



**POTABLE WATER MASTER PLAN  
AND  
DEVELOPMENT STRATEGY  
(2016 Update)**

Public Works Department  
Water Resources Division

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## BACKGROUND

Broomfield's water planning effort is a continuous process that forecasts the gap between current potable water supplies and the ultimate development of Broomfield, and identifies the scope and timing when significant capital improvements are required to close that gap. In addition, it covers the financial planning necessary to fund the construction of new capital facilities. This document serves as a planning tool with regard to potable water supply development and proposes five capital projects in order to meet potable water demands at ultimate build-out of Broomfield.

Broomfield's ability to sell water licenses and support future growth is dependent upon the quantity of existing supplies and the capacity of several key facilities. More specifically, four functional categories control Broomfield's ability to serve future customers. These include:

1. Water Supply – Broomfield's water supply portfolio includes Denver Water, Colorado-Big Thompson (C-BT) units, and Windy Gap units.
2. Transmission Conveyance (Peak summer demand) – Broomfield's supplies are delivered through two pipelines: Conduit 81 for Denver Water and the Southern Water Supply Pipeline for C-BT and Windy Gap units.
3. Water Treatment – Broomfield treats its supplies from C-BT and Windy Gap. Denver Water is delivered as treated water.
4. Water Distribution – The potable water system includes over 370 miles of pipeline, five booster pump stations, and four storage tanks.

Recent planning efforts have focused on the first three areas since they make up the greatest proportion of future capital expenditures and require the longest lead times to implement. In some instances, the duration of the planning and permitting efforts may span five to 20 years while the design and construction can be completed in as little as two to three years. When new water licenses are sold and the demands begin to approach the capacity limits of these functional categories, system improvements must be funded and constructed to avoid having to limit the sale of new water licenses or the possibility of having shortages or reduced service levels. Therefore, to avoid restricting water license sales, it is extremely important to time the construction of new capital projects as closely as possible to the need.

The last functional area, water distribution, is equally as important as the first three. The Capital Improvement Projects division of Community Development has recently worked with URS consultants to update plans for the existing potable water distribution system and the associated distribution system improvements needed to serve the ultimate build-out population.

Broomfield also utilizes non-potable water to irrigate some parks, golf courses, open space, commercial, and other areas of the City. The Water Resources division of Public Works has worked with Leonard Rice Engineers to evaluate the non-potable system as it exists today as part of a larger non-potable water system planning effort. The long-term potential to expand the non-potable water system through build-out will be evaluated in 2016 by Wright Water Engineers, Inc. (pending Council approval of a consulting agreement). A long-term planning document will be produced to identify the development strategy for the non-potable system in a similar manner as the potable water system. Therefore, this water planning update focuses on the potable water system only, since the non-potable system is part of a separate effort.

## CURRENT POTABLE WATER SUPPLIES

Broomfield obtains its potable water from two sources: treated water delivered by Denver Water, and raw water delivered by the Northern Colorado Water Conservancy District (Northern), as part of the Colorado-Big Thompson (C-BT) and Windy Gap Projects. Potable water from Denver Water is delivered to Broomfield through the Conduit 81 pipeline, undergoes re-chlorination at the Zuni Street Pump Station (located near the intersection of Zuni Street and Midway Boulevard), and is then mixed with Broomfield's other supplies. Broomfield's contract with Denver Water includes a minimum and maximum delivery amount on a monthly basis. Raw water from Northern is delivered through the Southern Water Supply Pipeline to Broomfield's Water Treatment Plant on 144<sup>th</sup> Avenue. There, it undergoes treatment, is mixed with Broomfield's Denver Water supplies, and is delivered to the water users of Broomfield.

### Water Supply

Water supply is most commonly measured in "acre-feet." An acre-foot provides a year's supply of water for approximately two households. Potable water demands in Broomfield during the past 10 years have ranged between 9,986 acre-feet and 12,760 acre-feet per year. The lower end of the range occurred in 2009 when Broomfield experienced high levels of precipitation, and the upper limit occurred in 2006, which had an uncharacteristically hot and dry spring. Last year, total potable demands were approximately 11,000 acre-feet.

