used on that land to the City, and specifies that a minimum of three acre-feet per acre be provided. Of this amount, at least one acre-foot must be from storage water rights. Non-historic water rights and cash in lieu of historic water rights are accepted by Longmont. The cost of cash in lieu of water rights is based on the cost per acre-foot for C-BT water as modified from time to time by the Longmont Water Board. Typically, funds from cash in lieu of water rights have been used to purchase C-BT units, or other water rights such as Union Reservoir shares. Since its adoption in 1964 the Raw Water Requirement Policy has provided Longmont with a significant portfolio of water rights.

3.1 2002 Water Rights Portfolio

Longmont's portfolio of water rights includes direct flow and storage rights, native and trans-basin rights, and municipal and irrigation rights. Many of Longmont's rights have been changed from irrigation to municipal use during the period 1981 through 2002, while some remain unchanged and are thus only available for irrigation. The full RWMP report lists Longmont's water rights ownership as of March 8, 2002.

3.2 Projected Water Rights Portfolio at LPA Buildout (2048)

As Longmont continues to grow, additional water rights will be obtained through application of the Raw Water Requirement Policy. City staff has estimated the number of shares of the various historical water rights that Longmont will obtain from currently undeveloped land through buildout of the LPA. The full RWMP report lists the complete portfolio of water rights Longmont anticipates owning at buildout of the LPA. With a few exceptions, ten percent of the water rights projected to be obtained through buildout of the LPA are assumed to be for raw water irrigation of new parks, schools and open spaces.

3.3 Raw Water Deficit at LPA Buildout

During its estimation of water rights ownership at buildout of the LPA, Longmont staff also determined that the historical water rights to be obtained through the Raw Water Requirement Policy would provide less than the required three acre-feet per acre. According to the staff projection, at buildout there will be a deficit of approximately 4,990 acre-feet associated with new development.

4.0 ANALYSIS OF EXISTING SUPPLIES TO MEET FUTURE DEMANDS

A Microsoft Excel spreadsheet computer model was used to simulate the use of Longmont's raw water resources during the design drought using the existing portfolio of rights as described in Section 3. The model considers a nine-year span of time including one average year followed by seven years of the 1-in-100 year drought described in Section 1, followed by one more average year. The early version of the model was developed during Phase I of this RWMP to perform a preliminary evaluation of the firming of Windy Gap units. It was also employed during the development of Longmont's Water Resources Quality of Life benchmark. It has been significantly upgraded during this effort to include additional capability and to consider additional water rights not included in early versions.

The existing water rights portfolio and existing reservoir capacities were evaluated to determine the municipal demand (along with the contractual demand and return flow replacement obligations) that can be supported through the 1-in-100 year design drought. This portfolio does not include any firmed Windy Gap, but does allow use of unfirmed Windy Gap units. It also assumes that the currently planned pump station from St. Vrain Creek to Union Reservoir is completed and available for use.

Results from the analysis indicate that the 2002 water rights portfolio (including the Xcel C-BT trade at 3,500 units and growth of the portfolio through the Raw Water Requirement Policy), Longmont's current storage capacities, and the soon to be constructed St. Vrain Creek/Union Reservoir Pump Station, are capable of being used to meet Longmont's projected growth and its corresponding water supply needs through 2025 (with a demand of 30,660 acre-feet), including a seven year drought during 2018 through 2024. This period includes the projected point of buildout of the residential development. Thus, the system is adequate to meet Longmont's needs through a 1-in-100 year drought starting 15 years in the future (2018), and exceeds the Quality of Life benchmark for raw water that requires adequacy of the existing system ten years in the future.

Projected demands forecast to occur beyond 2025 exceed Longmont's ability to provide water with the existing system, and additional supplies and/or facilities are required.

5.0 ALTERNATIVE SUPPLIES

This section presents alternatives evaluated for increasing Longmont's water resources system yields sufficiently to meet its projected demands through buildout of the LPA. A number of structural and non-structural elements are examined and given a preliminary evaluation as to their benefits, costs and social impacts. For a detailed discussion of each structural and non-structural element, the reader is referred to the full RWMP report.

5.1 Structural Plan Elements

Individual physical facilities built to improve water supply are referred to as *structural plan elements.* The recent drought has refocused attention on the need for storage to sustain supplies in times of severe shortage. Longmont has two principal storage reservoirs, Ralph Price Reservoir located upstream of Longmont, and Union Reservoir located downstream of Longmont. Longmont is also participating in studies regarding the construction of a new reservoir to store Windy Gap water. This section considers the potential for additional storage and yield at those three facilities. Also considered is a pipeline to deliver raw water from Union Reservoir to the new water treatment plant.

5.1.1 Ralph Price Reservoir Enlargement (Button Rock Dam Raise)

In a 1987 report, Woodward-Clyde described the feasibility of raising Button Rock Dam to increase the storage capacity at Ralph Price Reservoir. The study examined four dam raises consisting of 40 feet, 70 feet, 100 feet and 130 feet and presented the most feasible method of accomplishing the dam raise with earth and rock fill for the main dam and roller compacted concrete for saddle dams. For purposes of this RWMP a minimal 20-foot dam raise was also considered. Longmont owns sufficient water rights for raises up to and including the 100-foot raise, and owns land sufficient for up to the 70-foot raise. Table 8 summarizes firm yields and the cost per acre-foot of firm yield associated with each dam raise. Costs were inflated from the 1987 Woodward-Clyde estimates based on the Bureau of Reclamation's Construction Cost Trends index for earth dam construction.

Table 8

Ralph Price Reservoir Enlargement - Costs and Firm Yield Estimates

Raise (ft)	*2003 Total Cost*	*Firm Yield (ac-ft/yr)*	*Cost per Acre-Foot Of Firm Yield*
20	$25,100,000	2,410	$10,410
40	$33,100,000	4,560	$7,260
70	$61,300,000	7,090	$8,650
100	$95,400,000	8,950	$10,660
130	$144,600,000	9,750	$14,830

5.1.2 Union Reservoir Enlargement

In a 1986 report, RMC described the feasibility of raising Union Reservoir Dam to increase the storage capacity at Union Reservoir. The study examined two dam raises consisting of 13 feet and 20.5 feet adding 12,005 and 19,862 acre-feet of storage capacity respectively. For purposes of the RWMP, a 15-foot raise was also considered. Based on the results of analysis using the spreadsheet system model a 4,000 acre-foot enlargement (roughly a five foot dam raise) is also proposed. Costs for the 4,000 acre-foot enlargement have not been evaluated independently and are estimated at $1,500 per acre-foot (2003 dollars) based on the costs of the larger alternatives. The Bureau of Reclamation's Construction Cost Trends index for earth dam construction (CCT) was used to inflate 1986 construction cost estimates to 2003 dollars. Table 9 summarizes firm yields and costs associated with each dam raise.

