October 5, 2015

THE CITY OF ASPEN
WATER DEPARTMENT

Mr. Kevin Reidy
State Water Conservation Technical Specialist
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, CO 80203

Dear Mr. Reidy,

Subject: 2015 City of Aspen Municipal Water Efficiency Plan

Attached is the Final version of Aspen's Municipal Water Efficiency Plan that council adopted by resolution on September 28, 2015.

Please consider Lee Ledesma the contact person in connection with action items listed on the Municipal Efficiency plan and for any questions you may be have concerning the final plan submittal.

Her contact information is:
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City of Aspen Utilities
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Work #: 970-429-1975

The City appreciates the resources and opportunities that CWCB has provided that made the creation and adoption of the Regional Water Efficiency Plan and the Municipal Water Efficiency Plan possible.

Sincerely,

David Hornbacher
City of Aspen Utilities and Environmental Initiatives Director

Municipal Water Efficiency Plan

City of Aspen, Colorado

ELEMENT Water Consulting & WaterDM

October 2, 2015

MUNICIPAL WATER EFFICIENCY PLAN

City of Aspen, Colorado

THE CITY OF ASPEN

PREPARED BY

ELEMENT
Water Consulting

P.O. BOX 140785
DENVER, CO 80214

AND

WaterDM
DEMAND MANAGEMENT

1339 HAWTHORN AVENUE
BOULDER, CO 80304

October 2, 2015

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LIST OF ABBREVIATIONS

AF	acre-feet
AF/yr	acre-feet per year
AMI	automated metering infrastructure
AWC	average winter consumption
cfs	cubic feet per second
CII	commercial, institutional, and industrial
City	City of Aspen
CWCB	Colorado Water Conservation Board
ECU	equivalent capacity units
deg F	degrees Fahrenheit
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
MG	million gallons
MGD	million gallons per day

Report cover photograph taken from Red Mountain, provided by City of Aspen staff.

ACKNOWLEDGEMENTS

The development of the City of Aspen Water Efficiency Plan was a collaborative effort funded by a CWCB grant as part of the Roaring Fork Watershed Regional Water Efficiency Plan. The project has been supported through the financial and in-kind participation of the following stakeholders:

- City of Aspen;
- Town of Basalt;
- Town of Carbondale;
- City of Glenwood Springs;
- Snowmass Water and Sanitation District;
- Colorado Water Conservation Board;
- Ruedi Water & Power Authority;
- Roaring Fork Conservancy;
- Community Office for Resource Efficiency;
- Colorado River District.

City of Aspen staff provided access to detailed datasets and system information that facilitated the preparation of this Water Efficiency Plan. The consultant team would like to thank the following staff members and affiliated consultants for their time and input on this document:

- Lee Ledesma (City of Aspen)
- Phil Overeynder (City of Aspen)
- William Dolan (City of Aspen)
- David Hornbacher (City of Aspen)
- Jeff Rice (City of Aspen)
- Ashley Perl (City of Aspen)
- Valerie Forbes (City of Aspen)
- Tyler Benton (Wilson Water Group)
- Cynthia Covell (Alperstein & Covell, P.C.)

EXECUTIVE SUMMARY

PROFILE

The City of Aspen ("City" or "Aspen"), Colorado, located in Pitkin County, is a municipality established in 1881. Aspen is a Home Rule Municipality that operates under a council-manager governmental structure. Aspen is located in the upper reaches of the Roaring Fork Valley near the confluences of the main-stem of the Roaring Fork River with Hunter Creek, Castle Creek, and Maroon Creek at an elevation of approximately 7,900 feet. Aspen is located along Colorado State Highway 82 approximately 20 miles west of Independence Pass. The incorporated area (within the municipal boundary) consists of approximately 3.83 square miles. However, at this time, the total service territory is approximately 8.5 square miles, and includes unincorporated areas served by Aspen. The City's year-round, full-time service area population was approximately 10,506 residents as of 2014.

Aspen owns and operates its own water utilities. It provides treated (i.e. potable) water to all customers in the service area and raw water for irrigation and snowmaking purposes to a small subset of customers. Aspen obtains it treated water supply primarily from the surface water sources of Maroon Creek and Castle Creek, and the City also uses three groundwater wells as a supplemental supply. Aspen has adopted a policy to maintain streamflows in the creeks downstream of its diversion structures at flow rates at or above the Colorado Water Conservation Board's decreed instream flow rights for the protection of the fishery and the associated aquatic habitats in those streams.

POPULATION

According to the 2010 Census, the full-time population within the municipal boundary of Aspen was 6,658 people, up from 5,914 full-time residents as reported in the 2000 Census. The City also has contracts to provide water service to areas outside of the municipal boundary, and after adding these full-time residents, the total number of year-round, full-time residents served was approximately 8,895 in 2000 and 10,016 in 2010. The City uses a preferred planning growth rate projection of approximately 1.2% per year, under which the year-round, full-time service area population is projected to increase to approximately 11,285 people in 2020 and 13,496 people in 2035.

Due to tourism and seasonal population fluctuations, the 2013 peak month population was estimated to be approximately 36,540 people. When compared to historical data, the peak month population is approximately 3.5 times the full-time service area resident population.

WATER DEMAND FORECASTS

As part of the water efficiency planning process, three distinct treated water demand forecasts were prepared. The forecasting addresses treated water use only, and does not attempt to forecast future water use associated with raw water delivery or reclaimed water use. Each

forecast considers impacts from future increase in population, but assumes the same proportion of permanent to seasonal residents/visitors that exists today. Furthermore, the forecasts do not factor in impacts from additional future climate change beyond the impacts included in recent water use data.

First, a baseline demand forecast starting from 2015 and going out to 2035 was prepared. **This baseline forecast did not include the impact of water conservation of any kind, even passive water savings, and was developed only to assess the adequacy of future supplies with the current unit rate of water use but under a higher population, and to demonstrate the impact of anticipated efficiency improvements.** The baseline treated water demand used in forecasting was 3,377 acre-feet per year (AF/yr) and under the baseline forecast, is expected to increase by 803 AF/yr to 4,180 AF/yr in 2035.

A second treated water demand forecast through 2035 includes the impact of passive efficiencies from Colorado legislation, and federal plumbing codes and standards. This forecast found that City water demands will increase to 4,137 AF in 2035, or 43 AF less than under the baseline forecast.

A third forecast was prepared that includes the anticipated impact of the City's planned water efficiency program measures described in this plan. Under this forecast, treated demand increases to just 3,597 AF in 2035. Compared with the original baseline forecast, if the elements of this plan are fully realized, then it is estimated that treated water demand at 2035 will be reduced by 583 AF as a result of passive and active water conservation measures in Aspen.

These forecasts form the core of the Water Efficiency Plan and are the forecasts upon which estimated conservation savings are based. The analysis completed for this water efficiency plan indicates that the likely yield of the City's direct flow water rights is around 26,850 AF in a dry year; however, some of the City's water rights are decreed for irrigation use only, and cannot be used as part of the City's treated water supply. The maximum annual treated water use in Aspen over the past 5 years was 3,220 AF in 2012 and the range of forecast future demands in the year 2035 are from 3,597 AF to a maximum of 4,180 AF. While the historical dry year yield of the City's water rights appear sufficient to meet current and forecast future demands, the dry year supply figure is misleading. The City, unlike many Colorado municipalities, does not have a significant water storage component to its water system that would allow it to store water supplies when they are available, and release stored water when it is needed. Storage allows a water provider to retime deliveries of water supplies to match water deliveries with demands.[1] Without storage, the City is dependent upon streamflow availability at its river

[1] Aspen holds decreed conditional storage rights on Castle Creek and Maroon Creek, but environmentally-sensitive construction of these reservoirs will be extremely costly, so Aspen is first implementing other options

diversion points. Streamflow is susceptible to annual variation and changing conditions, including diurnal streamflow fluctuations, as well as catastrophic events such as landslides, fires or other events that can prevent diversion from Castle Creek or Maroon Creek for some period of time. For Aspen, the water supply is most vulnerable in the late summer, after the snowmelt runoff period when landscape irrigation demands are still high. Furthermore, the available water supply is limited by Aspen's commitment to actions to protect decreed instream flows, continue the effectiveness of conservation programs, as well as to implement water supply improvements already underway. These limitations are addressed in more detail in Section 5.1.1.

CLIMATE CHANGE IMPACT ON WATER USE AND HYDROLOGY

Recent climate change forecasts for the Aspen region indicate a warming trend throughout the year, including irrigation season temperature increases, with potential for more precipitation to occur as rain rather than snow (Lukas et al. 2014). While it is becoming more common to consider potential climate change impacts on water supply planning, the likely impacts on water demands are less well understood. Some climate change impacts on water demands may already be included in the forecasts provided in this plan, because recent water demands are utilized to project future water demand patterns and the recent demands reflect actual consumption patterns based on current climate conditions. Regular updates to these projections and this plan can assist in better understanding both demand-side and supply-side impacts from future climate change. Without conducting a more detailed investigation of potential climate change impacts on both supplies and demands, a sensible approach to water demand forecasting in a changing climate is to regularly update and refine demand projections based on actual current conditions. In addition to tracking changes in water use, tracking changes in hydrology (such as base flow conditions that are reached earlier in the year) would benefit water conservation efforts by focusing attention on the need to reduce water usage during peak water use periods, recognizing that peak water use periods may shift as a result of climate change.

WATER EFFICIENCY PLANNING PROCESS AND GOAL SETTING

The City carefully developed this Water Efficiency Plan in accordance with the Colorado Water Conservation Act of 2004 so that it meets or exceeds all statutory requirements according to Colorado Revised Statute § 37-60-126. The City utilized the Colorado Water Conservation Board (CWCB) *Municipal Water Efficiency Plan Guidance Document* dated July 2012 to inform and guide the development of this plan.

To fulfill Colorado's statutory water conservation planning requirements, a series of water conservation program scenarios were developed that incorporated a wide variety of indoor and

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discussed in this plan in its effort to efficiently provide a legal, reliable water supply to its customers. The timing, cost and ultimate configuration of the storage reservoirs will continue to be evaluated.

outdoor efficiency measures that have been cost-effective when implemented in other Colorado utility service areas. A number of indoor water conservation measures have already been implemented in Aspen. Therefore, for Aspen, a focus on outdoor water efficiency is the most appropriate and cost-effective approach to implement in the future. The following water efficiency measures have been identified as providing a reasonable cost savings for the utility or customers by reducing water demands:

- Landscaping regulations for new development,
- Water Shortage ordinance,
- Slow the Flow landscape water audits,
- Garden-in-a-Box price buy-down,
- Xeriscape educational seminars,
- Conservation pricing, and
- On-going customer education and information.

The City has demonstrated a long-term commitment to wise water stewardship and responsible and efficient use of its water resources. The City has established an average water efficiency goal of approximately 28 AF (0.7%) reduction in treated demand per year compared with a continuation of current demand. By 2035, it is estimated that this program will reduce treated demand by about 583 AF – an overall 14% reduction in demand.

Based on careful analysis of current treated demands and expected growth, the City believes this level of savings to be realistically achievable. This goal will be re-evaluated on a regular basis, as Aspen intends to update the Water Efficiency Plan every seven years. This means that at least two plan updates, and possibly more, are expected to be completed before 2035, affording ample opportunity to update and refine the City's efficiency program and goals as needed.

WATER EFFICIENCY PROGRAM

In 2006, the City added a Utilities Efficiency Division including a dedicated staff manager. The Utilities Administrative division oversees the water efficiency program with support from other staff members. In addition, the City hires outside contractors to assist in implementing certain water efficiency program activities such as leak detection. The City has demonstrated a commitment to water use efficiency, and has implemented many fundamental and proven water conservation measures including metering, a conservation-oriented water rate structure, utility water loss reduction (including water-saving equipment indoors), and public education and information about water efficiency.

The City approved its first water conservation plan in 1996, as an element of the larger Water Management Plan. While the 1996 plan did not contain all of the necessary elements to meet approval by the CWCB, it was quite progressive for the period. Aspen's water conservation and

efficiency plan is being updated as part of the City's participation in the Roaring Fork Watershed Regional Plan.

WATER EFFICIENCY PLAN APPROVAL

A 60-day public review period was conducted and to the extent possible, comments were incorporated in this plan. On September 28, 2015, the Aspen City Council adopted the plan with the updates included in this final version of the plan. On [**DATE**], the City received official notification that the plan was approved by the Colorado Water Conservation Board.

ROARING FORK REGIONAL WATER EFFICIENCY PLAN

The City of Aspen is the most upstream utility participating in the regional water efficiency planning effort. Aspen's Water Efficiency Plan has potential to directly impact flows in the upper Roaring Fork River basin, although Aspen cannot guarantee that water it saves through conservation efforts will benefit the entire reach of the Roaring Fork to the extent that other downstream water users may divert that water out of the river. One of the benefits of Aspen's water savings under this Water Efficiency Plan will be to strengthen its ongoing commitment to benefit and enhance streamflow in the upper Roaring Fork River basin as demonstrated by its 1980 lease of its senior Hunter Creek Flume & Pipeline water right to the CWCB for instream flow, its intergovernmental agreement with the CWCB to operate the City's Castle Creek water rights in a manner that allows the decreed minimum streamflow to be maintained under most conditions, participation in the "Forbearance Agreements" with the Colorado Water Trust in which Aspen bypasses a portion of its Wheeler Ditch water right during the irrigation season when the instream flow is not satisfied, and other activities. The City is interested in regional partnership to improve water efficiency and is committed to assisting with the implementation of the Roaring Fork Regional Water Efficiency Plan.