Developing reservoir storage so that water will be consistently available from year-to-year is known as "firming." Broomfield currently owns and has firmed enough water to supply up to 15,836 acre-feet annually through a treated water contract with Denver Water and 13,337 units owned in the C-BT Project. Broomfield also owns 56 units in the Windy Gap project. However, the number of water licenses that can be sold will be dependent upon Broomfield either firming the approximately 5,600 acre-feet of its Windy Gap supplies, or securing other water supplies. Projected demands on Broomfield's potable water system at ultimate build-out will be approximately 20,500 acre-feet per year. Table 1 below summarizes Broomfield's water sources, supplies and associated status.

**Table 1: Summary of Broomfield's Potable Water Supplies**

<b>Water Source</b>	<b>Units Owned</b>	<b>Yield of Supply (AF)</b>	<b>Status</b>
Denver Water	Contract	6,500	Firm
Colorado-Big Thompson (C-BT)	13,337	9,336	Firm
Windy Gap	56	5,600	Not Firm
<b>Total Firmed Supplies</b>		<b>15,836</b>	
<b>Total Supplies</b>		<b>21,436</b>	

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## Transmission Conveyance and Water Treatment

In addition to having firm water supplies to meet annual demands, Broomfield must have sufficient transmission and treatment capacities to meet peak summer daily demands. Since 2004, the peak summer day demand has been about 2.3 times higher than the annual average daily demand.

Peak day demands have ranged from 19.7 million gallons per day (MGD) to 23.5 MGD during the past five years, and the peak day in 2015 was 20.7 MGD. Broomfield's current peak transmission capacity is 30.9 MGD, which includes 10.6 MGD from Denver Water, 14.7 MGD from the Southern Water Supply Pipeline, and 5.6 MGD from Glasser Reservoir. An additional 14 MGD of transmission conveyance capacity is planned to meet projected demands of approximately 44 MGD at build-out. Existing and future peak day capacities for the potable water system are listed in Table 2.

**Table 2: Potable Water Conveyance Facilities and Associated Capacity**

<b>Conveyance Facility</b>	<b>Transmission Capacity (MGD)</b>
Denver Water	10.6
Southern Water Supply Pipeline	14.7
Glasser Reservoir	5.6
Additional Capacity to Meet Future Demands	14.0
<b>Total Build-out Capacity</b>	<b>44.9</b>

Two separate alternatives, a second pipeline from Carter Lake or construction of a local reservoir (i.e. Broomfield Reservoir), were previously evaluated by Broomfield staff as possible alternatives to increase the capacity of the transmission conveyance system. The Broomfield Reservoir option was selected as the most cost effective and beneficial alternative to meet Broomfield's peak summer needs.

Similarly, the capacity of Broomfield's Water Treatment Plant (WTP) is currently 20 MGD. All of Broomfield's Northern Water supplies are treated at this facility. In order to meet peak day demands at ultimate build-out, a capital project is proposed to expand the WTP by 12 MGD. Current plans are to implement this expansion in two separate 6-MGD phases. The first phase of the expansion is planned to begin this year with the engineering design.

## **DEMAND PROJECTIONS**

Broomfield's capital improvement program and the 2015 Long Range Financial Plan Update both include all the additional supplies and new projects required to serve build-out conditions. In addition, Broomfield is implementing a water conservation plan that was approved by the State in 2012. The conservation plan has a targeted water savings of 15.8% of Broomfield's projected demands in 2020. The targeted savings will be achieved through a combination of various water conservation programs, such as incentives for switching to low-flow toilets, water