Table 9

Union Reservoir Enlargement - Firm Yield Estimates

Raise (ft)	*2003 Total Cost*	*Firm Yield (ac-ft/yr)*	*Cost per Acre-Foot Of Firm Yield*
5	$6,000,000	670	$8,960
13	$14,600,000	1,770	$8,250
15	$15,800,000	2,040	$7,750
20.5	$19,300,000	2,760	$6,990

If this element is pursued, we recommend that the construction be planned for the smallest enlargement that benefits Longmont's municipal use, the 4,000 acre-foot expansion, but constructed in such a way as to allow for a further raise or partnering should future conditions warrant. Raises beyond 5 feet could be accomplished through partnering with others, and we recommend that Longmont explore those options. We also recommend that further studies be completed to determine the extent to which additional storage space at Union Reservoir could be used to firm any unfirmed Windy Gap units after construction of the new Windy Gap storage reservoir (see Section 5.1.3).

5.1.3 Windy Gap Project Storage

When the Windy Gap Project (a/k/a Six Cities Project) was conceived it was intended to provide a yield of 100 acre-feet per unit per year of fully consumable transmountain water. However, because the project's water rights are very junior, and because it shares storage and conveyance facilities with the Colorado-Big Thompson Project, Windy Gap is prone to periods of low yield due to being out-of-priority and having previously stored water spilled from the C-BT reservoirs. During severely dry years the yield is nearly zero.

The present owners of the project are participating in studies to develop new storage to firm up the yield of a portion of the project units. Longmont is participating at a level of 10,000 to 16,000 acre-feet expected to provide firming for 30 to 50 units depending on the final ratio of new project storage to firm yield. Table 10 summarizes the project costs and firm yields.

Table 10

Windy Gap Firming Project - Cost and Firm Yield Estimates

Units Firmed	*Storage Capacity (ac-ft)*	*Increased Firm Yield* [1]	*Storage Cost* [2]	*Capitalized O&M Cost* [3]	*Total Cost*	*Cost per Acre-Foot* [4]
30	10,000	2,560	$20,000,000	$2,250,000	$22,250,000	$8,690
50	16,000	4,260	$32,000,000	$3,750,000	$35,750,000	$8,390
80	26,400	6,820	$52,800,000	$6,000,000	$58,800,000	$8,620

Notes:

1 *Increased Firm Yield* based on 85.2 acre-foot increase per firmed unit

2 *Storage Cost* based on $2,000 per acre-foot.

3 *Capitalized O&M Cost* based on $65 per acre-foot per year over 50 years at 7 percent = $880 per acre-foot present value.

4 See discussion of reuse and reduction in cost per acre-foot below. Differences in table values from $8,630 reported in text are due to rounding and slightly different ratio of storage to yield for 50 units versus 30 or 80 units.

5.1.4 Union Reservoir Pipeline

The final structural element considered in this study is the Union pipeline. Water would be pumped from Union Reservoir through a pipeline to the new water treatment plant to be located near Dowe Flats. Two capacities are considered, 10-cfs and 20-cfs. For the 10-cfs option a significant length of existing treated water transmission pipeline in Highway 66 would be converted to raw water transmission, at considerable cost savings. Table 11 shows the estimated project cost and firm yields.

Table 11

Union Pipeline - Cost and Firm Yield Estimates

Capacity (cfs)	*2003 Total Cost*	*Firm Yield (ac-ft/yr)*	*Cost per Acre-Foot Of Firm Yield*
10	$18,800,000	4,950	$3,800
20	$36,100,000	7,180	$5,030

It appears that the increased benefit from pumping is reduced for capacities above 12 cfs. Therefore, because of hydraulic considerations in the existing pipe, 10 cfs appears to be the practical limit of pipeline capacity.

5.1.5 Summary of Structural Alternatives

Four structural alternatives have been described including enlargements of Ralph Price Reservoir and Union Reservoir, completion of the Windy Gap firming project reservoir, and construction of a pipeline from Union Reservoir to Longmont's planned water treatment plant at Dowe Flats. Table 12 shows a comparison of the structural alternatives including their capital costs, present values of future operating costs, yields and total costs per acre-foot of yield. The results show that the 10-cfs capacity Union pipeline at $3,800 per acre-foot and the 20-cfs Union pipeline at $5,030 are the most

economical alternatives. These are followed by closely bunched alternatives including two Button Rock Dam raises, the Union Reservoir enlargements and Windy Gap firming at $8,000 to $9,000 per acre-foot. If reuse is considered the Windy Gap alternatives become the second cheapest at approximately $5,330 per acre-foot of firm yield.

Table 12

Comparison of Structural Plan Elements

Element	*Sub-Element*	*2003 Total Cost*	*Firm Yield (ac-ft/yr)*	*Cost per Acre-Foot of Firm Yield*
Button Rock Dam Raise	20-feet	$25,100,000	2,410	$10,410
	40-feet	$33,100,000	4,560	$7,260
	70-feet	$61,300,000	7,090	$8,650
	100-feet	$95,400,000	8,950	$10,660
	130-feet	$144,600,000	9,750	$14,830
Union Dam Raise	5-feet	$6,000,000	670	$8,960
	13-feet	$14,600,000	1,770	$8,250
	15-feet	$15,800,000	2,040	$7,750
	20.5-feet	$19,300,000	2,760	$6,990
Windy Gap Firming Res.	30 units	$22,250,000 [1]	2,560	$8,630 [2]
	50 units	$35,750,000	4,260	$8,630
	80 units	$58,800,000	6,820	$8,630
Union Res. Pipeline	10-cfs	$18,800,000 [2]	4,950	$3,800
	20-cfs	$36,100,000	7,180	$5,030

Notes:

1 Windy Gap Firming Reservoir costs include $2,000 per acre-foot capital construction costs and $880 per acre-foot capitalized annual operation and maintenance costs.

2 With reuse of 62 percent, the Windy Gap cost per acre-foot drops to approximately $5,330 per acre-foot.

3 Union Reservoir Pipeline costs include $6,800,000 capital construction costs, $2,000,000 capitalized annual operation costs, and $10,000,000 treatment costs for the 10-cfs pipeline, and $12,200,000 capital construction costs, $3,900,000 capitalized annual operation costs, and $20,000,000 treatment costs for the 20-cfs option.

While the cost per acre-foot of firm yield can be used to compare relative values on a project basis, the real measure of value is the ability of the project to increase the overall performance of Longmont's water supply system in the 100-year drought. Table 13 shows the increase in Longmont's overall water supply capability considering the addition of each of the structural plan elements described in Section 6.1 and the cost per acre-foot of each on that basis. As shown in Table 13, the 10-cfs Union Pipeline alternative at $4,810 per acre-foot is still the cheapest on a system yield increase basis. This is followed by Windy Gap firming at $8,260 to $8,880 per acre-foot, the 20-cfs Union pipeline at $9,230 per acre-foot and then by the five-foot Union enlargement and the 40-foot raise of Button Rock Dam at $12,240 to $12,880 per acre-foot respectively.