1. PROFILE OF EXISTING WATER SUPPLY SYSTEM

1.1 OVERVIEW[2]

The Aspen area was originally discovered by the Ute Indians and called "Shining Mountains". The first silver miners arrived in the Roaring Fork Valley in the summer of 1879 and set up camp at the foot of Aspen Mountain. Before a permanent settlement could be established, news of a nearby Indian uprising prompted Colorado's Governor Frederick Pitkin to urge the settlers to flee back across the Continental Divide for their safety. Most of them did, and only a handful of settlers remained in the Roaring Fork Valley during the winter of 1879. Those that remained attempted to organize the camp and passed a resolution to respect the claims of those who had fled, as well as the claims of those settlers who stayed. This action transformed the small group of settlers into a "sovereign" body in the eyes of the State of Colorado and recognized that the rules of local mining districts under the federal mining law of 1866 were to be followed. The citizens had begun the process of organizing themselves into a political body.

The City of Aspen, Colorado is a municipality that was incorporated in 1881. Aspen is a Home Rule Municipality that operates under a council-manager governmental structure. First christened Ute City, the town of 300 residents was renamed Aspen in 1880. By 1891, Aspen had surpassed Leadville as the nation's largest single silver producing mining district. The demonetization of silver in 1893 led to Aspen's decline as a mining town. During the silver boom days of the 1890s, Aspen's population grew to 12,000 citizens. After the silver bust in the early 1900s, as few as 700 people remained in Aspen. Reborn as a ski town in the 1940s, Aspen was also molded into a cultural center.

Aspen is located in the upper reaches of the Roaring Fork Valley near the confluences of the main-stem of the Roaring Fork River with Hunter Creek, Castle Creek (**Figure 1**), and Maroon Creek at an elevation of approximately 7,900 feet. Aspen is located along Colorado State Highway 82, approximately 20 miles west of Independence Pass. The mean annual precipitation in Aspen is 24.6 inches, and the mean temperature from May to September is 63.2 °F (WRCC 2014).

[2] Historical information was obtained from http://www.aspenpitkin.com/Exploring-the-Valley/History/.

Figure 1. Photograph of Castle Creek.

The City is expanding slowly and has a preferred long-term planning growth rate projection of 1.2 percent per year. It is estimated that the year-round, full-time population of Aspen's service area will increase to approximately 11,285 people in 2020 and 13,496 people in 2035.

1.2 Regional Setting

The Roaring Fork Watershed is located within the Colorado River Basin in central Colorado on the west side of the Continental Divide. The watershed includes the Sawatch, Collegiate and Elk Mountain Ranges and 8 peaks exceeding 14,000 feet in elevation. Snowmelt from the mountainous headwaters contributes to the streamflow in three primary rivers (Roaring Fork, Fryingpan, and Crystal) that eventually contribute to the flow in the Colorado River in the City of Glenwood Springs. The drainage area of the Roaring Fork watershed is approximately 1,450 square miles.

According to the State Water Supply Initiative (SWSI, 2010), the Colorado River Basin has a projected 2035 M&I water supply gap of 40% with respect to projected water demands. The Colorado River Basin supplies water to over 30 million people in the arid southwest, with the Roaring Fork Watershed contributing about 991,100 AF to the Colorado River per year (USGS, 2013).

The Roaring Fork Watershed experiences a wide range of climatic conditions from year-to-year as well as from season to season. Climatological records provide evidence of recurring major

droughts in Colorado of various length and intensities. Water suppliers in the West accommodate this uncertainty through reservoir storage, consideration of "firm yields" in estimates of water availability, raw water supply development, and "demand side" strategies such as voluntary or mandatory restrictions on outdoor water usage. Plans to reduce usage are necessary to stretch the available water supply to help meet future demands and sustain supplies during periods of drought.

Water supply systems in the Roaring Fork Watershed are at risk from possible forest fire, floods, failure of dams/mains/wells, and contamination of all or part of the raw water supply. In order to respond to emergency or drought situations, contingency plans are typically designed for implementation of mandatory water use restrictions in stages that minimize impacts to the economy, life-styles, and environment of the community.

1.3 WATER SUPPLY AND RELIABILITY

Aspen owns and operates its own water utilities with the exception of the wastewater treatment plant, which is maintained by the Aspen Consolidated Sanitation District. The City of Aspen Water Department (**Figure 2**) provides a legal, reliable supply of safe, high quality drinking water. City staff maintain raw water deliveries to the water treatment plants (WTPs) in sufficient quantities to meet system demands. Staff also perform operations and maintenance functions for the treatment facility, booster stations, pump stations, vaults and storage tanks, and the Thomas Reservoir located adjacent to the treatment plants. Crews perform routine laboratory testing and reporting per the Colorado Department of Public Health and Environment (CDPHE) guidelines and requirements.

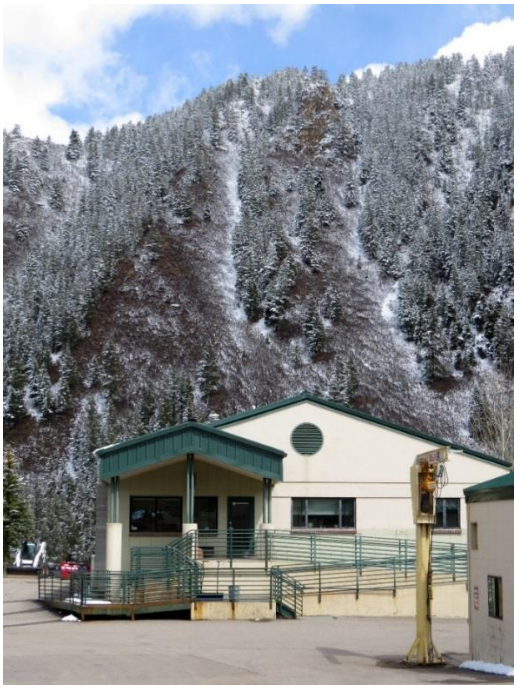

Figure 2. Photograph of City of Aspen Water Department.

The City utilizes water from five primary sources: Maroon Creek, Castle Creek, Little Nell Well, Mill Street Well, and Rio Grande Well. Aspen has a long history of commitment to protecting instream flows. In 1980, Aspen entered into an agreement with the CWCB to allow the City's very senior 15 cfs Hunter Creek Flume and Pipeline water right to be used for instream flows on Hunter Creek, and the water court approved that use. In 1993, the City Council adopted water management policies intended to provide for current and future municipal water needs while at the same time maintaining decreed minimum streamflows and aquatic habitat. Aspen has an intergovernmental agreement with the CWCB to protect the natural environment of Castle Creek by operating the City's water rights on Castle Creek in a manner that will allow the decreed minimum streamflow of 12 cubic feet per second to be maintained under all but the most severe drought conditions, or emergencies. Although Aspen does not have a similar agreement regarding Maroon Creek, Aspen also operates its senior Maroon Creek water rights in a way that protects the decreed instream flows. More recently, Aspen negotiated temporary "Forbearance Agreements" with the Colorado Water Trust in 2013 and 2014, under which Aspen agrees to not divert a portion of its senior Wheeler Ditch water right during the irrigation season when the CWCB's decreed instream flow in the Aspen reach of the Roaring Fork River is not being satisfied.

1.3.1 Treated Water Supply

Aspen has two river sources of raw water supply for its treated water system. The primary supply intake is on Castle Creek and another intake on Maroon Creek is generally used as a supplemental supply. These diversions are conveyed to the City's WTPs located on the city-owned Thomas property. Both intakes utilize "run of the river" and are not currently backed up by a significant raw water storage reservoir. All water delivered to the WTPs is first delivered to the Leonard Thomas Reservoir (**Figure 3**) before undergoing treatment. The capacity of Leonard Thomas Reservoir is 13 acre-feet (AF) or 4.2 million gallons (MG). Aspen also has water rights and a water treatment facility on Hunter Creek, which is presently not operational because there is adequate treatment capacity for the Castle Creek and Maroon Creek diversions. Since the supplies from Castle Creek and Maroon Creek, backed up with the wells, meet Aspen's current needs, and the Hunter Creek Flume and Pipeline water right is being used for instream flow protection, Aspen does not have current plans to operate the Hunter Creek plant in the immediate future.

Figure 3. Photograph of Leonard Thomas Reservoir.

The treated water system is also supplemented by three municipal groundwater wells located in the downtown area that are treated at the source: Little Nell Well, Mill Street Well, and Rio Grande Well. The groundwater wells have a combined capacity of approximately 3.0 million gallons per day (MGD). The wells can be used during drought periods when the City wants to reduce diversions from its surface water sources for quality reasons or to protect decreed instream flows when streamflows are approaching the instream flow thresholds. Well water can also be used for other municipal purposes. Water produced from the groundwater wells does not meet the water quality standard for fluoride level, so the water must be blended with other supplies or used for non-potable purposes.

The City of Aspen's water distribution system consists of 16 separate pressure zones. The pressure zones are supplied by 14 water storage tanks that are fed by 14 pumping stations and the three wells. The water distribution system is comprised of approximately 73.2 miles of water mainlines that range in size from 24" to 4" in diameter.

1.3.2 Raw Water Supply

Aspen’s raw water (i.e. non-potable) system, managed by the City of Aspen Raw Water Division, provides an irrigation supply to the City of Aspen golf course, selected parks, and limited private

properties. The City uses raw water supplies for maintenance of "aesthetic features" such as fountains, the City malls, and many of the City's street trees located along the ditch system.

On the east end of downtown, the City operates the Wheeler, East Aspen, and Durant ditch system, which provides water for the downtown mall, fountains and aesthetic features, and stormwater cleaning at Rio Grande Park. At the west end of downtown, the City operates the Si Johnson Ditch which provides water for street trees as well as providing raw water service for irrigation of private properties, including Aspen Institute. Outside of the City's boundaries, water which originates from Aspen's Castle Creek and Maroon Creek rights and is delivered to the Leonard Thomas Reservoir is used as a supply for irrigation for the Meadowood common area, as well as the hospital and medium-density housing developments in the area. Raw water from Leonard Thomas Reservoir is also used as the source of supply for snowmaking operations at the Aspen Ski Resort.

The Holden and Marolt ditch systems are also operated by the City from diversion points on Castle Creek. These ditch systems provide water for irrigation of the Municipal Golf Course, the Marolt Open Space, the Red Butte Cemetery, and numerous private properties comprising the Castle Creek Homeowner Association.

The City operates the Maroon Creek hydroelectric plant which utilizes water diverted at the Maroon Creek headgate near the T-Lazy-7 Ranch and returns it to Maroon Creek approximately ½-mile south of the entrance to the Aspen Highlands Ski Area. Maroon Creek diversions are primarily made for hydroelectric generating purposes; however, diversions are also conveyed to the WTPs when necessary to supplement or, at times, to replace diversions from Castle Creek.

1.3.3 Water and Wastewater Treatment

The City currently has two filtration plants in operation, which are referred to as the West and East Treatment Plants, or collectively as the "WTPs" in this document. The West Treatment Plant was constructed in 1965 and has a design capacity of 8 MGD; the East Treatment Plant was constructed in 1985 with a design capacity of 12 MGD. The water treatment facilities are located adjacent to one another and receive raw surface water diversions from both Castle and Maroon Creeks. Each stream has a dam and inlet structures with underground pipelines that convey water to the 13 AF receiving reservoir, Leonard Thomas Reservoir, located at the site of the WTPs. The Castle Creek Pipeline is approximately two miles in length and the Maroon Creek Pipeline is about five miles in length. The WTPs collectively produce approximately 1.0 billion gallons of treated water per year, or approximately 3,070 AF/yr.

City staff indicate that both plants are in excellent condition and have the capacity to supply the City with 100% of its treated water demands at this time. The City has an additional treatment plant, with a design capacity of 0.5 MGD, located off Hunter Creek Road on Red Mountain. That plant is not currently in use. The Hunter Creek facility was constructed to treat water from Hunter Creek during times when that source of supply was necessary. As noted above, the Hunter Creek supply is not currently needed for treated water uses, and is being used for

instream flow protection. The City does not plan to use this water plant in the foreseeable future.

Each treatment plant is designed to operate with pretreatment, filtration, and disinfection before distribution. Pretreatment is accomplished through chemical addition to the raw water before it enters the sedimentation basin or the clarification basins. The chemicals react with the water to cause the sediment particles to attach to each other thus becoming larger and heavier causing the sediment to fall out of suspension prior to filtration. In the filter plant, polymers are added to aid the filters in separating out the remaining small particles in the water. The water is then filtered. Fluoride and chlorine are added before the water goes to the 2 MG contact tank. The 2 MG contact tank allows time for the chlorine to react (disinfect) with the remaining bacteria and microscopic organisms before going out into the distribution system. In order to keep up with requirements of the CDPHE, a serpentine curtain has been installed in order to increase the contact time of the water with chlorine. This baffle has been in use since 1994.