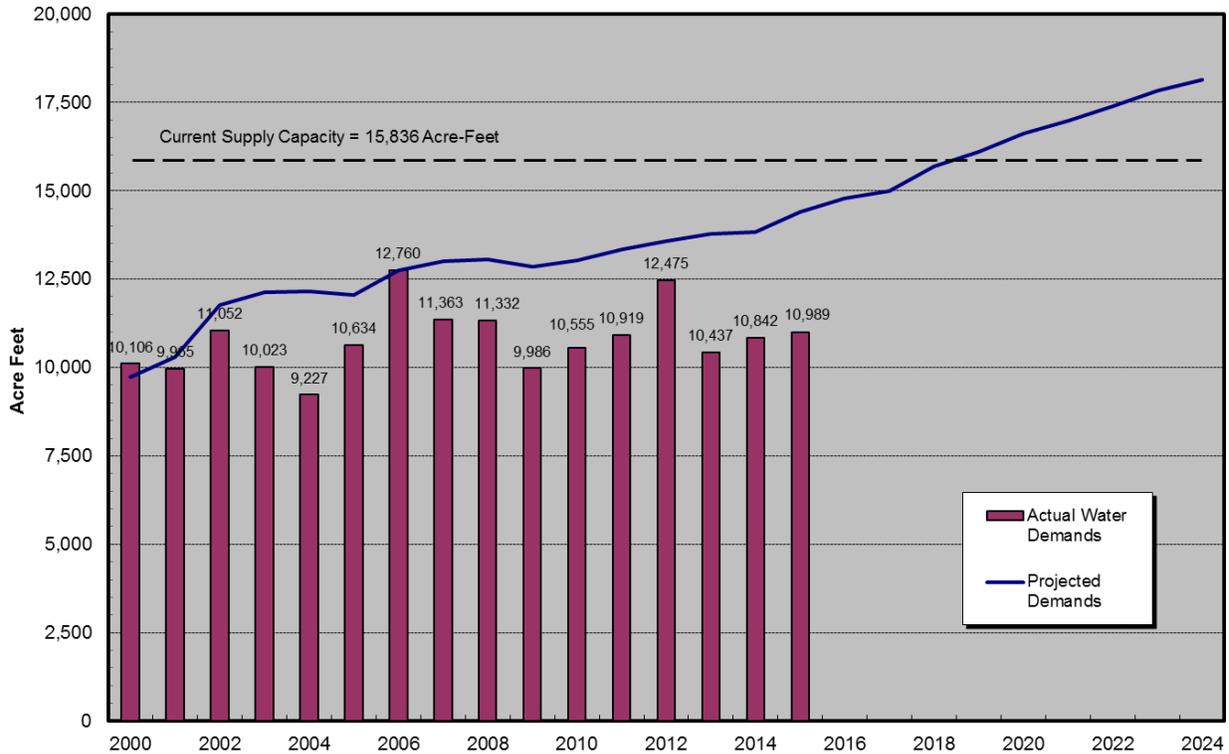
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audits, encouraging use of water efficient fixtures and appliances, and continued expansion of the non-potable water system.

## Demand Projections

Figure 1, below, shows Broomfield's annual water demands, actual and projected, and the current capacity of the water system. Currently, Broomfield has enough supply capacity to meet projected demands until 2018.