Table 13

Summary of Effect of Structural Plan Elements on System Yield

Element	*Sub-Element*	*2003 Total Cost*	*Increased System Yield (ac-ft/yr)* [1]	*Cost per Acre-Foot of Increased Yield*
Button Rock Dam Raise	20-feet	$25,100,000	990	$25,350
	40-feet	$33,100,000	2,570	$12,880
	70-feet	$61,300,000	4,330	$14,160
	100-feet	$95,400,000	6,700	$14,240
	130-feet	$144,600,000	6,700	$21,600
Union Dam Raise	5-feet	$6,000,000	490	$12,240
	13-feet	$14,600,000	490	$29,800
	15-feet	$15,800,000	490	$32,240
	20.5-feet	$19,300,000	490	$39,390
Windy Gap Firming Res.	30 units	$22,250,000 [2]	2,570	$8,660
	50 units	$35,750,000	4,330	$8,260
	80 units	$58,800,000	6,700	$8,880
Union Res. Pipeline	10-cfs	$18,800,000 [3]	3,910	$4,810
	20-cfs	$36,100,000	3,910	$9,230

Notes:

1 Increased System Yield is the difference between the greatest annual municipal demand that can be satisfied with the particular structural plan element/sub-element in place versus the baseline demand that the existing system can satisfy of 30,660 acre-feet per year.

2 Windy Gap Firming Reservoir costs include $2,000 per acre-foot capital construction costs and $880 per acre-foot capitalized annual operation costs.

3 Union Reservoir Pipeline costs include $6,800,000 capital construction costs, $2,000,000 capitalized annual operation costs, and $10,000,000 treatment costs for the 10-cfs pipeline, and $12,200,000 capital construction costs, $3,900,000 capitalized annual operation costs, and $20,000,000 treatment costs for the 20-cfs option.

5.2 Non-Structural Plan Elements

Non-structural plan elements are individual means of improving water supply without constructing of physical facilities. Non-structural plan elements examined in this RWMP include demand reduction through water conservation, acquiring historical water rights at annexation via Longmont's Raw Water Requirement Policy, enlarging the existing trade with Xcel (whereby Longmont uses Xcel's C-BT units and supplies Xcel with water from the WWTP or Union Reservoir), purchasing additional units of C-BT, and purchasing non-historical St. Vrain Creek basin water rights.

Demand reduction, obtaining historical water rights through annexation and enlarging the Xcel C-BT trade are available at little cost and without significant non-economic impacts. Purchase of additional C-BT units would also have little if any political, social or environmental impact, but a high financial cost based on current market conditions. The final option, purchase of non-historical water rights in the St. Vrain Creek basin, would have the most significant non-economic costs, primarily the removal of area lands from irrigation, but at a financial cost that is lower than purchasing C-BT units.

5.2.1 Demand Reduction (Water Conservation)

In 1996 Longmont created its 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*." Among its efforts Longmont has identified nine best management practices (BMPs) to reduce water use and identified many means for implementing those BMP's.

Costs to implement the BMPs, for the items that had cost estimates, included one-time costs of approximately $473,000 and annual costs of $15,500 per year. Capitalized at seven percent and 50 years, the annual costs are equal to a present value of approximately $214,000. To further reduce demands through water conservation a higher cost would be expected and the total cost of this option could well be $1,000,000.

We believe that a maximum planning goal for demand reduction through water conservation would be a ten percent average demand reduction for the City of Longmont during the 1-in-100 year drought. Additional drought response measures would be implemented for more severe drought situations.

Notwithstanding the 10 percent recommendation cited above, Longmont's existing water supply portfolio and system were evaluated for their response to water conservation efforts. Demands otherwise projected during the 1-in-100 year drought were reduced in increments of 5 percent and the system evaluated to determine the additional population/demand that could be satisfied. The analysis reveals that if Longmont's municipal demand could be reduced by 22 percent, the existing water rights portfolio would be adequate to meet the projected demand at buildout of the LPA. At the recommended 10 percent goal for water conservation, the adequacy of the existing system is extended five years from the residential buildout service population of 104,000 with associated non-residential demands at 2025, to the same 104,000 plus additional non-residential demand at 2030. These and the other results are shown in Table 14.

Table 14

Results of Analysis of Existing Water Rights with Conservation

Conservation Level	*Projected Last Year Supply Is Adequate*	*Projected Service Population* [1]	*Projected Demand without Conservation* [2] *(ac-ft/yr)*	*Projected Demand with Conservation (ac-ft/yr)*
0%	2025	104,000	30,660	30,660
5%	2027	104,000	31,650	30,070
10%	2030	104,000	32,950	29,660
15%	2036	104,000	34,570	29,380
20%	2046	104,000	36,850	29,480
22%	2056	104,000	37,360	29,140

Notes:

1 Residential buildout of 104,000 projected to occur in 2024.
2 Demand increases are due to additional commercial/industrial development. Buildout of non-residential land projected to occur in 2048.

Because of the low cost and benefits, we recommend that Longmont develop a specific plan to reduce water use by ten percent. While demand reduction through conservation is a worthy goal, it is critical that the efforts be successful if the achievement of that savings is required in order to meet future demands. Adoption of the ten percent demand reduction through water conservation, and depending on its success to lower future demands (by 3,740 acre-feet per year at buildout), will require close monitoring to determine the effectiveness of the programs intended to secure those savings.

5.2.2 Acquisition of Historical Water Rights through Annexation (Raw Water Requirement Policy)

At buildout of the LPA, the raw water requirement policy is expected to have provided additional average and firm yields of approximately 2,900 and 1,700 acre-feet per year respectively for Longmont's uses. Between now and buildout, the growth of the water rights portfolio is not projected to provide new water supply at a sufficient pace to keep up with the projected growth in demand. This result is due in part to the deficit (as described in Section 4) between historical water supplies and the requirement to provide three acre-feet per acre. Thus, the capability of the system with the 2002 water rights portfolio, sufficient to supply a population of 104,000 through 2025, is not augmented enough by the addition of new water rights by 2026 to meet the 2026 demand.

Regardless of the rate of growth of Longmont's water supply estimated to be attributable to the raw water requirement policy, a significant yield is expected to be provided to Longmont through its continuation. The cost of converting these irrigation rights to municipal use through the water court is minimal compared to the cost of developing additional water supplies, and is conservatively estimated to be approximately $1,000,000. There are no negative environmental or social consequences to the acquisition of water rights in this way as the land historically irrigated is converted to developed land within the City. We recommend that the raw water requirement policy be continued in the future, and that the new water rights acquired in that manner be converted to municipal uses in a timely manner.

5.2.3 Enlarge Existing Xcel C-BT Trade

The current 15-year agreement between the City of Longmont and Xcel Energy provides that Longmont may trade water with Xcel on the yield of between 2,000 and 3,500 units of Xcel's C-BT Project water. In the trade Longmont supplies Xcel with water at St. Vrain Creek below Longmont in the same amount as the C-BT quota times the number of units Longmont is trading upon. Longmont then receives the use of Xcel's C-BT water through the Project's St. Vrain Supply Canal and Southern Water Supply Pipeline. The C-BT trade is a non-structural way of taking water available to Longmont at the bottom end of its system and making it into high quality water available for treatment and municipal use at the top end of the system. There is virtually no cost to the trade, and insignificant social or environmental impacts. It achieves a result similar to the Union pipeline without the capital, operational, or water treatment expenses.