1.3.4 Capacity and Reliability

For water supply planning purposes, the City of Aspen uses the critically dry year of 1977 which is on par with the more recent critically dry years of 2002 and 2012 and is a good representation of the firm yield of the City's water rights from both Maroon and Castle Creeks under current climate conditions. The City's water consultant has estimated the dry year firm yield of the City's water rights based on the following assumptions (Wilson Water Group 2014):

- Water diverted from Maroon and Castle Creeks is used in addition to the yield from one of the three wells[3] currently in place.
- Year-round instream flows of 14.0 cfs on Maroon Creek and 13.3 cfs[4] on Castle Creek are met, which include the CWCB instream flow water rights and additional instream flow on Castle Creek that the City of Aspen plans to maintain.
- Maximum capacity of the water treatment plant is approximately 30.9 cfs (20 MGD).
- Irrigation requirements are based on historical diversions from 2011-2013 and totaled 32 cfs. This represents diversions through the Holden, Marolt, and Si Johnson Ditches. Irrigation diversions were assumed to take place May through October.

Based on these assumptions, the annual firm (1977) water supply available for treated and raw water irrigation diversions from Castle Creek and Maroon Creek is estimated to be around 26,850 AF/yr at current infrastructure capacities. However, the City does not have a storage component that would allow it to retime water supplies to match water deliveries with demands. Rather the City is dependent upon streamflow availability, which is susceptible to annual variability and changing conditions, as well as daily variability. For Aspen, the water supply is most vulnerable in the late summer, after the snowmelt runoff period has ended, and

[3] The analysis limits the yield to one of the three wells due to current water quality-related pumping limits.
[4] The Castle Creek instream flow decree is for 12 cfs but the City intends to maintain a flow of 13.3 cfs.

when landscape irrigation demands are still high. Under historical hydrology patterns, and considering Aspen's goal of protecting decreed instream flows as described above in addition to continued raw water diversion for irrigation, the daily firm yield of the treated water system is estimated to be around 7.8 MGD.

While the City's supplies appear to be sufficient for current and future demands under historical hydrology conditions, without storage, a change in the volume or timing of streamflow and/or demand growth beyond the levels currently projected (this plan considers growth in demand through 2035 while the City's water planning extends to 2065) would result in the City having a water supply issue in dry years. For example, **Figure 4** below shows a potential municipal demand scenario in the year 2065[5], based on the City's water planning and forecasting that is conducted independent of this water efficiency plan. As depicted, this scenario would result in a significant water supply shortage during the late summer if the water supply was similar to a historical critically dry year such as 1977.[6] This emphasizes the importance of demand management, particularly for landscaping purposes.

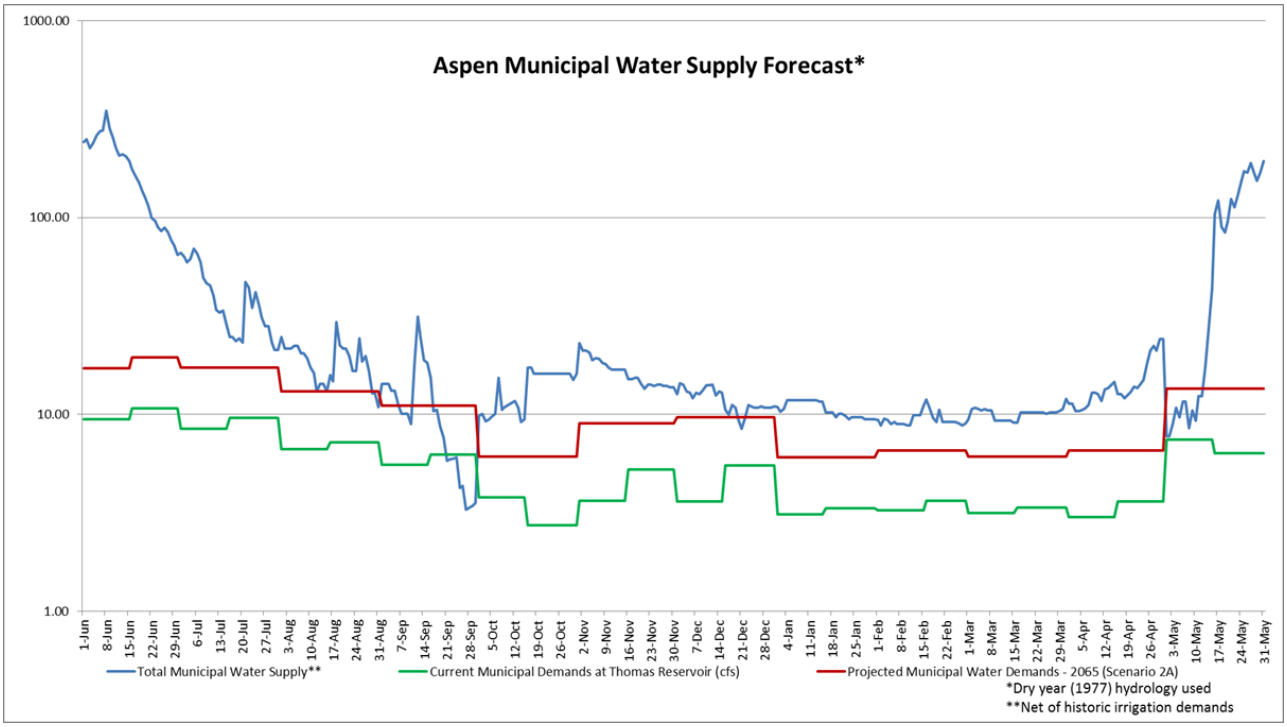

Figure 4. Potential Municipal Demand Scenario in the Year 2065.

[5] The 2065 projected municipal water demand shown in Figure 4 does not include use of reclaimed water.
[6] This projection does not include storage in the Castle Creek Reservoir or Maroon Creek Reservoir, for which Aspen holds conditional storage rights. Because of the very high cost and complexity of constructing these reservoirs to be both environmentally-sensitive and to provide water when Aspen needs it, the current planning scenario does not include these reservoirs. However, Aspen continues to study the cost and timing of these reservoirs, and the conditional decrees remain an important component of Aspen's portfolio of water rights.

1.3.5 Current and Proposed Water Supply Projects

Earlier studies indicated that Aspen's available water supply would be fully utilized to meet anticipated treated and untreated water needs by the mid-1990's and that it would be necessary to develop surface water storage expeditiously in order to meet the continuing growth within the service area. Actual growth has closely matched earlier growth projections; however, an aggressive water conservation program has reduced the amount of water used to a point where surface water storage can be deferred. The following is a current list of projects being implemented, or considered for implementation.

1.3.5.1 Reclaimed Water System

Aspen's Reclaimed Water System is being constructed to increase the availability of water in Castle Creek by shifting a portion of the diversions for the Aspen Golf Course and other irrigation demands to utilize treated wastewater effluent as a source of supply rather than to rely exclusively on delivery of water from Castle Creek. This shift will free up an additional 1.0 MGD of supply from Castle Creek, which can be used to supply the treated water system that relies on this same source of supply. At the same time, it also contributes to the City's commitment to maintain instream flows of 13.3 cfs on Castle Creek for aquatic habitat, even during critically dry periods. The Reclaimed Water System will be completed in 2015. It is anticipated that this system will increase the available raw water supply by approximately 12% over the current rated capacity. On an equivalent capacity unit (ECU) basis, the available supply will be increased from 18,250 to approximately 20,400 ECU when the Reclaimed Water System is online. At historical growth rates of approximately 200 ECUs per year (net), this implies that the next source of supply beyond the reclaimed water project would need to be brought on line in approximately a 10-year period, or by approximately 2025. Note that neither the demand forecasts nor the supply estimates for this water efficiency plan include the use of reclaimed water.

1.3.5.2 Roaring Fork Supply

The City of Aspen may eventually need to develop and utilize its water rights that allow for the diversion of water directly from the Roaring Fork River for municipal treated water uses. Constraints associated with the use of this water supply for treated water uses include the need to meet water quality standards and the need to pump developed supplies up to the gravity zone that supplies Aspen's core area. It is likely that more extensive water treatment, including micro-filtration, would be necessary for this source since multiple prior uses may have degraded source water quality. Land availability for facilities necessary for this alternative is also constrained due to the developed nature of sites near the river.

1.3.5.3 Salvation Ditch Pumpback

This alternative source of supply would require developing an agreement with the owners and users of the Salvation Ditch to exchange water from its current point of diversion on the Roaring Fork River for a new supply diverted from the Roaring Fork River below its confluence with Maroon Creek. A new water right for this location would be used to pump water into the

Salvation Ditch and replace existing Salvation Ditch diversions with a substitute supply. The water exchanged from the Salvation Ditch would be used to supply a new (or replacement) water treatment facility. Candidate treatment plant sites include the City's existing Hunter Creek Treatment Plant site.

1.3.5.4 Wellfield Development

Development of the City's alluvial groundwater supplies has been impeded by several water quality issues, including the adoption of a fluoride standard and the presence of higher levels of radionuclides. The water quality restrictions currently limit the extent that these wells can be utilized as a treated water supply. While it may be possible to blend water from the alluvial wells with other sources of supply or otherwise treat this water supply to a level that fully complies with drinking water standards, currently the amount of water that can be produced from the three wells during a critical dry period is less than previously assessed. Modifications to the wells and distribution system, or further treatment, could be employed to reduce the limitations on well use. Also the City has converted irrigation systems on selected parks and open spaces to accept water from the existing wells, thereby freeing up treated water currently used for this purpose.

Development of bedrock wells with completion depths greater than 1,000 feet may provide an additional source for Aspen's supply of treated water. Feasibility analyses are needed to assess the viability of developing this groundwater resource.

1.3.5.5 Reservoir Storage

The potential need for surface storage of snowmelt runoff from Castle and Maroon Creeks has been included in the City's Water Management Program since the 1960's. After the Fryingpan-Arkansas Project's western slope compensatory storage facility was moved from the originally-proposed Aspen Reservoir site to the Ruedi Reservoir site, Aspen appropriated the Castle Creek and Maroon Creek Reservoir water rights. Aspen has always known that these are expensive, difficult reservoirs to construct, and in the mid-1990s, staff, with the approval of City Council, determined to focus on leak detection and repair, conservation, and development of a well system to reduce water demand from the creeks, thereby deferring further into the future the need for this reservoir storage. The development of surface water storage at specific sites identified in conditional water rights held by the City for this purpose is expected to eliminate water shortage conditions, even if there is a significant shift in the amount or timing of snowfall accumulation and runoff due to factors such as climate change.

2. WATER DEMANDS AND HISTORICAL DEMAND MANAGEMENT

As part of the water efficiency planning process, three distinct treated water demand forecasts were prepared. The purpose of these forecasts was to present a range of reasonable estimates of treated water demand for Aspen through the year 2035, given anticipated population growth, and to estimate the impact of the water conservation measures that occur both

"passively" as a result of compliance with national and state plumbing codes and standards and "actively" as a result of specific programs and measures to be implemented by the City. These forecasts were also used for the important purpose of evaluating the adequacy of Aspen's water supply system to meet future demands.

The first step in the forecasting process was to gather data and information on the history of treated water demands and conservation in Aspen. Through a careful review of these data and information, a baseline demand for Aspen was established. Next, historical population data were used to establish the baseline population, and Aspen planning data were used to forecast population growth out to 2035. This section of the Aspen Water Efficiency Plan describes historical water demands and demand management efforts in the City.

2.1 Demographics and Service Area Characteristics

The City of Aspen provides both treated and raw water service to a total of approximately 3,870 customer connections within the City and in adjoining areas through service contracts. Aspen typically experiences seasonal population changes, associated with non-permanent residents and visitors. The weeks before/of Fourth of July and Christmas typically result in the highest water demands. With events like X Games, the City's population can increase up to a total of 100,000 consumers.

Aspen's metered customer connections are the primary focus of this water efficiency plan, but a number of additional customers are served by the City's water system. The water requirements of these customers (described in section 2.1.1) are also considered and accounted for in the demand forecasts presented later in this plan.

2.1.1 Additional Customers and Raw Water Sales

Approximately 8% of the treated water Aspen produces each year is provided for snowmaking and other purposes briefly described below.

- The City provides treated water for snowmaking at Aspen Mountain. Aspen Highlands receives raw water for snowmaking from the City via the Thomas Raw Water System.
- The City provides treated water to approximately 80 homes in West Buttermilk. This demand is metered in bulk by the City.
- The City has a small amount of bulk water sales each year for filler hydrant draw permits, typically related to construction.
- The City also has approximately 72 flat rate unmetered customers, typically for construction projects before a permanent meter is installed.

In addition to municipal treated water, the City provides untreated water from its irrigation ditch rights to the municipal golf course, selected municipal parks and for use by private landowners under raw water agreements. The City is currently evaluating use of its groundwater wells for the irrigation of some municipal parks to reduce the demand on raw surface water supplies.

2.1.2 ECUs

Aspen has a comprehensive system of record-keeping for water demand factors based on a fixture count (toilets, lavatories, outside irrigation, etc.) of each residence and business connected to the treated water distribution system. These fixtures are then converted to ECUs as a measure of the water demand expected from existing and new development. Aspen's Water Department has determined that an ECU can be approximated by a one bedroom, one bathroom home with a fully equipped kitchen, an exterior hose bib, and a ¾-inch domestic service line. The current inventory of ECUs connected to the system as of February 2014 is approximately 17,300, including wholesale supply contract deliveries. As a result of tracking water demand factors for building permits for all new construction and remodels, as well as limiting the total water demand in all new extraterritorial water service contracts, the City has a relatively accurate estimate of existing and anticipated future water demand factors on the treated water distribution system.