**Figure 1: Annual Water Demands and Supply Capacity**  
(Denver Water and CBT Units)

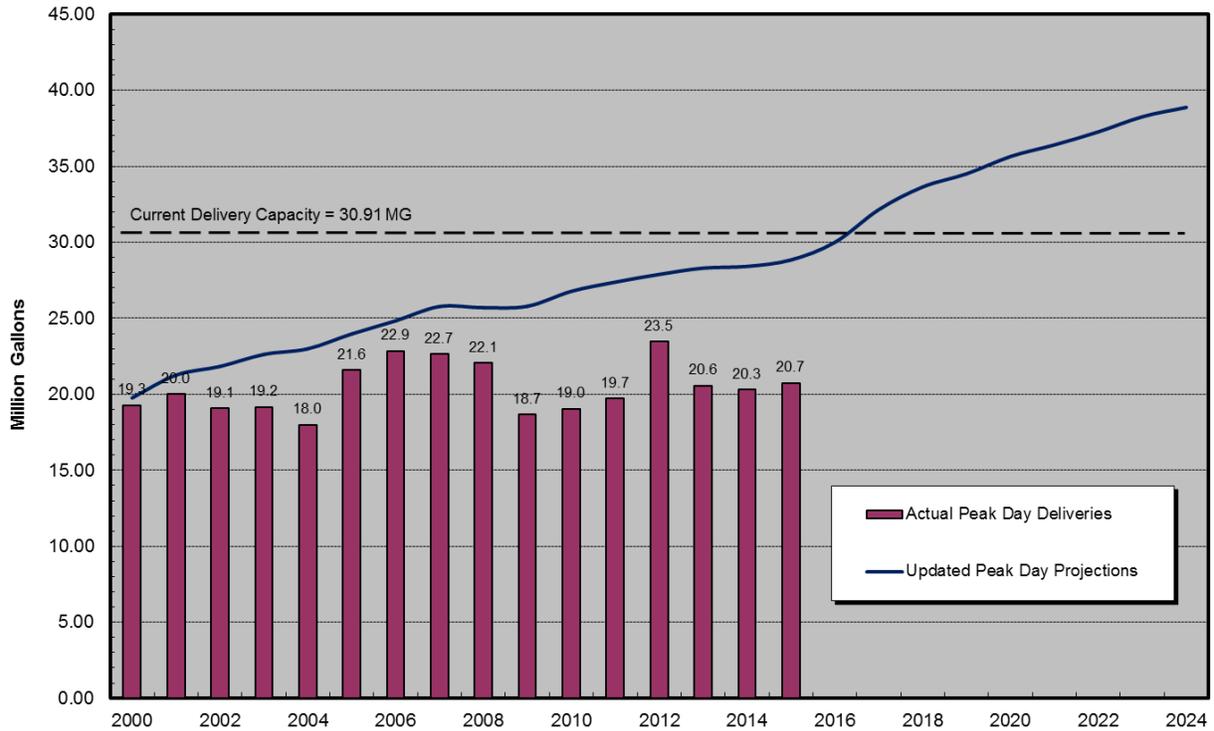


The existing supply capacity, represented by the black dashed line, consists of Denver Water and C-BT units only. It excludes Windy Gap, since those supplies have not been firmed yet. The blue line represents the demand growth projections used to estimate future supply needs.

Figure 2 provides a graphical representation of the actual peak day summer demands against projected peak day growth patterns. The projected peak day demands are based on conservative estimates that represent both hot and dry conditions that can occur during the peak summer months. Broomfield has been fortunate in recent years to have seen lower water demands due to favorable weather conditions.

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**Figure 2: Peak Day Demands and Delivery Capacity**



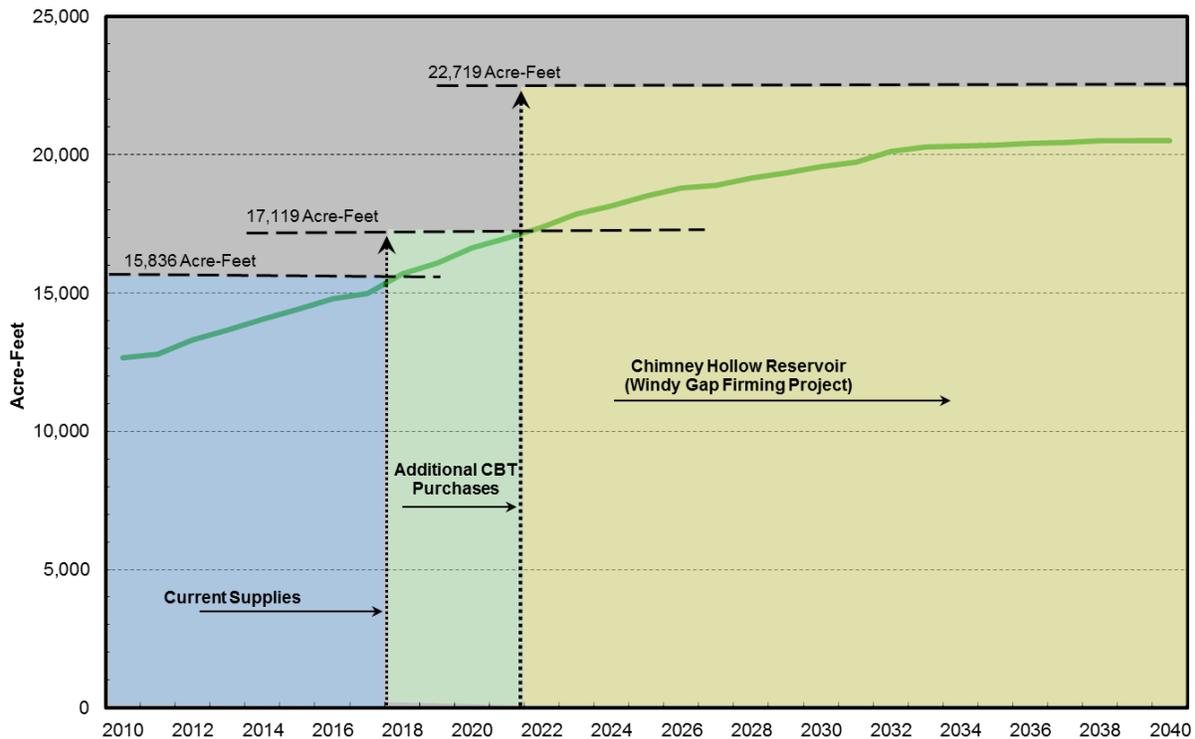
The current delivery capacity is shown as the dashed black line and includes Denver Water, the Southern Water Supply Pipeline, and Glasser Reservoir. The blue line represents the current peak day projections. This shows additional peaking capacity is needed by 2017.