In order to use this element as a component of a plan for meeting Longmont's demands at buildout of the LPA, we recommend that the trade be made permanent. Longmont would have until the end of the current 15-year agreement to make a permanent arrangement with Xcel.

Table 15 presents the results of an enlarged C-BT trade analysis. The year 2026 is the latest that demands are projected to be satisfied using the existing system plus an enlarged trade with Xcel. If trades larger than 5,000 units were allowed, the demand could be met through 2028 based on trading 6,200 units. Demands after 2028 could not be met with any level of trade using the existing system plus the trade only.

Table 15

Results of Analysis of Enlarged Xcel C-BT Trade

Period	*Largest Projected Service Population*	*Largest Projected Demand (ac-ft/yr)*	*Minimum Trade Required To Meet Demands (units)*	*Enlargement Of Trade Required Above 3,500 Units (units)*	*Maximum Trade Allowed While Meeting Demands (units)*
2010-2018	95,920	26,310	0	0	6,200 [2]
2011-2019	96,900	26,710	0	0	6,200 [2]
2012-2020	97,890	27,110	0	0	6,300 [2]
2013-2021	99,680	27,820	0	0	6,300 [2]
2014-2022	101,470	28,530	600	0	6,200 [2]
2015-2023	103,270	29,240	1,300	0	6,200 [2]
2016-2024	104,000	29,950	2,300	0	6,200 [2]
2017-2025	104,000	30,660	3,200	0	6,200 [2]
2018-2026	104,000	31,150	4,300	800	6,400 [2]
2019-2027	104,000	31,650	5,200 [1]	1,700	6,500 [2]
2020-2028	104,000	32,150	6,200 [1]	2,700	6,800 [2]

Notes:
1 Minimum number of units required exceeds acceptable limit of 5,000 units.
2 Maximum number of units allowed exceeds acceptable limit of 5,000 units.

We recommend that the Xcel trade be evaluated further using differing hydrologic conditions to better determine the opportunities available by making the trade permanent and enlarging it up to 5,000 units, and the delivery obligations that would come with an enlarged trade.

5.2.4 Purchase Additional C-BT Units

C-BT Project units are bought and sold on the open market throughout the Northern Colorado Water Conservancy District boundaries, primarily in the Front Range area from Broomfield to Ft. Collins. Currently units are valued at approximately $12,000 each and have produced from a low of 0.5 acre-feet per unit (the 2003 quota), to a high of 1.0 acre-feet per unit. In an average type year, the quota would be set at 0.7 acre-feet per unit. The project firm yield is considered to be the average yield during the seven years of the 1-in-100 year drought, or 0.66 acre-feet per unit. Results show that it would require ownership of approximately 13,900 additional units of C-BT to meet Longmont's demands through a 100-year drought at buildout of the LPA.

In addition to the capital cost of purchasing additional C-BT units, ownership of Project units bears an annual assessment for operation and maintenance of the system that diverts, stores and delivers the water. The total present worth of the purchase of one unit, and of one acre-foot per year of firm yield, would be $18,600 ($18,180 plus capitalized O&M of $420 per unit).

5.2.5 Purchase of St. Vrain Creek Basin Water Rights

Continued application of Longmont's Raw Water Requirement Policy is projected to provide Longmont with certain additional shares of ditch stock and their associated water rights. However, other shares are used on lands not in the LPA (non-historical) and therefore are not expected to be acquired through the annexation and development process. Such shares could be purchased in order to make the water rights available for Longmont's use (after a change of use and point of diversion in Water Court). It is noted that purchase of water rights and removal of land from irrigation may not be consistent with Longmont's stated interest in preserving the local agricultural environment.

The portfolio of water rights projected at buildout, plus the purchase of additional shares, would be sufficient to meet Longmont's projected needs through 2033 including a seven year long, 1-in-100 year drought occurring in 2026 through 2032. The population served and the demand met in 2033 are projected to be 104,000 and 33,790 acre-feet per year respectively. Thus, the purchased water rights would provide the ability to serve an additional demand of 3,130 acre-feet per year. When the purchase price cost is compared to the increased demand that can be supplied, the cost per acre-foot of the purchased water increases to $8,100 per acre-foot.

5.2.6 Summary of Non-Structural Alternatives

Five non-structural alternatives have been described including water conservation, acquiring additional water rights through the Raw Water Requirement Policy, enlarging the current trade for Xcel Energy's C-BT units, purchasing additional C-BT units, and purchasing St. Vrain basin water rights. Table 16 shows a comparison of the non-structural alternatives including their capital cost, present value of future operating costs, yield and total cost per acre-foot of yield. The first three alternatives are available without appreciable cost. The C-BT purchase option is the most expensive at $18,600 per acre-foot of firm yield. St. Vrain basin water rights purchases are estimated at $5,770 per acre-foot of firm yield and $8,100 per acre-foot of additional demand they can support during the 100-year drought.

Table 16

Comparison of Non-Structural Plan Elements and Firm Yield

Element	*Sub-Element*	*2003 Total Cost*	*Firm Yield (ac-ft/yr)*	*Cost per Acre-Foot Of Firm Yield*
Water Conservation	5%	$500,000	1,870 [1]	$270
	10%	$1,000,000	3,740 [1]	$270
	15%	$1,500,000	5,600 [1]	$270
	20%	$2,000,000	7,470 [1]	$270
	22%	$2,200,000	8,220 [1]	$270
Continue Raw Water Requirement Policy		$1,000,000	1,700	$590
Enlarge Xcel C-BT Trade	800 units more	$0	800	$0
	1,700 units more	$0	1,700	$0
	2,700 units more	$0	2,700	$0
Purchase Additional C-BT	1,000 units to	$12,300,000 [2] to	660 to	$18,600
	13,900 units	$170,700,000 [2]	9,200	$18,600
Purchase St. Vrain Basin Water Rights		$25,350,000	4,390	$5,770

Notes:

1 Firm yield of conservation estimated at demand reduction percentage times municipal demand at LPA buildout of 37,360 acre-feet per year. Cost based on $1,000,000 for 10% reduction and others scaled accordingly.

2 Total cost of C-BT includes purchase price of $12,000 per unit, plus capitalized annual costs of $280 per unit. Firm yield is estimated at 0.66 acre-feet per unit per year based on average yield during seven years of 1-in-100 year drought.

Table 17 shows the increase in Longmont's overall water supply capability considering the addition of each of the non-structural plan elements described in Section 5.2 and the cost per acre-foot of each on that basis.