2.1.3 Metered Customers

Metered water customers are the primary focus of this water efficiency plan. To better understand water use among different categories of customers, Aspen uses the following customer category assignments for its water service accounts.

- Single family residential (detached single family homes)
- Multi-family with 2-4 units
- Multi-family with greater than 5 units
- Commercial
- City facilities
- Other – Irrigation Only

Customer information is stored in the utility's customer billing system.

2.2 HISTORICAL WATER DEMANDS

Total treated water demand for Aspen's system (including snowmaking, West Buttermilk bulk deliveries, etc.) was 3,220 AF in 2012 and 2,955 AF in 2013 as shown in **Table 1** below. Annual metered treated water use in the City of Aspen, the focus of the demand analysis for this efficiency plan, has ranged from 2,568 AF to 2,752 AF over the last 5 years (Table 1). Metered treated use was within 4% of the average in each of the 5 years, which suggests that the system demands fluctuate very little on an annual basis. Increases in population over the last five years have not caused a resultant increase in water demands (Table 1). These changes are typical of

municipal demand trends across the United States, which have generally declined or held steady in recent years even as population has increased. The City's current water rate structure, water efficiency program, national plumbing codes and standards, and programs like EPA WaterSense contribute to this decrease in per capita water use.

Baseline treated water demands of 3,186 AF/yr, (2,661 AF/yr for City customers and 525 AF/yr for snowmaking, West Buttermilk, etc.) were selected for use in forecasting future demand in Aspen as shown in Table 1.

Table 1. Annual Treated Water Deliveries from 2009 through 2013 and Baseline for Forecasting.

Year	City of Aspen Water Customers							Additional Water Sales				Total
	Full-Time Population	Single-Family Res.	Multi-Family Res.	Comm.	City Facilities	Other - Irrig. Only	**Total**	Unmetered Sales (Est.)	Snow Making (Aspen Ski Co.)	West Buttermilk	Bulk Water Sales	
2009	9,897	1,210	446	760	132	68	**2,616**	295	126	-	6	**-**
2010	10,016	1,289	497	785	115	66	**2,752**	273	142	-	6	**-**
2011	10,136	1,245	458	668	125	72	**2,568**	218	146	45	6	**2,983**
2012	10,258	1,390	485	647	129	85	**2,736**	246	151	81	6	**3,220**
2013	10,381	1,265	483	626	124	75	**2,573**	110	192	73	6	**2,955**
BASELINE	10,318	1,280	484	697	125	75	**2,661**	246	192	81	6	**3,186**

An estimated breakdown of indoor and outdoor historical metered treated water demands of all City customers in Aspen based on periodic consumption data provided by City staff are shown in **Table 2**. Typically, about 57% of the annual water demand in Aspen is for indoor purposes and 43% is for outdoor irrigation.

Table 2. City Customers, Total Treated Indoor and Outdoor Water Deliveries from 2009 through 2013.

Year	Indoor (AF/yr)	Outdoor (AF/yr)	% Indoor	% Outdoor	Temp (deg F)
2009	1,626	990	62%	38%	41.5
2010	1,535	1,217	56%	44%	41.8
2011	1,485	1,083	58%	42%	40.1
2012	1,515	1,221	55%	45%	41.4
2013	1,415	1,157	55%	45%	39.7
5-YR AVG	**1,515**	**1,133**	**57%**	**43%**	**40.9**

Aspen's metered treated consumption data were further disaggregated by water use sector as shown in **Table 3**. Indoor and outdoor demands for each category were estimated using a standard average winter consumption (AWC) approach where indoor use from the winter months (January, February, and December), when there is typically no outdoor irrigation occurring, is used to estimate indoor use for the entire year. Indoor use is then deducted from the total to estimate outdoor use.

Table 3. Sectoral and Seasonal Treated Water Deliveries from 2009 through 2013 (AF/yr).

Year	Residential		Multi-Family (2-4 units)		Multi-Family (5+ units)		Commercial		City Facilities		Other-Irrig. Only	Total	Unmetered Sales (Est.)	Snow Making (Aspen Ski Co.)	West Butte rmilk	Bulk Water Sales	Total[1]
	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	-	-					
2009	538	672	63	28	305	52	643	117	78	54	68	**2,617**	295	126	-	6	-
2010	469	821	61	65	303	69	641	144	62	53	66	**2,754**	273	142	-	6	-
2011	455	791	65	30	303	60	596	72	66	58	73	**2,570**	218	146	45	6	**2,985**
2012	518	873	62	38	307	78	559	89	69	59	85	**2,736**	246	151	81	6	**3,220**
2013	449	817	61	40	292	90	548	79	65	59	75	**2,574**	110	192	73	6	**2,955**
Avg.	**486**	**795**	**62**	**40**	**302**	**70**	**598**	**100**	**68**	**57**	**73**	**2,651**	228	151	66	6	**3,053**

[1]Totals are not available for 2009 and 2010, therefore the average total water deliveries are based on the average for 2011 through 2013.

As with most municipalities in Colorado, the City of Aspen's demands are higher during summer months due to outdoor water use. **Figure 5** shows the average monthly metered treated water demands over the past 5 years from 2009 to 2013 by water use sector versus the mean monthly temperature (WRCC 2014). As a result of outdoor water use, all water use sector demands increase during summer months from June through October. The residential pattern correlates particularly well with temperature during summer months, and the peak usage in July is 6.4 times the AWC. Multi-family residential and commercial water usage increases during summer months to a lesser degree, as evidenced by the peak monthly usage being 2.1 and 1.8 times the AWC, respectively. The peak city facilities usage exceeds the AWC by a factor of 4.0 in July, which suggests there is a fair amount of outdoor irrigation or other seasonal water uses. The distribution of treated sector demands in Aspen are also very consistent between years, as shown in **Figure 6**.

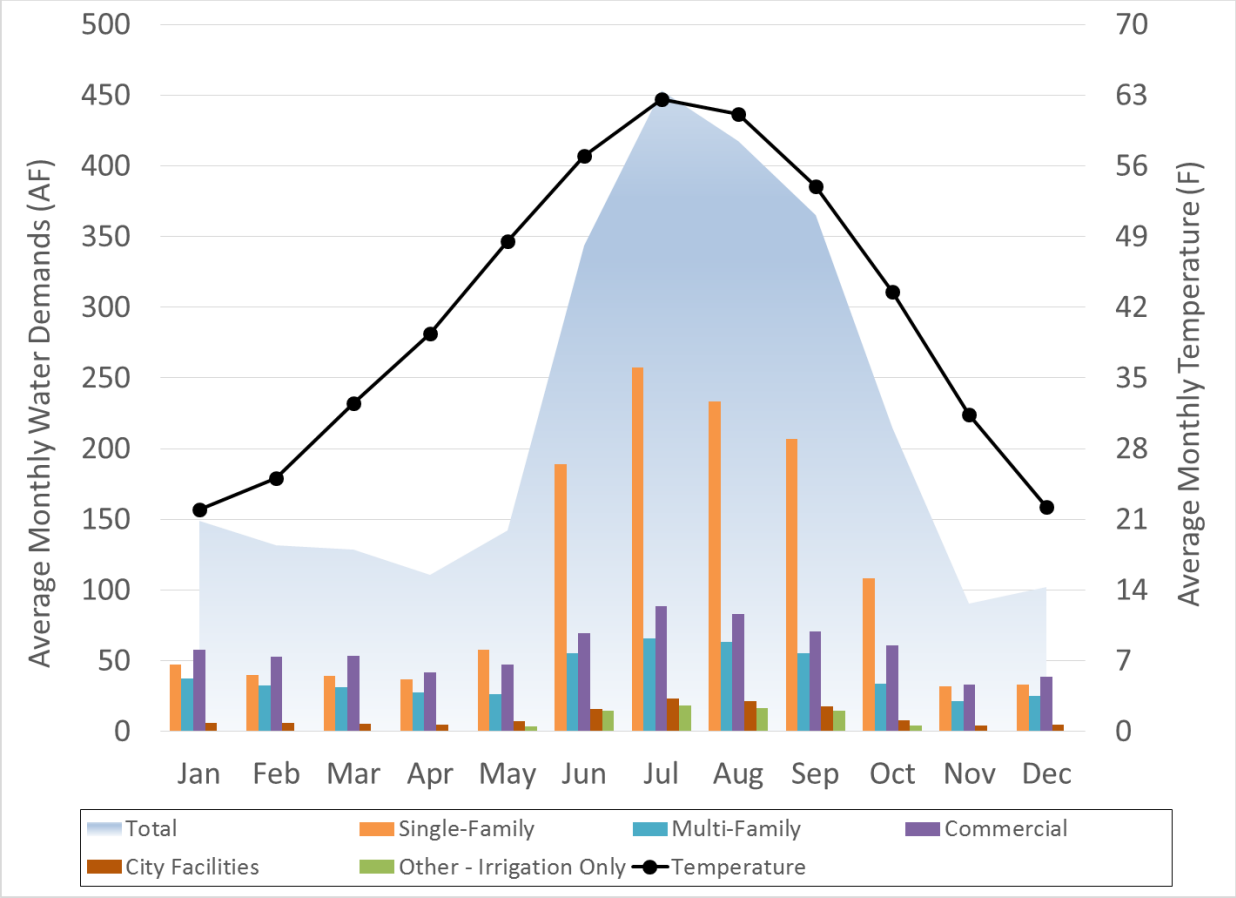

Figure 5. City of Aspen, Average Monthly Metered Treated Demands by Sector from 2009 through 2013.

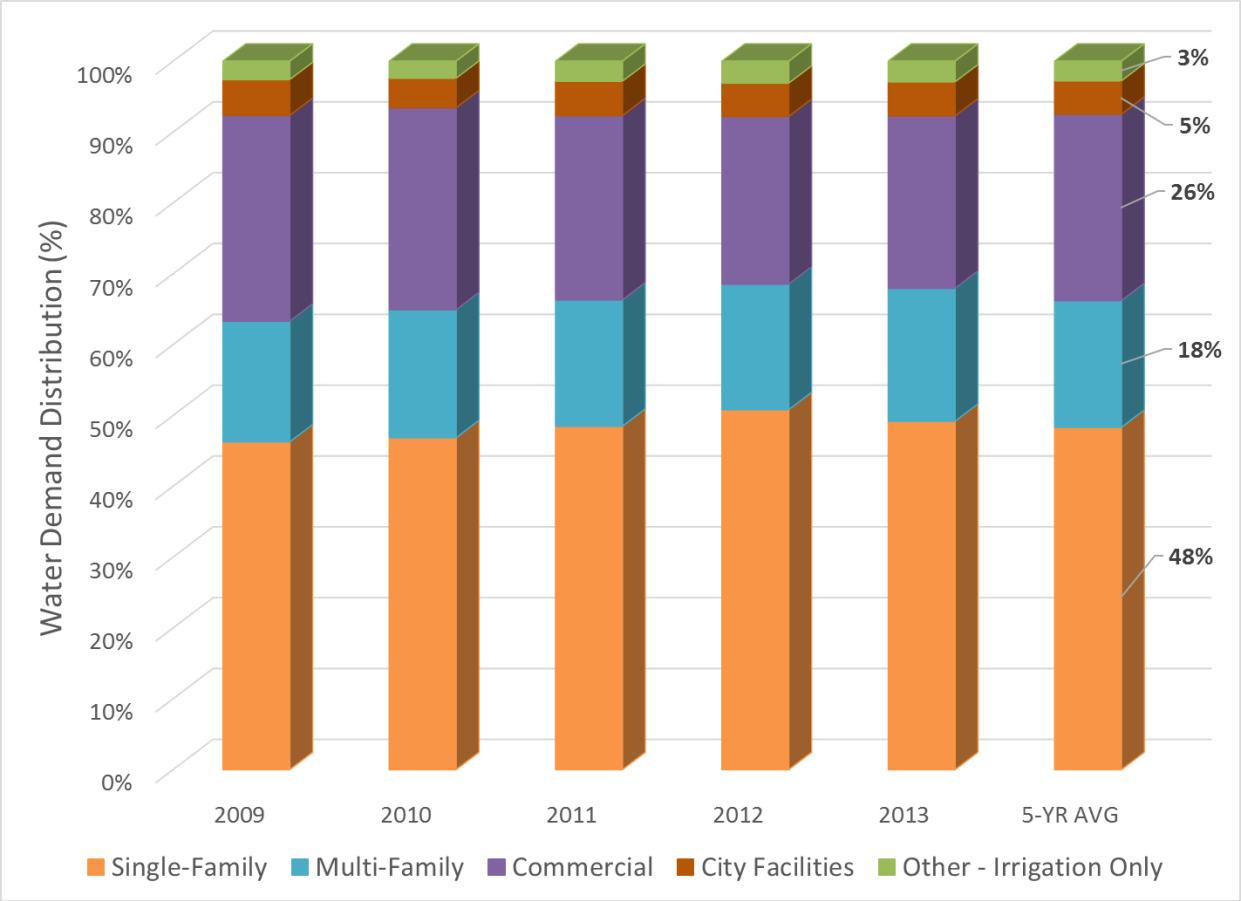

Figure 6. Distribution of Treated Metered Demands by Sector from 2009 through 2013.