### CAPITAL IMPROVEMENTS TO MEET PROJECTED DEMANDS

Although Figure 2 only illustrates data through 2024, the data for the supply and peaking projections developed for Figures 1 and 2 were extended through the year 2040, which is Broomfield’s projected build-out year. These forecasts were used to determine how long the existing system can support water license sales without exceeding current functional capacities. Four capital projects for water supply and transmission conveyance were identified to bridge the gap between current and ultimate build-out conditions.

The gap between current supplies and ultimate build-out conditions is 5,600 acre-feet. Thus, the supplies from the Windy Gap Firming Project (WGFP) and other sources are required to meet ultimate demands in Broomfield. One proposed capital project is the purchase of additional CB-T units. Broomfield could purchase an additional 1,283 acre-feet of supplies in the C-BT system while staying under the cap established by the Northern Colorado Water Conservancy District. This approach for meeting Broomfield’s future water demands is shown in Figure 3.

**Figure 3: Projected Annual Water Use**  
Potable Water System

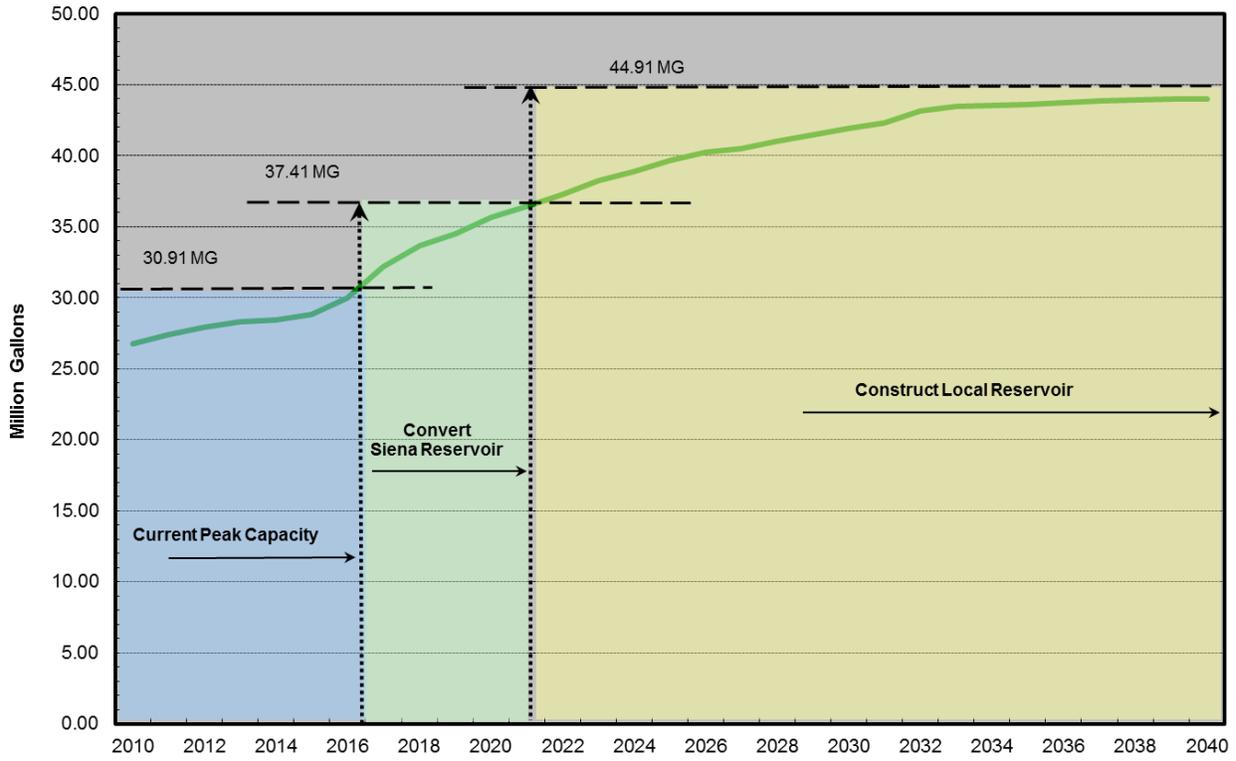


The blue shaded area indicates the length of time Broomfield can rely on the existing supplies of 15,836 acre-feet. As shown in the yellow area, a second capital project, the WGFP, is a critical element in meeting ultimate potable water demands. The WGFP includes the construction of a 90,000 acre-feet storage reservoir (Chimney Hollow) on the Front Range, located west of Carter Lake in Larimer County. If Chimney Hollow is not available for use in the 2016 to 2020 timeframe, Broomfield can effectively increase its supplies by purchasing an additional 1,283 acre-feet of C-BT units. This would delay the need for the WGFP by another five years to 2021, which is the projected completion date. The value of C-BT units has been steadily rising since 2010, when the average cost was \$7,000 per unit. Within the past five years, the average cost per unit has increased to \$26,500 per unit. Broomfield's Public Works staff will be working closely with the Finance staff to revise the long-range capital financing projections as part of the 2017 budget process to account for these price fluctuations.

Under today's peaking projections, a local reservoir with 1,300 acre-feet of useable storage is required to supply peak summer demands at build-out. Based on current projections, additional peaking capacity needs to be available by 2017. A third capital project, the conversion of Siena Reservoir to a peaking reservoir, would meet this need in the short term before the final local reservoir is built. Siena Reservoir was previously included in the ultimate service plan for the non-potable, rather than potable water system, but has recently been transferred to the potable water system to allow for this conversion. This phased approach for meeting expected increases in peak day summer demands is shown in Figure 4.