Table 17

Summary of Effect of Non-Structural Plan Elements on System Yield

Element	*Sub-Element*	*2003 Total Cost*	*Increased System Yield (ac-ft/yr)* [1]	*Cost per Acre-Foot of Increased Yield*
Water Conservation	5%	$500,000	1,870 [1]	$270
	10%	$1,000,000	3,740 [1]	$270
	15%	$1,500,000	5,600 [1]	$270
	20%	$2,000,000	7,470 [1]	$270
	22%	$2,200,000	8,220 [1]	$270
Continue Raw Water Requirement Policy		$1,000,000	n/a	n/a
Enlarge Xcel C-BT Trade	800 units more	$0	490 [2]	$0
	1,700 units more	$0	990 [2]	$0
	2,700 units more	$0	1,490 [2]	$0
Purchase Additional C-BT	1,000 units to	$12,300,000 [3] to	490 to	$25,100 to
	13,900 units	$170,700,000 [3]	6,700	$25,500
Purchase St. Vrain Basin Water Rights		$25,350,000	3,130	$8,100

Notes:

1 Increased System Yield is the difference between the greatest annual municipal demand that can be satisfied with the particular structural plan element/sub-element in place versus the baseline demand that the existing system can satisfy of 30,660 acre-feet per year. Increased system yield of water conservation is demand reduction percentage times municipal demand at LPA buildout.

2 Increased yield of the enlarged Xcel trade is the difference between the greatest municipal demand that can be served and the 2025 demand that can be served by the existing system (including the trade of 3,500 of Xcel's C-BT units.

3 Total cost of C-BT includes purchase price of $12,000 per unit, plus capitalized annual costs of $280 per unit.

6.0 ANALYSIS OF ALTERNATIVE PLANS

6.1 Description of Alternative Plans

Section 5 described and evaluated individual structural and non-structural plan elements that might be considered for increasing Longmont's water supply to meet the projected demand at buildout of the LPA. In this section, twelve alternative plans consisting of combinations of plan elements are described. The goal is to determine which if any alternatives can meet the 2048 demand through the seven years of the 1-in-100 year drought and at what cost.

Because of the low cost and obvious benefit, certain of the non-structural plan elements are included in all alternative plans. These include demand reduction through water conservation, continuation of the Raw Water Requirement Policy, and enlargement of the Xcel C-BT trade. Demand reduction through water conservation is described in Section 5.2.1 and reduces the otherwise projected demands during the 1-in-100 year drought by ten percent at a cost of $1,000,000. Continuation of the Raw Water Requirement Policy builds Longmont's water rights portfolio to its projected level at buildout of the LPA around 2048 at a cost of $1,000,000 as described in Section 5.2.2. The Xcel C-BT trade provides water for Longmont's use at the upper end of Longmont's system in trade for water Longmont makes available to PSCo at the lower end of the system (see Section 5.2.3) at no cost.

Because of the high cost, enlarging Ralph Price Reservoir beyond the 70-foot raise of Button Rock Dam (19,545 acre-foot) is not included in any of the alternatives. Nor is firming of all 80 Windy Gap units, since the existing reservoir project is not planned to be large enough to firm that many units.

Eleven alternative plans were considered in this RWMP. Subplans considered in this analysis are based on variable components such as heights of dam raises, amounts of C-BT units considered in the Xcel trade, amounts of C-BT units purchased, and whether or not additional St. Vrain water rights are purchased. Table 18 shows the alternative plans in a matrix format indicating the size of the particular elements incorporated in each of the alternatives.

6.2 Evaluation of Alternative Plans

Many but not all of the alternative plans examined are capable of providing sufficient water supply to meet Longmont's projected demand at buildout of the LPA, depending on the number of C-BT units purchased or traded for with Xcel. Meeting demand at buildout is considered as satisfying the municipal demand for the nine year period starting in 2048 and including the seven year long, 1-in-100 year drought. The dry year demand at that level is 37,360 acre-feet per year.

Table 19 lists the 25 alternative plans that meet Longmont's projected demand at buildout of the LPA without requiring more than a 5,000 unit Xcel C-BT trade. Table 20 lists the alternative plans examined in order of cost and briefly lists advantages and disadvantages for each plan. The Guiding Water Principles satisfied by each alternative plan are also presented in Table 20.

Generally, alternatives consisting of either the Union pipeline and the non-structural elements (10 percent demand reduction, continuation of the Raw Water Requirement Policy, and enlarging the Xcel C-BT trade), or the Union dam raise plus Union pipeline and non-structural elements, are the most economical means for building Longmont's raw water supply system to the degree required to meet the projected demand at buildout of the LPA. As shown in Table 19 the total cost of these alternatives ranges from $20,800,000 for Alternative E.1 to $35,400,000 for Alternative G.2. Also included in the middle of this group is the non-structural alternative involving enlarging the Xcel trade to 5,000 units and buying 300 units of C-BT (A.3.2) at an estimated cost of $31,000,000.

A group of eight alternative plans have costs between $37,000,000 and about $50,000,000. In order of increasing estimated cost these include firming 50 Windy Gap units (D.2), the 20-cfs Union pipeline (E.2), the 13-foot Union enlargement with water rights purchase (J.2), firming 30 units of Windy Gap and constructing the 10-cfs Union pipeline (H.1), the 20-foot Button Rock Dam raise and 10-cfs Union pipeline (F.1), raising Button Rock Dam 20 feet and firming 30 Windy Gap units (M.1), firming 30 Windy Gap units with water rights purchase (K.1), and non-structural with water rights purchase (A.2.2).

Most of the alternatives that failed to make the cut required the enlargement of the Xcel C-BT trade beyond the maximum of 5,000 units, some to more than 10,000 units. While enlarging the C-BT trade is an extremely effective way to increase the water supply, unless it is made permanent it should not be relied upon as part of an alternative plan to meet the projected demand at buildout of the LPA.

Alternatives that do not rely to a significant degree on the Xcel trade generally include the construction of additional reservoir storage and the Union pipeline as elements, including: Alternative G.2 - enlarging Union Reservoir, Alternatives H.1 and H.2 - firming 30 or 50 Windy Gap units, Alternative F.1 - raising the dam at Button Rock, Alternatives K.1 and K.2 - firming Windy Gap and constructing the Union pipeline, Alternative L.1 - firming 50 Windy Gap units plus enlarging Union Reservoir, and Alternatives M.3 and M.4 raises of Button Rock dam and firming Windy Gap. Without constructing the Union pipeline the alternatives that do not rely greatly on the Xcel trade include Alternatives K.1 and K.2 firming 30 and 50 Windy Gap units and purchasing area water rights, and Alternatives M.3 and M.4 raising Button Rock dam and firming Windy Gap.

Totally non-structural alternatives are generally the most expensive, primarily due to the required purchase of large numbers of C-BT Project units to meet demands with costs in the $87,000,000 to $148,000,000 range. A change in the market price of C-BT units could significantly affect the costs of these alternatives, however the change would have to be on the order of a 50 to 80 percent decrease to make these alternatives comparable in cost to other options available at $21,000,000 to $50,000,000. This seems unlikely given the municipal market interest in C-BT units and the decreasing number of units available for purchase. The two non-structural alternatives that are not among the highest cost alternatives (A.2.2 and A.3.2) include the purchase of area water rights or C-BT and depend on the Xcel C-BT trade at the current level or greater.