In 2013, residential demand (single-family and multi-family) accounted for approximately 68% of the annual treated water demand for the City of Aspen water customers shown in Table 1. Commercial customers accounted for 24% of the treated demand, and the other categories (city facilities and irrigation) accounted for the remaining 8%. A pie chart showing the distribution of 2013 water usage including the additional water sales (unmetered, snowmaking, West Buttermilk, and bulk sales) is presented in **Figure 7**.

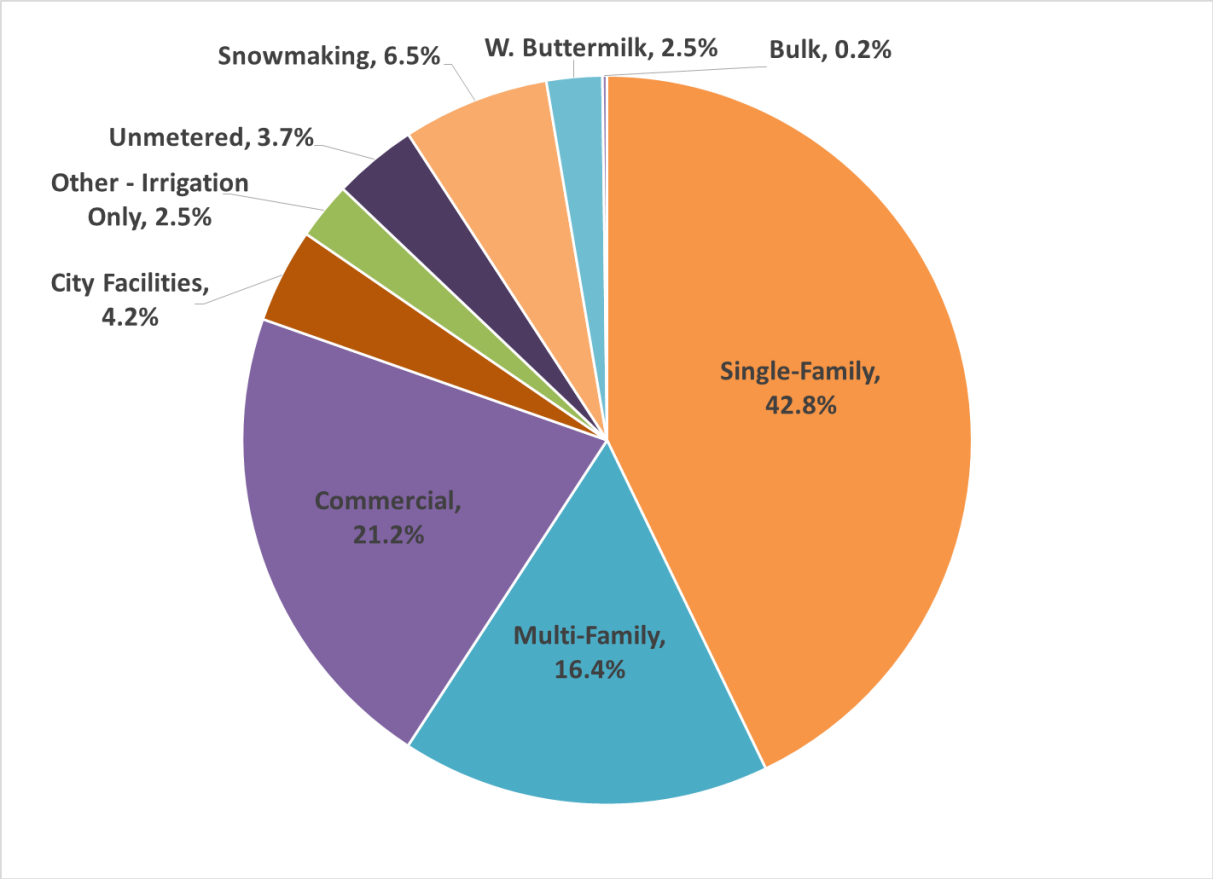

Figure 7. Distribution of Annual Water Use by Sector in 2013.

A pie chart showing the percentage of connections in 2013 by water use sector in Aspen is provided in **Figure 8**. Residential customers (single-family and multi-family) are most prevalent in Aspen, accounting for 84.5% of all service connections. Commercial customers account for 11.0% of connections, dedicated irrigation accounts account for 2.0% of connections, and the remaining accounts are attributed to city facilities connections.

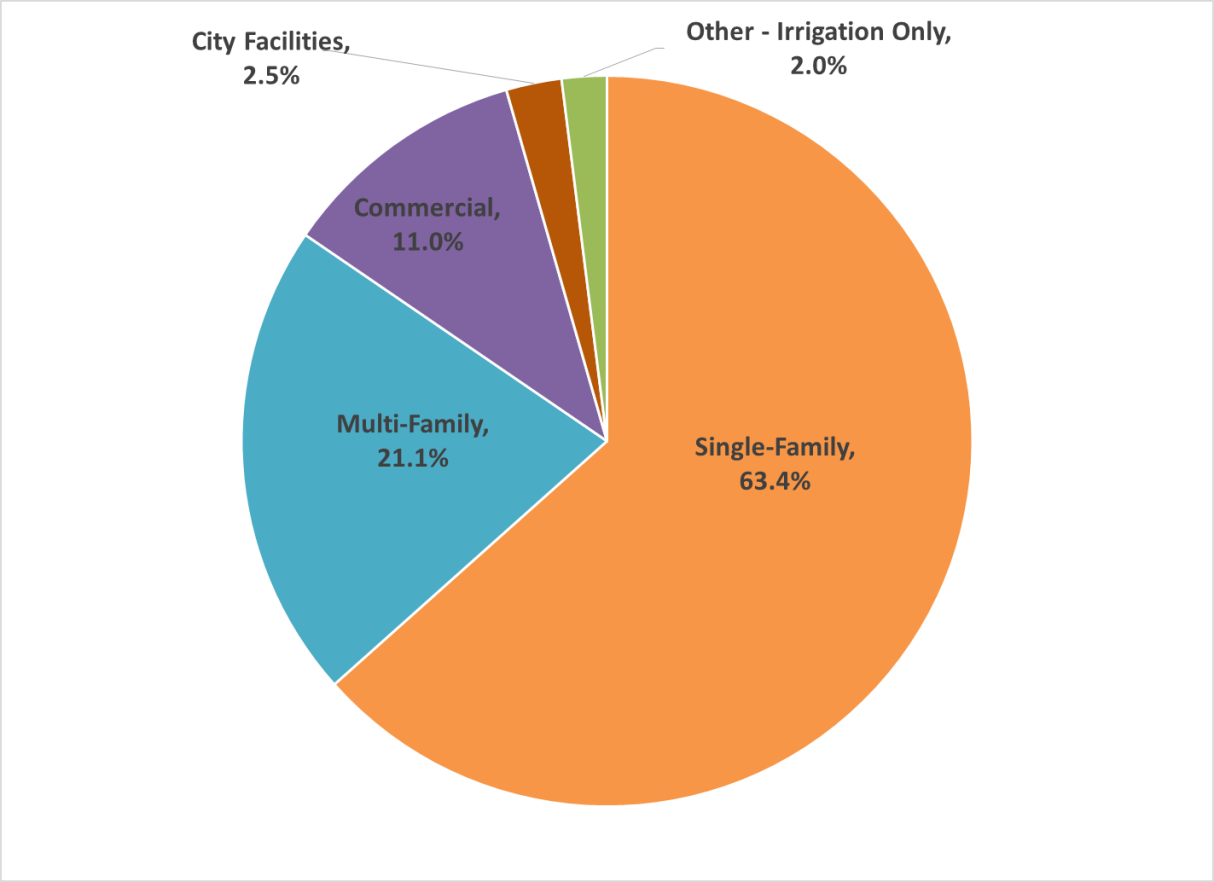

Figure 8. Distribution of Aspen City Customer Connections in 2013.

It is important to note that the values presented in this section reflect only treated water deliveries. The treated water deliveries for snowmaking operations, wholesale deliveries to West Buttermilk, bulk and flat rate water sales were included in the forecasting completed as part of this Water Efficiency Plan, but are not part of the efficiency measures or water savings estimates. Raw water deliveries for irrigation and snowmaking purposes were not included in the forecasting or as part of the efficiency measures and water savings estimates.

2.3 Seasonal and Peak Day Demands

A summary of the City of Aspen's annual and peak water production values from 2008 to 2013 is presented in **Table 4**. The data indicate the average daily production from 2009 to 2013 is 2.68 MGD, with an average maximum daily flow of 6.19 MGD. This indicates that a peaking factor of approximately 2.3 is reasonable for Aspen. The City has determined that firm yield production capacity, which is driven by water supply limitations in the late summer, is approximately 7.8 MGD after considering instream flow restrictions and continuation of historical raw water deliveries. The system capacity is constrained by the availability of streamflow and water quality issues associated with well production, not the capacity of the WTPs or the supply pipelines that convey water from Castle and Maroon Creeks to the WTPs.

The peak daily flows in 2012 and 2013 were 7.6 MGD and 6.97 MGD respectively. Although this indicates that demands were approaching the City's reported firm yield capacity, the peak demands occurred earlier in the season, so the City likely has sufficient supply to meet these demands even under drier streamflow conditions during the study period of current year through 2035, assuming the supply and demand curve do not shift significantly as a result of climate change. However, without storage to regulate supplies to match timing of demands, it is important for the City to monitor changes in precipitation from snow to rain and trends in the streamflow hydrology and demands. Managing landscape irrigation demands can help mitigate the City's vulnerability to streamflow conditions.

Table 4. Annual and Daily Flow and Treated Water Production Characteristics from 2008 through 2013.

Year	Annual Production (AF/yr)	Annual Production (MG)	Average Daily Flow (MGD)	Maximum Daily Flow (MGD)	Peaking Factor	Peak Day
2009	2,618	853	2.34	4.61	1.97	July 24, 2009
2010	2,817	918	2.51	6.13	2.44	June 25, 2010
2011	2,832	923	2.53	5.81	2.30	July 30, 2011
2012	3,484	1,135	3.11	7.60	2.44	June 21, 2012
2013	3,203	1,044	2.86	6.97	2.44	July 3, 2013
Averages	**3,007**	**980**	**2.68**	**6.19**	**2.30**	-

2.4 System Water Losses

The City's water mains are in good shape and system leakage is well below the 10% threshold that is often estimated as the national average. Aspen tracks water losses by regularly comparing production and metered usage values. Water loss audits over the last 8 years have shown loss values ranging from 0.6% to 8.4%, with an average of 3.9%. The City also annually conducts a leak detection program that utilizes sophisticated listening equipment to locate leaks, and repairs are then made based on this analysis.

On the customer side, approximately 800 of the customer connections have automated metering infrastructure (AMI) using the Aclara system, and the City uses this technology to identify potential leaks on a weekly basis.

The City could improve overall water loss control and accountability by implementing an annual water audit using the AWWA M36 methodology as discussed later in this document.

2.5 Past and Current Demand Management Activities

The City of Aspen's conservation program dates back to the early 1970s when water service began to be based on metered usage and the City completed an inventory of ECUs connected to the system. Aspen's water efficiency program has evolved over time, including the initiation

of the water audit and leak detection programs in 1995 and the implementation of a tiered water rate structure in 2006. The City of Aspen created its Efficiency Division in 2006. Dedicated Water Department staff are responsible for overseeing the water conservation program with assistance from other staff members. The City has demonstrated an exceptional commitment to water use efficiency, and has already implemented many of the most essential water conservation program measures.

In 1996, Aspen approved its first water conservation plan, which was included as an element of the larger Water Management Plan. While the 1996 plan did not contain all of the necessary elements to meet approval by the CWCB under the current statute, it was quite progressive for the period. Aspen's water conservation and efficiency plan is being updated as part of the City's participation in the Roaring Fork Watershed Regional Plan.

2.5.1 Analysis of Water Savings from Past Demand Management Efforts

In 1990, the City of Aspen's annual water demand was 4,368 AF and the population of combined permanent and seasonal residents was 23,435 people. This equates to an average gallons per capita per day in 1990 of 156.4 gpcd. In 2013, the gallons per capita per day as calculated using identical methods was just 62.8 gpcd.

To estimate the water savings achieved by the City of Aspen during the time period between 1990 and 2013 (23 years), a hypothetical demand forecast was developed using the gpcd from 1990 and the population from 2013 (36,540 permanent and seasonal residents). This analysis revealed that if 1990 demand patterns had continued in Aspen without any reduction from various demand management efforts, the 2013 hypothetical annual water demand in Aspen would have been 6,810 AF.

In reality, the 2013 annual water demand in the City of Aspen was 2,661 AF. This is 1,707 AF (39%) lower than Aspen's water demand in 1990, even though the population has increased by 13,105 people (56%). **This analysis suggests that since 1990, demand management efforts have successfully conserved 4,238 AF/yr of water, a savings of 63.5% compared to the hypothetical forecast using 1990's gpcd.** This is a significant achievement in water savings that has certainly reduced the amount of money that might have been spent obtaining new water supplies and expanding infrastructure. **Figure 9** shows the actual demand in Aspen from 1990-2013 compared with a hypothetical forecast based on the average gpcd in 1990. The erratic changes in demand are due to actual fluctuations in Aspen's population over the time period.