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**Figure 4: Projected Peak Day Demands**  
Potable Water System



Similar to the previous annual demand graph, the blue shaded area represents the length of time that existing facilities can meet peak day demands. However, additional facilities will need to be added in 2016 to accommodate growth and support associated water license sales. The green shaded area represents the current plan that delays the construction of a local reservoir by nearly five years, until 2021. This would be accomplished by converting Siena Reservoir from the non-potable to the potable water system, which is a less expensive and quicker project to achieve since the reservoir itself is already built and filled with water.

Broomfield acquired Siena Reservoir from Pulte Homes as part of an agreement that provided water licenses in exchange for non-potable water facilities and supplies. Siena Reservoir has a capacity of 450 acre-feet but the volume of storage that would be used for meeting peak summer demands would be limited to approximately 300 acre-feet. The estimated cost of the conversion is approximately \$7.5 million. If this sequencing is pursued, another local reservoir (Broomfield Reservoir, the final capital project proposed in this plan) will not need to be constructed until the 2021 timeframe to provide the balance of storage required for ultimate peak day demands. However, with the increased costs of C-BT units, staff also plans to reevaluate the timing and sizing of Broomfield Reservoir as an interim firming storage project.

# Potable Water Master Plan and Development Strategy

Figures 3 and 4 were used to develop an implementation plan for further evaluation using Broomfield's financial model. The components of the plan are as follows:

- Potential purchase 1,283 additional acre-feet of Colorado-Big Thompson units
- Convert Siena Reservoir to provide interim peaking
- Expand the Water Treatment Plant by 6 MGD
- Windy Gap Firming Project (Construction of Chimney Hollow)
- Construct the Broomfield Reservoir for ultimate peak day demands and potentially for interim firming storage capacity
- Second Water Treatment Plant expansion of 6 MGD

Table 3 includes a detailed listing of the individual capital projects, along with the expected funding year, on-line year, and estimated costs. In keeping with "growth pays its way" approach, the majority of capital projects are funded by license fees paid to connect to the water system.