Alternatives involving Windy Gap firming (D.2 and H.1), ranked 6th and 9th in cost, add redundancy by creating additional reservoir storage above Longmont and provide high quality reusable water. Button Rock dam raise alternatives do not add redundancy as the new storage is part of the existing facility, but do allow for the capture of high quality, high flow rate North St. Vrain Creek water available for storage to a junior priority.

The two most significant non-economic factors are the water quality associated with Union Reservoir, and the dry-up of irrigated farmland required with the purchase of St. Vrain Creek basin water rights. The alternatives that meet the buildout demand without one of these elements are the firming of 50 units of Windy Gap (D.2), the small Button Rock dam raises with Windy Gap firming (M.1 - M.4), and the 70-foot dam raise at Ralph Price Reservoir (B.3). These alternatives have total costs estimated at $37,750,000 to $85,550,000.

To the extent that supplies are developed beyond the projected needs for municipal use, Longmont would have a factor of safety built into the supply, would have additional opportunities to use its water supply system for other beneficial purposes, including enhancement and preservation of the environment, especially the St. Vrain Creek corridor, and for the support of continued agriculture in the area. We recommend that Longmont consider these goals as it develops the water supply system.

Table 18

Matrix of Plan Alternatives

Alternative	*Structural Elements*				*Non-Structural Elements*				
	Ralph Price Reservoir Enlargement	*Union Reservoir Enlargement*	*Firmed Windy Gap Units*	*Union Pipeline Capacity*	*Water Conservation Level*	*Continue Raw Water Policy?*	*Xcel C-BT Trade*	*C-BT Purchase*	*Water Rights Purchase*
	(acre-feet)	*(acre-feet)*	*(units)*	*(cfs)*	*(percent)*	*(yes/no)*	*(units)*	*(units)*	*(yes/no)*
Plan A – Non-Structural Elements									
A.1.1	0	0	0	0	10%	Yes	0	Variable	No
A.1.2	0	0	0	0	10%	Yes	0	Variable	Yes
A.2.1	0	0	0	0	10%	Yes	3,500	Variable	No
A.2.2	0	0	0	0	10%	Yes	3,500	Variable	Yes
A.3.1	0	0	0	0	10%	Yes	5,000	Variable	No
A.3.2	0	0	0	0	10%	Yes	5,000	Variable	Yes
Plan B – Button Rock Dam Raise plus Non-Structural Elements									
B.1	3,686	0	0	0	10%	Yes	Variable	0	No
B.2	9,420	0	0	0	10%	Yes	Variable	0	No
B.3	19,545	0	0	0	10%	Yes	Variable	0	No
Plan C – Union Dam Raise plus Non-Structural Elements									
C.1	0	4,000	0	0	10%	Yes	Variable	0	No
C.1	0	12,005	0	0	10%	Yes	Variable	0	No
C.2	0	14,100	0	0	10%	Yes	Variable	0	No
C.3	0	19,862	0	0	10%	Yes	Variable	0	No
Plan D – Windy Gap Firming plus Non-Structural Elements									
D.1	0	0	30	0	10%	Yes	Variable	0	No
D.2	0	0	50	0	10%	Yes	Variable	0	No
Plan E – Union Pipeline plus Non-Structural Elements									
E.1.1	0	0	0	10	10%	Yes	0	0	No
E.1.2	0	0	0	10	10%	Yes	Variable	0	No
E.2.1	0	0	0	20	10%	Yes	0	0	No
E.2.2	0	0	0	20	10%	Yes	Variable	0	No

Table 18 (cont.)

Matrix of Plan Alternatives

Alternative	*Structural Elements*				*Non-Structural Elements*				
	Ralph Price Reservoir Enlargement	*Union Reservoir Enlargement*	*Firmed Windy Gap Units*	*Union Pipeline Capacity*	*Water Conservation Level*	*Continue Raw Water Policy?*	*Xcel C-BT Trade*	*C-BT Purchase*	*Water Rights Purchase*
	(acre-feet)	*(acre-feet)*	*(units)*	*(cfs)*	*(percent)*	*(yes/no)*	*(units)*	*(units)*	*(yes/no)*
Plan F – Minimum Button Rock Dam Raise plus Non-Structural Elements plus Union Pipeline									
F.1	3,686	0	0	10	10%	Yes	Variable	0	No
Plan G – Minimum Union Dam Raise plus Non-Structural Elements plus Union Pipeline									
G.1	0	4,000	0	10	10%	Yes	Variable	0	No
G.2	0	12,005	0	10	10%	Yes	Variable	0	No
Plan H – Windy Gap Firming plus Non-Structural Elements plus Union Pipeline									
H.1	0	0	30	10	10%	Yes	Variable	0	No
H.2	0	0	50	10	10%	Yes	Variable	0	No
Plan I – Minimum Button Rock Dam Raise plus Non-Structural Elements plus Water Rights Purchase									
I.1	3,686	0	0	0	10%	Yes	Variable	0	Yes
Plan J – Minimum Union Dam Raise plus Non-Structural Elements plus Water Rights Purchase									
J.1	0	4,000	0	0	10%	Yes	Variable	0	Yes
J.2	0	12,005	0	0	10%	Yes	Variable	0	Yes
Plan K – Windy Gap Firming plus Non-Structural Elements plus Water Rights Purchase									
K.1	0	0	30	0	10%	Yes	Variable	0	Yes
K.2	0	0	50	0	10%	Yes	Variable	0	Yes
Plan L – Minimum Union Raise, Windy Gap Firming, Union Pipeline plus Non-Structural									
L.1	0	4,000	50	10	10%	Yes	Variable	0	No
Plan M – Button Rock Raise, Windy Gap Firming plus Non-Structural									
M.1	3,686	0	30	0	10%	Yes	Variable	0	No
M.2	9,420	0	30	0	10%	Yes	Variable	0	No
M.3	19,545	0	30	0	10%	Yes	Variable	0	No
M.4	3,686	0	50	0	10%	Yes	Variable	0	No