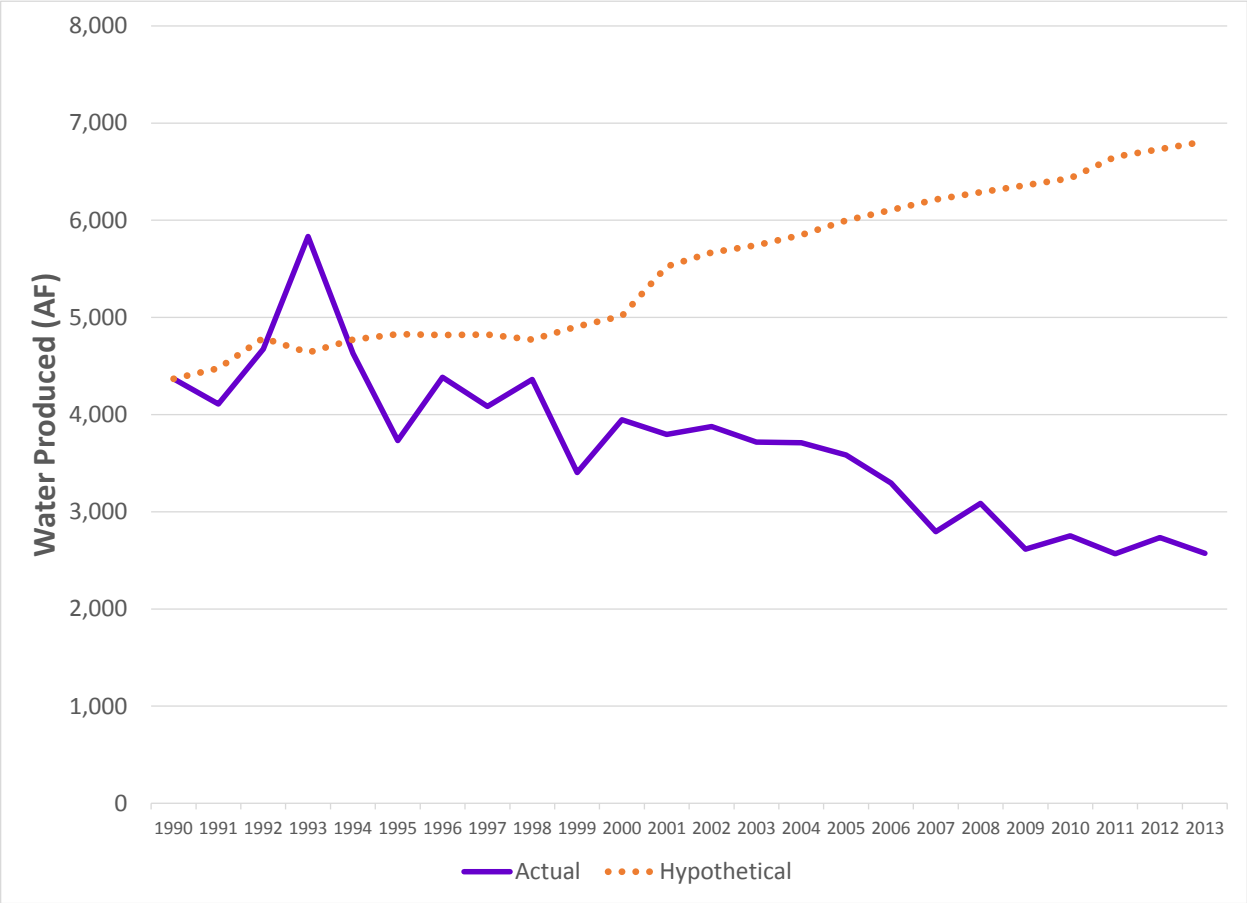

Figure 9. Actual and hypothetical consumption in Aspen from 1990 through 2013.

2.6 DEMAND FORECAST

As part of the preparation of the water efficiency plan, three separate treated demand forecasts were prepared:

1. Baseline Forecast (without conservation)
2. Passive Savings Forecast
3. Passive and Active Savings Forecast

The baseline forecasting method used historical treated demand patterns to establish baseline per capita demand and then to increase these demands with population out to 2035 as if the 2014 per capita water use patterns continue without change to 2035. This is a standard approach to demand forecasting, but it does not take into account conservation and the expected impacts of water efficiency.

The second two forecasts were developed using a more robust approach, where treated demands were separated out by sector (e.g. residential, commercial, irrigation, schools, etc.), with seasonal and non-seasonal demands (outdoor and indoor) disaggregated for each

category. Then a separate treated demand forecast out to 2035 was prepared for indoor and outdoor demand in each of Aspen's customer sectors. This allowed the impacts of specific water efficiency measures like high-efficiency toilets and clothes washers to be considered.

2.6.1 Population Planning Projections

Aspen is one of the most popular destination ski areas in the United States and also attracts many visitors in the summer months as well. Because of this, two separate service area population forecasts were developed for Aspen – one for the permanent, full-time population and one for the seasonal, part-time population. These forecasts are both presented in **Table 5** and **Figure 10**.

Table 5. Population Growth Projections from 2015 through 2035.

Year	Permanent Population	Seasonal Population
2015	10,632	26,791
2016	10,759	27,112
2017	10,888	27,437
2018	11,019	27,767
2019	11,151	28,100
2020	11,285	28,437
2025	11,979	30,185
2030	12,715	32,040
2035	13,496	34,009

2.6.1.1 Permanent Population

According to the 2010 Census, the full-time population within the municipal boundary of Aspen was 6,658 people, up from 5,914 full-time residents as reported in the 2000 Census. The City also has contracts to provide water service to areas outside of the municipal boundary, and after adding these additional full-time residents, the total number of residents served increases to approximately 8,895 in 2000 and 10,016 in 2010. The City uses a preferred long-term growth rate for planning purposes of 1.2% per year, which means that the year-round, full-time service area population is projected to increase to approximately 11,285 people in 2020 and 13,496 people in 2035 (Table 5 and Figure 10).

2.6.1.2 Seasonal Population

According to data provided by the City, the seasonal/part-time population of Aspen was 18,015 people in 2000. Using the City's preferred long-term growth rate for planning purposes of 1.2% the seasonal/part-time is projected to increase to approximately 28,437 people in 2020 and 34,009 people in 2035 (Figure 10).

The population projections for this water efficiency plan assume the seasonal population grows at the same rate as the permanent population. However, climate change and other factors could lead to a higher seasonal population growth rate and/or a larger portion of the seasonal population extending their duration in Aspen. As other cities plan for more extreme heat events and more frequent drought, Aspen is faced with the potential for 'climate refugees' to seek more time in Aspen. Aspen will continue to monitor its permanent and seasonal population and related impacts on water demands.

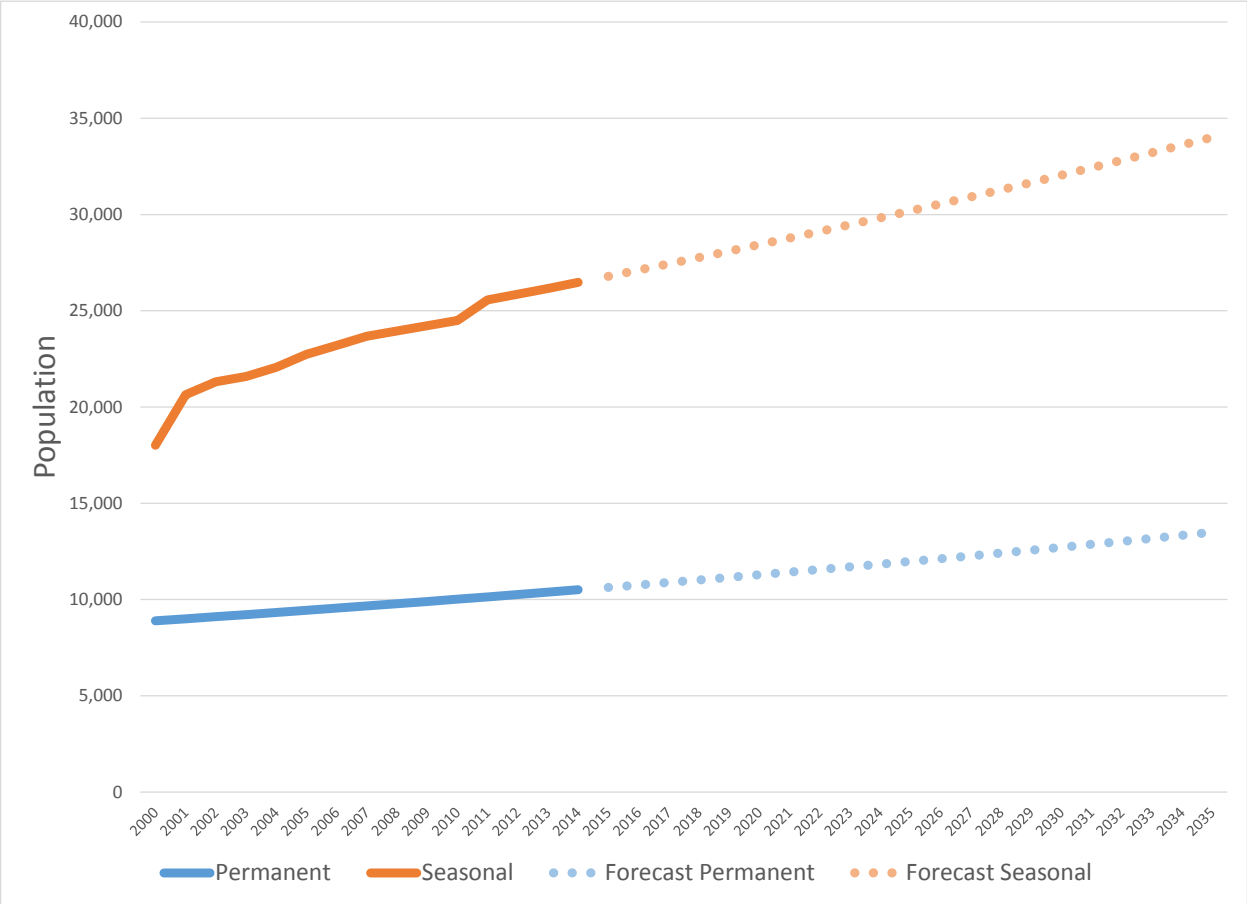

Figure 10. Actual and Forecast Permanent and Seasonal Population from 2000 through 2035.

The City of Aspen has adopted a Growth Management Quota System to limit future growth, as outlined in Chapter 26.470 of the City Code. The code limits the annual allotment of potential growth within the City, by land use type, as follows: 18 residential units (free market), 33,300 square feet of leasable commercial space, and 112 lodging pillows. No limits are in place for affordable housing or essential public facilities.

2.6.2 Demand Forecasts

As part of the water efficiency planning process, three distinct treated water demand forecasts were prepared. A description of each scenario and the forecasting methodology is presented below. The costs and benefits associated with these scenarios are considered in the next section of this plan document.

2.6.2.1 Forecast Methodology

First, a baseline treated demand forecast starting from 2015 and going out to 2035 was prepared. This baseline forecast did not include the impact of water conservation of any kind, even future passive water savings; it was developed only to assess the adequacy of future supplies if population increases and the unit rate of water use remains the same as current conditions (without considering climate change), and to demonstrate the impact of anticipated efficiency improvements. The baseline forecast is based on a combination of anticipated demographic and land use changes in Aspen. In the baseline forecast, all treated water demands (indoor and outdoor) increase proportionally with the population at the current rate of usage. Treated water demands for snowmaking, West Buttermilk, unmetered customers, and bulk sales were held constant in all forecasts at 525 AF/yr.

A second treated water demand forecast to 2035 was developed that includes the impact of passive efficiencies from Colorado legislation, and federal plumbing codes and standards. A third forecast was prepared that includes the anticipated impact the City's planned water efficiency program measures described in this plan.

The second and third forecasts include the impacts of water efficiency and were developed using a more robust approach that considers anticipated changes in each customer sector in Aspen. To develop these forecasts, treated demands were separated out by water use sector (e.g. residential, commercial, irrigation, and city facilities), with seasonal and non-seasonal demands (outdoor and indoor) disaggregated for each category as shown in Table 3. Then a separate demand forecast out to 2035 was prepared for indoor and outdoor demand in each customer sector. This allowed the impacts of specific water efficiency measures like high-efficiency toilets and clothes washers to be considered.

These three forecasts form the core of the water efficiency plan and are the forecasts upon which estimated conservation savings are based. Each forecast shows demand starting in 2015 and going through the planning horizon of 2035 (20 years). The results are provided in **Figure 11** and further described in the sections below.