The \$17.5 million for additional C-BT unit purchases was based on a C-BT unit cost of approximately \$7,500 per unit. Public Works staff will coordinate with Finance on providing updated cost projections for the Long Range Financial Plan.

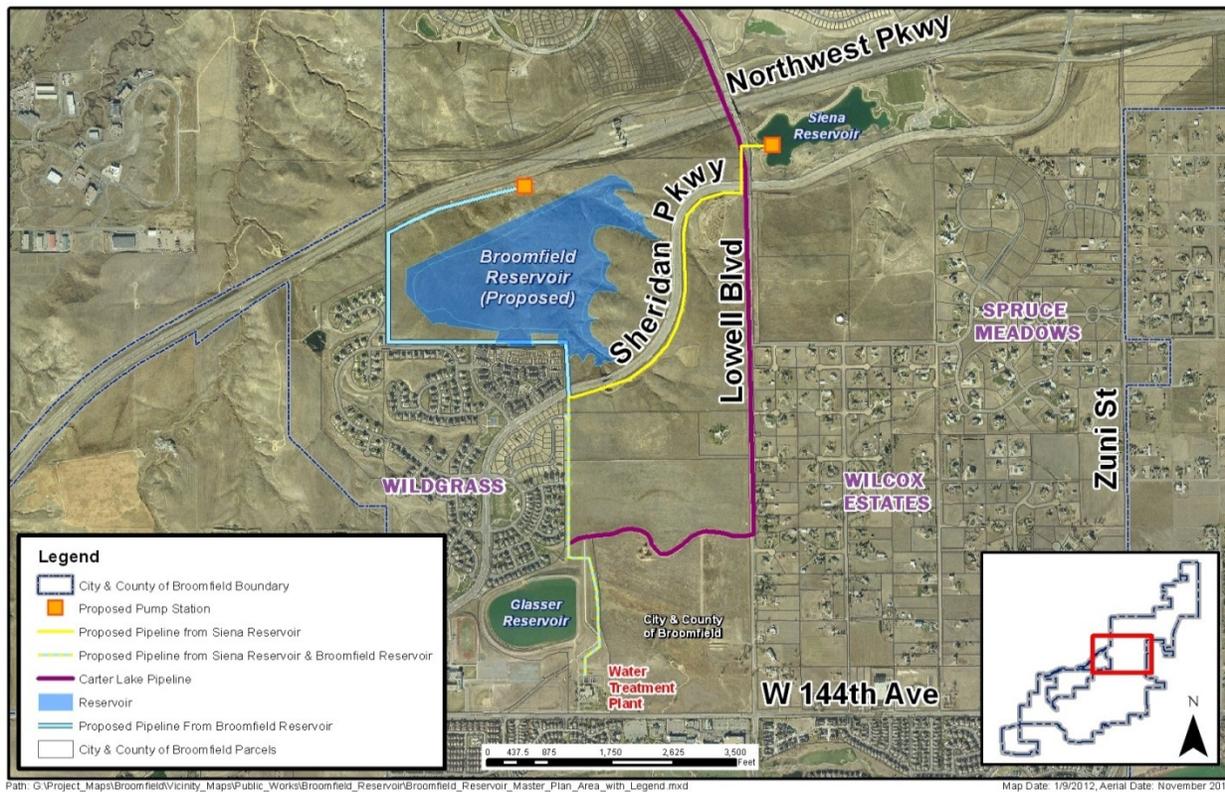
**Table 3: Summary of Capital Improvement Projects and Associated Estimated Costs**

Capital Project	Funding Year	Projected On-line Year	Est. Cost (millions)
C-BT Purchases	2013 - 2017	As purchased	\$ 17.5
Convert Siena Reservoir (6.5 MGD)	2015	2017	7.5
WTP Expansion #1	2015	2018	10.4
Windy Gap Firming	2014 - 2018	2021	110.8
Broomfield Reservoir (7.5 MGD)	2023	2024	18.5
WTP Expansion #2	2024	2025	15.0
<b>Total</b>			<b>\$ 179.7</b>

Figure 5 shows the locations of the Broomfield and Siena Reservoirs with respect to the WTP and the proposed piping alignments for each reservoir.