Table 19

Comparison of Costs of Alternative Plans that Meet Buildout Demand

	Description	*Sub-Plan*	*Requires*	*2003 Total Cost*
A.1.1	Non-Structural w/o Water Rights Purchase	0 Xcel Trade	Buy 11,900 C-BT	$148,100,000
A.1.2	Non-Structural w/ Water Rights Purchase	0 Xcel Trade	Buy 5,300 C-BT	$92,400,000
A.2.1	Non-Structural w/o Water Rights Purchase	3,500 Xcel Trade	Buy 8,400 C-BT	$105,200,000
A.2.2	Non-Structural w/ Water Rights Purchase	3,500 Xcel Trade	Buy 1,800 C-BT	$49,500,000
A.3.1	Non-Structural w/o Water Rights Purchase	5,000 Xcel Trade	Buy 6,900 C-BT	$86,700,000
A.3.2	Non-Structural w/ Water Rights Purchase	5,000 Xcel Trade	Buy 300 C-BT	$31,000,000
B.3	Button Rock Raise plus Non-Structural	70-foot Raise	Trade 3,000 C-BT	$63,300,000
D.2	Windy Gap Firming plus Non-Structural	50 units	Trade 1,700 C-BT	$37,750,000
E.1	Union Pipeline plus Non-Structural	10-cfs	Trade 3,400 C-BT	$20,800,000
E.2	Union Pipeline plus Non-Structural	20-cfs	Trade 1,800 C-BT	$38,100,000
F.1	Button Rock, Non-Structural & Union Pipeline	20-foot/10-cfs	Trade 0 C-BT	$45,900,000
G.1	Union, Non-Structural & Union Pipeline	5-foot/10 cfs	Trade 1,100 C-BT	$26,800,000
G.2	Union, Non-Structural & Union Pipeline	13-foot/10-cfs	Trade 700 C-BT	$35,400,000
H.1	Windy Gap, Non-Structural & Union Pipeline	30 units/10 cfs	Trade 0 C-BT	$43,050,000
H.2	Windy Gap, Non-Structural & Union Pipeline	50 units/10 cfs	Trade 0 C-BT	$56,550,000
I.1	Button Rock, Non-Structural & Rights Purchase	20-foot Raise	Trade 3,100 C-BT	$52,500,000
J.1	Union, Non-Structural & Rights Purchase	4-foot Raise	Trade 4,700 C-BT	$33,400,000
J.2	Union, Non-Structural & Rights Purchase	13-foot Raise	Trade 4,100 C-BT	$42,000,000
K.1	Windy Gap, Non-Structural & Rights Purchase	30 units	Trade 600 C-BT	$49,400,000
K.2	Windy Gap, Non-Structural & Rights Purchase	50 units	Trade 0 C-BT	$62,600,000
L.1	Union, Windy Gap, Non-Structural & Pipeline	5-ft/50 units/10-cfs	Trade 0 C-BT	$62,550,000
M.1	Button Rock, Windy Gap, Plus Non-Structural	20-foot/ 30 units	Trade 3,700 C-BT	$49,350,000
M.2	Button Rock, Windy Gap, Plus Non-Structural	40-foot/ 30 units	Trade 1,900 C-BT	$57,350,000
M.3	Button Rock, Windy Gap, Plus Non-Structural	70-foot/ 30 units	Trade 0 C-BT	$85,550,000
M.4	Button Rock, Windy Gap, Plus Non-Structural	20-foot/ 50 units	Trade 0 C-BT	$62,850,000

Table 20

Presentations of Pros and Cons of Alternative Plans that Meet Buildout Demand

	Description	*2003 Total Cost*	*Advantages*	*Disadvantages*	*Guiding Water Principles Met*
E.1	Union Pipeline to WTP plus Non-Structural (no C-BT trade)	$ 20,800,000	Access to additional storage C-BT trade at/near current limit or less	Questionable Water Quality	1,2,3,5,6,7,8,9
G.1	Union Raise (4,000AF) & Union Pipeline to WTP, Non-Structural	$ 26,800,000	Access to additional storage Small C-BT trade required	Questionable Water Quality	1,2,3,5,6,7,8,9,11
A.3.2	Non-Structural w/ Water Rights Purchase	$ 31,000,000	High Water Quality	Depends on large C-BT trade No additional storage Area impacts from dry up	1,2,3,4,5,6,7,8,9
J.1	Union Raise, Non-Structural & Rights Purchase	$ 33,400,000	Adds Storage	Area impacts from dry up Depends on enlarged C-BT trade	1,2,3,4,5,6,7,8,9,10,11
G.2	Union Raise (12,000 AF) & Union Pipeline, Non-Structural	$ 35,400,000	Access to additional storage Small C-BT trade required	Questionable Water Quality Costs more than G.1	1,2,3,5,6,7,8,9
D.2	Windy Gap Firming plus Non-Structural	$ 37,750,000	Redundancy to Button Rock Reusable return flows C-BT trade at/near current limit or less		
E.2	Union Pipeline plus Non-Structural	$ 38,100,000	Access to additional storage C-BT trade at/near current limit or less	Questionable Water Quality Costs more than E.1	1,2,3,5,6,7,8,9
J.2	Union Raise, Non-Structural & Rights Purchase	$ 42,000,000	Adds Storage	Area impacts from dry up Depends on enlarged C-BT trade Costs more than J.1	1,2,3,4,5,6,7,8,9
H.1	Windy Gap, Non-Structural & Union Pipeline	$43,050,000	Redundancy to Button Rock Reusable return flows No C-BT trade required	Questionable Water Quality Costs more than D.1	1,2,3,4,5,6,7,8,9,10,11 1,2,3,5,6,7,8,9,10,11
F.1	Button Rock, Non-Structural & Union Pipeline	$ 45,900,000	Captures North St. Vrain Flows Gravity delivery Adds storage Not dependent on C-BT trade	No redundancy Questionable Water Quality Costs more than B.2	1,2,5,6,7,8,9
M.1	Button Rock, Windy Gap plus Non-Structural	$ 49,350,000	Captures some North St. Vrain flows Redundancy to Button Rock Reusable return flows	Requires slight enlargement of C-BT trade	1,2,3,4,5,6,7,8,9,10,11
K.1	Windy Gap, Non-Structural & Rights Purchase	$ 49,400,000	Redundancy to Button Rock Reusable return flows Barely dependant on C-BT trade	Area impacts from dry up	1,2,3,4,5,6,7,8,9,10,11
A.2.2	Non-Structural w/ Water Rights Purchase	$ 49,500,000	C-BT trade at/near current limit or less	Area impacts from dry up No redundancy	1,2,3,4,5,6,7,8,9

Unless noted, non-structural includes 10 percent demand reduction, continuation of raw water requirement policy, and Xcel C-BT trade.

Table 20 (cont.)

Presentations of Pros and Cons of Alternative Plans that Meet Buildout Demand

	Description	*2003 Total Cost*	*Advantages*	*Disadvantages*	*Guiding Water Principles Met*
H.2	Windy Gap, Non-Structural & Union Pipeline	$ 56,550,000	Redundancy to Button Rock Reusable return flows Not dependant on C-BT trade	Questionable Water Quality No benefit over D.2	1,2,3,5,6,7,8,9,10,11
M.2	Button Rock, Windy Gap plus Non-Structural	$ 57,350,000	Captures North Saint Vrain flows Redundancy to Button Rock Reusable return flows		
L.1	Union, Windy Gap, Non-Structural & Pipeline	$ 62,550,000	Redundancy to Button Rock Reusable return flows Not dependant on C-BT trade	Questionable Water Quality Space for firming additional Windy Gap units	1,2,3,5,6,7,8,9,10,11
K.2	Windy Gap, Non-Structural & Rights Purchase	$ 62,600,000	Redundancy to Button Rock Reusable return flows Not dependant on C-BT trade	Area impacts from dry up	1,2,3,4,5,6,7,8,9,10,11
M.4	Button Rock, Windy Gap plus Non-Structural	$ 62,850,000	Captures North St. Vrain flows Redundancy to Button Rock Reusable return flows Not dependant on C-BT trade	1,2,3,4,5,6,7,8,9,10,11	
B.3	Button Rock plus Non-Structural	$ 63,300,000	Captures North St. Vrain flows Gravity delivery Adds storage	No redundancy	1,2,4,5,6,7,8,9
M.3	Button Rock, Windy Gap plus Non-Structural	$ 85,550,000	Captures North St. Vrain flows Redundancy to Button Rock Reusable return flows Not dependant on C-BT trade	Costs more than M.4 1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6,7,8,9,10,11
A.3.1	Non-Structural w/o Water Rights Purchase	$ 86,700,000		No redundancy	1,2,4,5,6,7,8,9
A.1.2	Non-Structural w/ Water Rights Purchase	$ 92,400,000	Not dependant on C-BT trade	Area impacts from dry up No redundancy	1,2,4,5,6,7,8,9
A.2.1	Non-Structural w/o Water Rights Purchase	$ 105,200,000		No redundancy	1,2,4,5,6,7,8,9
A.1.1	Non-Structural w/o Water Rights Purchase	$ 148,100,000	Not dependant on C-BT trade	No redundancy	1,2,4,5,6,7,8,9