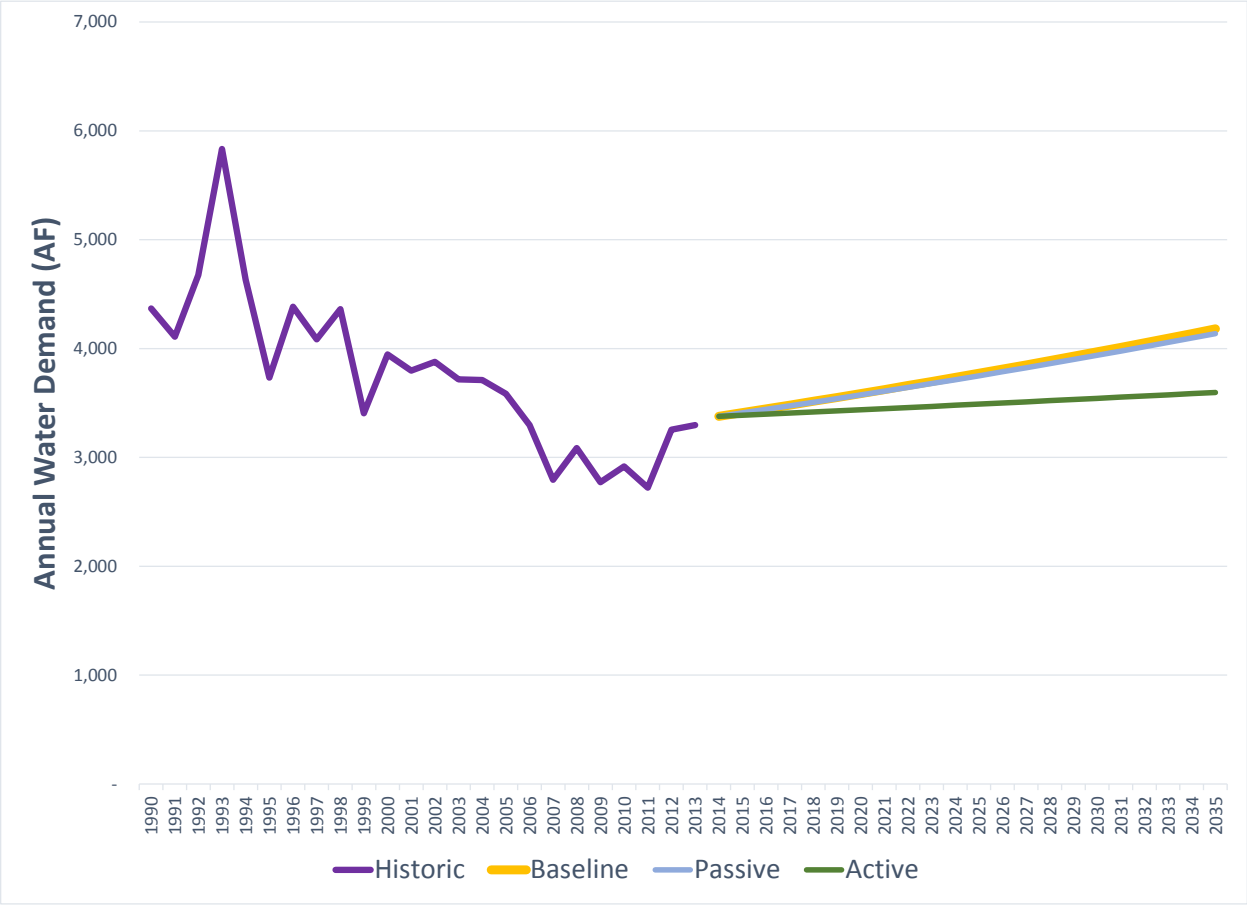

Figure 11. Baseline, Passive, and Active Treated Water Demand Forecasts through 2035.

Baseline Forecast

The concept of the baseline forecast is to exclude conservation of any kind and to simply assume that typical baseline treated water demand patterns (i.e. the water use patterns of 2009 through 2013) are continued into the future without change. It is also assumed that typical water demands for the City will change proportionally with increases in population. This assumes new customers joining the system use water identically to the current customer base. The fundamental purposes of the baseline forecast are to assess the adequacy of future supplies under reasonable "worst-case" conditions (i.e. no water efficiency gains) without considering impacts for additional future climate change, and to demonstrate the anticipated impact of water efficiency in Aspen from both passive and active conservation programs. The baseline forecast is presented in Figure 11. The impact of growth in both the permanent/full-time and seasonal/part-time population is included in all treated demand forecasts. The forecasting methodology uses the changes in both population forecasts as a key driver for future demands.

Key assumptions in the baseline forecast include:

- Baseline treated water use patterns for Aspen (Table 1).
- Population forecast for Aspen (Figure 10).
- Treated water use in all sectors both seasonal and non-seasonal changes proportionally with the population.
- Outdoor water use impacts from temperature and precipitation in 2035 are similar to 2015.
- Fixed annual demands of 525 AF/yr for snowmaking, West Buttermilk, unmetered customers, and bulk sales.

Baseline treated water demands in 2014, including water loss, totaled 3,377 AF (2,661 AF for City customers and 525 AF for snowmaking, West Buttermilk, etc., and 191 AF water loss). With this baseline forecast, demand is expected to increase by 803 AF to 4,180 AF in 2035.

Passive Conservation Forecast

A second treated water demand forecast was prepared to 2035 that includes the impact of anticipated passive efficiencies from Colorado legislation, and federal plumbing codes and standards on a sector-by-sector basis for both indoor and outdoor use. Colorado Senate Bill 2014-103, which was passed in 2014 and phases out the sale of low-efficiency lavatory faucets, showerheads, flushing urinals, and tank-type toilets, is an example of local legislation that is accounted for in the forecast of passive conservation between 2015 and 2035. However, a large component of these water savings have already been achieved in Aspen. Because Aspen has had water efficient building codes in place and many older properties have been renovated over the past 20 years, the impact of passive conservation is not anticipated to be great. This forecast found that treated water demands will increase to 4,137 AF in 2035. The passive forecast is presented in Figure 11.

Key assumptions in the passive conservation forecast include:

- Baseline treated water use patterns for Aspen (Table 1).
- Population forecast for Aspen (Figure 10).
- Outdoor water use in all sectors increases proportionally with the population.
- Outdoor water use impacts from temperature and precipitation in 2035 are similar to 2015.
- 0.6% per year decrease in combined SF and MF residential indoor per capita water use (from 56.7 gallons per capita per day (gpcd) in 2014 to 50.5 gpcd in 2035) continuing trends of the past 15 years[7] and recent Colorado legislation under Senate Bill 14-103

[7] Based on results from the Water Research Foundation *Residential End Uses of Water Update* (to be published in 2014).

that phases in the sale of only high-efficiency WaterSense labeled fixtures starting in 2016.
- 0.75% per year decrease in per capita commercial indoor use from ongoing replacement of fixtures, appliances and equipment and new Colorado legislation assuring high-efficiency plumbing in new construction.
- 0.75% per year decrease in per capita city facility indoor use from ongoing replacement of fixtures, appliances, and equipment and new Colorado legislation assuring high-efficiency plumbing in new construction.
- 0.75% per year decrease in per capita school indoor use from ongoing replacement of fixtures and appliances and new Colorado legislation assuring high-efficiency plumbing in new construction.
- Fixed annual demands of 525 AF/yr for snowmaking, West Buttermilk, unmetered customers, and bulk sales.

The passive conservation forecast hypothesizes a 22.5% increase in treated water demand over the next 20 years and suggests that more efficient fixtures and appliances could help reduce future demands in 2035 by 43 AF compared with the baseline.

Active Conservation Forecast

A third forecast was prepared that includes the anticipated impact the City's planned water efficiency program measures described in this plan. Under this forecast, treated water demand increases to just 3,597 AF in 2035. Compared with the original baseline forecast, if the elements of this plan are fully realized, then it is estimated that water demand at 2035 will be reduced by 583 AF as a result of passive and active water conservation measures in Aspen. The active conservation forecast is presented in Figure 11.

Key assumptions in the active conservation forecast include:

- Baseline treated water use patterns for Aspen (Table 1).
- Population forecast for Aspen (Figure 10).
- Outdoor water use in all sectors increases proportionally with the population, but is reduced by 0.25% per year due to a combination of factors including: Aspen's conservation-oriented rate structure which charges higher rates for outdoor use, densification as the City grows, anticipated smaller lot sizes in future developments, proposed landscape code for new development, irrigation efficiency improvements and irrigation audits, ongoing landscape transformation from traditional turf to water-wise plants, and the City's ongoing education and information efforts including Xeriscape seminars.
- Outdoor water use impacts from temperature and precipitation in 2035 are similar to 2015.
- 1.0% per year decrease in combined SF and MF residential indoor per capita water use (from 56.7 gpcd in 2014 to 47.0 gpcd in 2035), considering Aspen's active conservation

program and recent Colorado legislation under Senate Bill 14-103 that phases in the sale of only high-efficiency WaterSense labeled fixtures starting in 2016.
- 0.75% per year decrease in per capita commercial indoor use from ongoing replacement of fixtures, appliances and equipment and new Colorado legislation assuring high-efficiency plumbing in new construction.
- Fixed annual demands of 525 AF/yr for snowmaking, West Buttermilk, unmetered customers, and bulk sales.

The active conservation forecast hypothesizes a 6.5% increase in water demand over the next 20 years and suggest that more efficient fixtures and appliances could help reduce future demands in 2035 by 583 AF compared with the baseline.

The analysis completed for this water efficiency plan indicates that the likely yield of the City's direct flow water rights is around 26,850 AF in a dry year. The maximum annual treated water produced by Aspen over the past 5 years was 3,220 AF in 2012 and the range of forecast future demands in the year 2035 are from 3,597 AF to a maximum of 4,180 AF. On an annual basis, the dry year yield of the City's water rights appears to be more than sufficient to meet current and forecast future demands.[8] However, the City does not have storage to regulate the timing of supply to match demands, and therefore is vulnerable to peak demand shortfalls in dry years when physical streamflow conditions are limited, or in emergencies such as a fire or landslides when one or more particular water supply sources may become unavailable. Accordingly, the City has elected to focus on water efficiency measures that could reduce peak demands, primarily related to outdoor water use, which are financially viable and could potentially eliminate or delay infrastructure projects.

2.6.2.2 Climate Change Impact on Water Use

Recent climate change forecasts indicate a warming trend in irrigation season temperatures in the Roaring Fork region. A 2014 report from CIRES, warns that temperatures for the 2035 to 2064 time period are likely to increase by an average of approximately *4 degrees F* as compared to the period from 1971 to 2000 (CIRES 2014). More frequent and severe heat waves, droughts, and wildfires are projected. Such changes will impact both water supply and demand and the City is conducting additional research regarding these potential impacts. A hotter irrigation season means higher water requirements for landscapes. While this may increase the uncertainty in outdoor water demand projections, the net effect depends on numerous factors such as the amount and type of landscaping material, irrigation management practices, etc. Climate change also has the potential to impact the ski industry and increase demands for snowmaking. Water demands in Aspen could also increase if 'climate refugees', seeking to escape the heat from other cities, start spending more time in Aspen in houses that are currently vacant part of the year.

[8] The City uses the historical dry year of 1977 for planning purposes, and in its planning, accounts for changing its diversion patterns as needed to protect decreed instream flows.

Aspen's long-term commitment to water conservation is helping prepare the City for these changes. Increased indoor and outdoor efficiencies achieved over many years enable flexibility in meeting season needs.

Changing temperature and precipitation patterns are ongoing and are impacting Aspen's customers already. Climate change impacts are included to some degree in the water demand forecasts provided in this plan to the extent that current demands and climate patterns (which have already been affected by climate change) are utilized as the starting point to project future water demand patterns. It is important to consider both demand-side, as well as supply-side impacts of future climate change on overall water supply conditions. The forecast methodology provided in this plan, along with regular updates to the demand projections, can assist in this process.

2.6.2.3 Estimated Cost of New Supply Options

The City's water demands have continuously decreased over the past several decades (as shown above in Figure 9 and Figure 11), to the credit of its water users, staff, and progressive water conservation program. In 2014, Aspen has an ample water supply to meet present needs and most projected future needs, with the caveat that emergencies such as fires or landslides can prevent use of one or more supply sources, thereby creating a shortfall in supply, which may be temporary or long-term, depending on the impact of the emergency.

Based on the historical use patterns, it is reasonable to conclude that the City's water conservation efforts have at least delayed the need for storage. Today the City's water rights yield more than ample supply on an annual basis, but the City experiences late summer usage that approaches its available firm yield water supply during the period of mid-July through the end of the irrigation season. Absent additional storage or some treatment method to address water quality issues associated with well pumping, the City is obligated to manage the late summer demands based on local streamflow hydrology. Additional water treatment and/or additional water storage along with customer-side demand management of irrigation could provide Aspen increased system stability under a variety of hydrologic conditions, and in emergencies. Any option must be carefully evaluated in terms of financial, environmental, and other potential impacts.

The City has a $100,000 annual unallocated budget to fund water conservation programs and incentives, in addition to staff salaries and efforts related to metering. Under the City's planned conservation program, it is estimated that approximately 28 AF of water per year will be saved. Given the City's conservation program budget, it is estimated the City is spending just $3,500 - $5,200 per AF conserved.

The City plans to continue focusing on demand management as an alternative to near-term construction of expensive storage, and will monitor and evaluate the situation through its integrated planning process.