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**Figure 5: Broomfield Reservoir and Siena Reservoir Vicinity Map**



The original design plans for Broomfield Reservoir included a pump station and pipeline to the WTP. The approximate alignment for the pipeline is shown in blue. For both alternatives that use Siena Reservoir, a similar pump station and pipeline will need to be constructed. The pipe alignment for the Siena Reservoir is shown in yellow. Since both alignments overlap between Sheridan Parkway and the WTP, a single pipeline would be constructed in this segment.

## FINANCIAL CONSIDERATIONS

The proposed capital improvement plan was based on Broomfield's water utility financial projection model. This model serves to support the ongoing implementation of the Long Range Financial Plan. The model takes into account the capital spending needs and resulting increases needed in operating charges and license fees that are specific to the plan. The basic assumptions in the financial model include:

- The number of license fee (TE) sales each year – based on the most recent evaluation of forecasting for future development;
- Maintenance of the operating reserve for the fund at 16% of annual operating expenditures;
- Maintenance of the debt service reserve for each year at a level to cover three years of debt service payments;
- Maintenance of positive annual ending operating and capital fund balances, net of reserves; and,
- Positive ending fund balances at year 2040.

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Table 4 is a summary of the detailed costs included in the Five-Year Capital Improvement Project Plan and Broomfield's financial model. The financial model is updated at least annually to reflect changes in the capital plan, revised planning assumptions and differences in actual versus budget. Present assumptions include issuance of \$70 million of new debt in 2019 to cover a portion of the costs of the Windy Gap Firming Project. Included in the \$156 million debt service costs shown are \$40 million in payments on existing debt (with final maturity in 2022) and \$116 million for the new debt. Projected revenues from monthly user charges, with increases, and license fees are adequate to support this plan.

**Table 4: Financial Considerations**

Year	Funded Through Monthly User Charges	Funded Through License Fees		
	Operating Capital Costs	Capital Expansion Costs	Debt Service	Total Capital Expansion
2016	\$ 2,816,767	\$ 10,898,638	\$ 5,726,850	\$ 16,625,488
2017	720,796	7,912,035	5,720,450	13,632,485
2018	915,360	14,203,799	5,714,850	19,918,649
2019	820,031	97,529,635	9,227,450	106,757,085
2020	915,812	11,308,413	11,334,231	22,642,644
2021 - 2025	5,117,995	36,912,684	39,555,655	76,468,339
2026 - 2030	14,733,360	15,254,271	28,099,905	43,354,176
2031 - 2035	14,674,055	12,644,099	28,099,905	40,744,004
2036 - 2040	15,218,882	12,994,280	22,479,937	35,474,217
<b>Total 2016 - 2040</b>	<b>\$ 55,933,057</b>	<b>\$ 219,657,854</b>	<b>\$ 155,959,233</b>	<b>\$ 375,617,087</b>

## NEXT STEPS

Future water planning activities will continue to build and expand on the progress already made. It will be important to periodically re-evaluate growth and demand projections and adjust the scope and timing of the capital improvements contained in this plan based on actual growth. In addition, there is a need to monitor overall climatic changes to determine the potential impacts on available water supply and modifications to water use patterns.

The following planning-related activities and water system capital projects will be presented to Council for direction and consideration of approval in the near future. These activities include:

- Consideration to Provide Additional Funding for the Windy Gap Firming Project – The Municipal Subdistrict of the Northern Colorado Water Conservancy District is requesting additional funding to complete the final phases of federal permitting before design begins.
- Consideration to Award Design Contract for Conversion of Siena Reservoir – Engineering design is needed for the pumps, pipelines, and other facilities needed to convert Siena Reservoir into a peaking reservoir.

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- Consideration to Award Design Contract for Expansion of the Water Treatment Plant – Engineering design is needed for the expansion of the Water Treatment Plant.
- Consideration to Award Contract for Non-potable Water System Master Plan – Two phases of this plan have been completed to date. Three additional phases are required to complete the plan. The purpose of this plan is to provide a more detailed analysis to project the timing and geographic location of future demands, define the scope and scheduling of capital improvements, and evaluate the sources of revenues and estimated fees necessary to build out the non-potable water system.
- Notification of Purchase of Additional C-BT Units – Based on recent water system planning efforts, additional purchases of C-BT Units were included in the capital budget beginning in 2013 and Broomfield plans to purchase units as they come available.