Unless noted, non-structural includes 10 percent demand reduction, continuation of raw water requirement policy, and Xcel C-BT trade.

7.0 RECOMMENDATIONS

General Raw Water Supply Strategy Recommendations

Because it is not consistent with Longmont's long-term stated goal of supporting the continuation of agricultural activities in the area, we recommend against Longmont considering the purchase of St. Vrain Creek water rights that are not currently decreed for municipal water use in order to meet future demands.

Cash-in-Lieu Recommendations

Cash received in lieu of water rights should be retained to use for the funding of facilities construction, acquisition of water rights and the development of Longmont's existing and future water rights, rather than being used for large scale purchase of C-BT Project units. The $13,000,000 projected to be received through cash-in-lieu of water rights represents from about one-fourth to more than one-half the cost of the most economical alternatives.

Windy Gap Recommendations

Until the issues regarding the potential success of water conservation, the permanence of the Xcel C-BT trade and the potential for use of Union Reservoir water (either directly or by exchange with area ditch companies) are resolved, we recommend that Longmont continue to pursue firming a portion of its Windy Gap water through participation in the proposed Windy Gap Firming Project in the range of 10,000 to construction of 16,000 acre-feet of storage. The high quality, reusable water provided by Windy Gap is a valuable resource. Reuse of Windy Gap makes it cost effective. Redundancy provided by the new reservoir in case of an emergency or the need to empty Ralph Price Reservoir would be very valuable for the future reliability of the water supply system. At the conclusion of the environmental study and permitting phase of the firming project, Longmont should re-evaluate its raw water supply needs and at that time determine the appropriate level of participation in the project.

Union Reservoir Recommendations

Pipeline Alternatives

The Union pipeline alternatives represent some of the least expensive options on the basis for which costs were evaluated for this RWMP. We recommend that a thorough water quality investigation and analysis be conducted to determine any limitations to use, and the additional cost of treatment, that would be involved in blending water from Union with other supplies for a raw water supply for treatment for potable water use in the non-irrigation season. We also recommend that a feasibility level study be conducted to further refine the estimated costs.

We recommend that further analysis be conducted on the use of the pipeline to supply irrigation water to parks, schools and golf courses in Longmont. Specifically, the irrigation demands (amount and duration) of the areas to be served should be further refined and an operational study should be designed to determine the best use of the pipeline for meeting those demands. Finally, Longmont

should also explore exchange opportunities with the Highland Ditch and Rough & Ready Ditch. The Union pipeline may be constructed in phases, with differing incremental costs and benefits. We recommend that Longmont more fully evaluate the opportunities and costs associated with phasing the Union pipeline, including the possibility that it is only completed to 85th Street (Phase 2).

Union Reservoir Enlargement Alternatives

Longmont should conduct a feasibility study to investigate phased raises at Union Reservoir for a 5-foot, or 4,000 acre-feet, enlargement and an additional optional enlargement level between 13 and 20.5 feet. of Union Reservoir. Dam raises of 13-feet and 20.5 feet have been studied previously. Longmont should continue to acquire land at Union Reservoir, to the degree required for the final raise height option recommended in that feasibility study as well as five-foot dam raise, if any, and should exploring what alternatives such as berming might be available for reducing or eliminating land acquisition and impacts to neighboring properties.

For Union Reservoir enlargements beyond 4,000 acre-feet, we recommend that Longmont pursue partnering with other water users.

C-BT Recommendations

Some of the lowest cost alternatives require enlargement of the Xcel C-BT trade, currently capped at 3,500 units. In order to make these alternatives viable, and for the general good it provides at no cost, we recommend that Longmont seek to make the trade permanent. Without the security of a permanent trade agreement, Longmont would be advised to consider alternatives that are not dependent on the trade. We recommend that negotiations continue with Xcel exploring the possibility of making the trade permanent. As mentioned in Section 6.2.3, we also recommend that additional analyses be conducted to determine the effects of the trade during hydrologic conditions that differ from the years used in this analysis.

Long Term Recommendations

As mentioned in Section 2, the results of this analysis depend on various assumptions, many of which are related to projected future demands. Longmont should consider that any number of changes could occur in the future that would materially change those demands and the operation of its raw water supply system. We recommend that as needed Longmont update this work to incorporate updated demand projections and other changed circumstances affecting the system operation.

The alternative plans described in Section 7 include the continuation of the Raw Water Requirement Policy and its requirement that all historic water rights be provided to the City. We recommend that Longmont continue the Raw Water Requirement Policy, and in order to make that water useful, that Longmont continue to change the water rights received to municipal use in a timely manner.

We recommend that Longmont continue to preserve the conditional storage decrees at Ralph Price Reservoir and Union Reservoir. At this time, though it appears that the largest of the reservoir enlargements may not be required, there are many variable conditions, the outcome of which will

determine the degree to which those reservoir enlargements are needed. Until other items such as the completion of the Windy Gap firming project, making permanent the Xcel C-BT trade, determining the feasibility of the Union pipeline, and determining the success of water conservation efforts are accomplished, Longmont must retain the conditional storage decrees at Ralph Price Reservoir and Union Reservoir to allow for the construction of those enlargements if necessary.

Conservation Recommendations

Some of the alternatives examined may not be adequate to meet the buildout demand if Longmont does not achieve a demand reduction of ten percent over projected drought year demands at buildout of the LPA. We recommend that Longmont create a plan to achieve the ten percent demand reduction during the drought, and that it also track the demand growth as Longmont continues to develop toward buildout of the LPA. Should the tracking show that demands are expected to exceed the projections used for this RWMP, Longmont may be required to look at additional alternatives to meet the higher projected demand. We recommend that Longmont continue to use 10 percent as a reasonable goal for long term projected demand reduction. This may include a combination of long term sustainable water demand reductions as well as strategies to further reduce the demand during a drought to achieve an overall demand reduction necessary during any given drought event.