3. INTEGRATED PLANNING AND WATER EFFICIENCY BENEFITS AND GOALS

The City of Aspen utilizes a Comprehensive Water Management Plan to direct the use of its water rights and other resources to meet changing water demands while meeting the environmental goals of maintaining decreed instream flow levels to promote a healthy aquatic environment. Aspen has periodically updated studies on Raw Water Availability in order to track commitments for water service and to establish the adequacy of raw water to meet the changing levels of water demand over time. A complementary program is the Asset Management Plan which directs financial resources to specific construction projects and facilities required to develop added water supplies in a timely fashion considering the changing needs. Projects that will address any identified gaps between expected water demands and available supplies are scheduled and implemented through this program. These related documents have provided the basis to complete many projects and activities that have maintained a balance between water supply and demand while respecting the environmental goals of protection of decreed instream flows. For instance, the upgrade and expansion of the City's water treatment plant, improvements to raw water conveyance systems, the development of the City's well program (which is essentially development of groundwater storage) and the water conservation program (particularly leak detection and correction) have all resulted from direction provided by the Comprehensive Water Management Program. More recently the activities undertaken to obtain water rights and construct a reclaimed water project have followed from the Comprehensive Water Management Plan and will further increase the availability of raw water supplies to the City's water customers during critically dry periods.

4. SELECTION OF WATER EFFICIENCY ACTIVITIES

The City of Aspen considered a wide variety of water efficiency programs and measures before selecting the final components for inclusion in this plan. Efficiency measures were screened using a variety of criteria including:

- Feasibility and practicality.
- Water savings and estimated cost per AF.
- Potential to reduce peak water demands in the late summer irrigation season.

The City utilized the CWCB's *Municipal Water Efficiency Plan Guidance Document* (CWCB 2012) to inform and guide the development of this conservation plan, including the activity selection worksheets to assist in the screening process.

4.1 Summary of the Selection Process

The City implemented a tiered screening and selection process for evaluating potential water efficiency activities. Existing activities were included in the list of measures and unless duplicative, existing activities are expected to continue as part of the ongoing water efficiency program.

Initial Screening. An initial screening was conducted by the consultant team, using the CWCB screening and evaluation worksheets (CWCB, 2012) and the *Guidebook of Best Practices Guidebook for Municipal Water Conservation in Colorado* (CWW, 2010) as the key technical resources, along with professional experience. Activities that made it through the initial screening were assembled and passed along to the staff for screening.

Final Screening. The final level of screening and selection of water efficiency activities was made by the Utilities Finance and Administrative Services Manager. During the final screening, care was taken to select a suite of activities capable of achieving the level of water savings needed by Aspen to achieve the stated water efficiency goals.

This plan was carefully prepared to comply with State of Colorado planning requirements and legislation, which does not currently include water quality as part of the legal planning requirement. Thus, water quality was not included in the water efficiency activities selection criteria. However, the City understands that improving outdoor use efficiency to reduce irrigation runoff has the potential to reduce nutrient flows into local streams and rivers, providing an additional benefit from this water efficiency plan.

4.2 Water Efficiency Activities

Table 6 presents the new and updated water efficiency activities selected for inclusion in this plan, many of which have been ongoing since at least 1992. Each measure is described in more detail in the sections below.

Table 6. New and Updated Water Efficiency Activities and Water Savings Estimates.

Water Efficiency Activities	Sectors Impacted	Ongoing Activity?	Implementation Period of New Activities	Projected Water Savings 2015 - 2035 (AF/yr)
FOUNDATIONAL ACTIVITIES				
Automatic Meter Reading Installation and Operation	All	YES	2014-2018 for existing & ongoing for new customers	50
Enhanced Water Loss Control	All		annual	38
Conservation-Oriented Rates	All	YES	2015 – rate structure update	145
TARGETED TECHNICAL ASSISTANCE AND INCENTIVES, AND NATURAL REPLACEMENT OF FIXTURES AND APPLIANCES				
Fixtures, Appliances, and Incentives	All, indoor	YES	Ongoing	100
Outdoor Water Efficiency	All, outdoor	YES	Ongoing	20
Slow the Flow	All	YES	Ongoing	30
Info and education, Farmer's Market, xeriscape seminars, Efficient Parks, etc.	All	YES	Ongoing	40
Commercial, Institutional, and Industrial Water Efficiency	CII	YES	2015	70
ORDINANCES AND REGULATIONS				
Regulatory Measures	All	YES	Ongoing	
Water Reclaim and Recycling, Raw Water Irrigation	Irrigation	YES	Ongoing	
Waste of Water Ordinance Update	All	YES	2015	
Update landscape development regulations for new construction to place emphasis on water efficiency in residential development	SF & MF residential		2018	50
EDUCATIONAL ACTIVITIES				
Public information, customer outreach and education	All	YES	1992 - present	40
Community outreach event participation	All	YES	Before 2006 - present	
Utility billing inserts	All	YES	2008 - present	
TOTAL SAVINGS THROUGH 2035 (AF/YEAR)				**583**

4.2.2 Foundational Activities

4.2.2.1 Metering

A robust metering program is fundamental to the success of water conservation efforts. Colorado statute requires all water providers to meter the water use of their customers and to bill based on metered consumption. In Aspen, approximately 98% of the customers (including most municipal facilities) are metered and billed based on metered consumption.[9]

Aspen uses the Aclara STAR Network Advanced Metering Infrastructure (AMI) system for metering and billing purposes for approximately 800 of the 4,000 customer connections and is in the process of implementing the system for all customers. Data are remotely transmitted, and Aspen uses the AMI technology to complete weekly assessments of user accounts to identify outlier data points that are then flagged for further investigation. City staff report that the technology has been instrumental in identifying customer-side leaks and for general water management and system improvements.

4.2.2.2 Enhanced Water Loss Control

Leak detection and water loss control are also fundamental water efficiency practices for all water utilities. As discussed above in Section 2.4, system leakage in Aspen is currently estimated to average approximately 4%, which is well below the 10% threshold that is often estimated as the national average. This low rate of system leakage is not an accident, but rather the product of a progressive water main replacement and repair program in Aspen.

Conducting an annual system water audit, using the AWWA M36 Water Audits and Loss Control Programs methodology and the free AWWA water loss control Excel spreadsheet software, will further assist the City in managing its water by categorizing all water uses and identifying real losses that directly impact revenue, as shown in **Table 7** below.

The process of implementing the AWWA water audit takes just a few hours each year, but the results clearly show if water loss is a problem and evaluate the cost of real and apparent losses to the utility. This information is essential for informing water loss control programs and understanding where best to apply water loss control resources.

[9] It is common in Colorado for utilities to provide unlimited, free water to selected municipal connections based on historical practice, and all usage is metered.

Table 7. AWWA Water Audits and Loss Control Categories.

Billed Authorized Consumption	Billed Water Exported	Revenue Water
	Billed Metered Consumption (including water exported)	
	Billed Unmetered Consumption	
Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water
	Unbilled Unmetered Consumption	
Real Losses	Unauthorized Consumption	
	Systematic Data Handling Errors	
	Leakage and Overflows at Utility's Storage Tanks	
	Leakage on Service Connections	

4.2.2.3 Conservation-Oriented Water Rate Structure

Aspen currently bills its customers on a monthly basis using a four-tier inclining block rate structure. This conservation-oriented rate structure has been in place since January 2006. The City's rate structure provides for 5,000 gallons per ECU per month in tier 1, an additional 10,000 gallons of water per ECU per month in tier 2, and additional 5,000 gallons per ECU per month in tier 3, and all monthly usage greater than 20,000 gallons per ECU per month is billed at the tier 4 rate. The 5,000 gallon/ECU for block 1 is intended to represent a reasonable estimate of indoor water use for the residential unit that can be approximated by a one bedroom, one bathroom home with a fully equipped kitchen, and exterior hose bib; a typical residential unit is equivalent to approximately 2.6 ECU. Given that the number of ECUs and the resultant billing is based on the number of fixtures, it is possible that the current structure may be providing a tier 1 budget that is too large for larger homes. The City is considering changes that would take a step toward addressing this issue. Separate rate structures apply to bulk water purchases and raw water customers.

4.2.2.4 Billing System and Water Rates

Aspen utilizes a computerized billing system that includes approximately 800 AMI meters. The AMI system enables frequent remote interrogation of water meters. The City is makes use of the advanced technology to help identify leaks and abnormal usage.

The standard 2014 schedule of rates and charges for water customers in Aspen is shown in **Table 8.** Water Rates and Rate Structure for 2014. **(Rates are $/1,000 gallons. Tier gallons are per ECU)** In this rate structure, tier 2 represents a 29% increase over tier 1, tier 3 represents a 42% increase over tier 2, and tier 4 represents a 41% increase over tier 3. The rates themselves are set based on Aspen's cost of service requirements. The rates vary by billing area to more

accurately reflect the changes in the cost of service. Aspen provides a 10% discount on demand and fire protection charges for qualified senior citizens. As of the date of this report, the City is in the process of tightening the tiers by reducing the volume (in gallons) for each tier by 20%. If approved by City Council, this rate change is targeted to become effective in January 2015. In future updates, the City may consider creating separate tiers for indoor versus outdoor water, and developing water budgets for irrigation that are based on irrigated area, planting materials, and local evapotranspiration rates (which define plant demands).

Table 8. Water Rates and Rate Structure for 2014. (Rates are $/1,000 gallons. Tier gallons are per ECU).

Rate Tier	Water Rate
Tier 1 - Up to 5,000 gallons	$1.90
Tier 2 - 5,001 to 15,000 gallons	$2.46
Tier 3 - 15,001 to 20,000 gallons	$3.51
Tier 4 - Greater than 20,000 gallons	$4.96
Demand Charge ($/ECU/month)[1]	$4.57 to $9.15
Pumping Charge ($/1,000 gallons/month)[2]	$1.37 to $4.11
Fire Protection Charge ($/ECU/month)[3]	$1.54 to $3.08

[1]Demand charge varies with billing area.
[2]Pumping charge varies with the number of pump stations used.
[3]Fire protection charge varies with billing area.

The schedule of rates and charges for bulk water customers is shown in **Table 9**. Aspen currently provides treated water at a wholesale rate under three scenarios: 1) treated water to Aspen Ski Company for Aspen Mountain snowmaking; 2) treated water to 80 customers located in West Buttermilk; and 3) treated water for filler hydrant draw permits. Most bulk water charges are equal to the tier 4 rate. Bulk deliveries to West Buttermilk are subject to contractual rates and charges.

Table 9. Bulk Water Rates and Rate Structure for 2014.

Rate Tier	Water Rate
Rate per 1,000 gallons[1]	$4.96
Demand Charge ($/use)[2]	$15.00

[1]Equivalent to Tier 4 for metered treated water use.
[2]Flat fee per use (e.g. each time a truck is filled).

The schedule of rates and charges for general raw water customers is shown in **Table 10**. There are approximately 68 raw water accounts that are used for irrigation and snowmaking purposes. Charges for pressurized raw water are the same as for bulk water, which are based

on tier 4 rates. Non-pressurized raw water deliveries for irrigation purposes are charged according to the number of square feet of irrigated area.

Table 10. Raw Water Rates for 2014.

Rate Tier	Water Rate
Rate per 1,000 gallons - hydrant[1]	$4.96
Rate - non-pressurized irrigation ($/1,000 sq. ft. of irrigation/year)	$10.45
Demand Charge ($/use)	$15.00

[1]Equivalent to Tier 4 for treated water use.

Aspen provides raw water from its municipal and irrigation water rights. This water can be delivered from the Leonard Thomas Reservoir as well as other non-potable raw water supplies according to the rates shown in **Table 11**. Raw water delivered from Thomas Reservoir is used as a supply for irrigation in the Meadowood common area, the hospital, and medium-density housing developments in the area, and can be used at other locations as well. Raw water delivered from Thomas Reservoir is also used as the source of supply for snowmaking operations at the Highlands Ski Resort. All customers are required to have a metered connection; however, the rate structure provides for a backup billing mechanism based on irrigated area under special circumstances.

Table 11. Thomas Raw Water Rates and Other Pressurized Non-Potable Water for 2014.

Rate Tier	Water Rate
Rate per 1,000 gallons ($/year)	$1.20
Rate per 1,000 square feet of irrigation ($/year)[1]	$47.91
Demand Charge ($/use)	$15.00

[1]Bulk rate only allowable in exigent circumstances.

Aspen also has a schedule of punitive rates for unmetered water service as shown in **Table 12**.

Table 12. Water Rates and Rate Structure for 2014 Unmetered Service.

Rate Tier	Water Rate
Demand Charge ($/ECU/month)[1]	$79.96 to $159.92
Fire Protection Charge ($/ECU/month)[2]	$1.54 to $3.08

[1]Demand charge varies with billing area.
[2]Fire protection charge varies with billing area.

Advanced Metering Infrastructure (AMI)
In recent years the City has equipped approximately 800 of the customer connections have AMI using the Aclara system, and the City uses this technology to identify potential leaks on a

weekly basis. In fact, staff check for abnormal usage three times a week, and contact customers regarding potential leaks. This is a significant customer service benefit that has the potential to reduce customer-side leakage.

This Aclara system has the capability of interrogating water meters hourly (or even more frequently) and this allows for sophisticated analysis of flow patterns that can quickly identify abnormal usage and leakage. As the City expands the use of this system, it may be possible to dramatically reduce customer-side leakage through data analysis and rapid-alerts that identify potentially wasteful water loss.

AMI metering is not without problems and the City's pilot testing approach makes sense before selecting a vendor and metering all customers. Regardless of the technology or system chosen, the potential benefits of AMI for increased customer service and improved demand management are significant and will be pursued.

4.2.3 Targeted Technical Assistance and Incentives

4.2.3.1 Fixtures, Appliances, and Incentives

As demands increase, Aspen will continue to face the combination of water supply limitations that occur during periods of peak demand. This means that for Aspen there is value in reducing its non-seasonal, or indoor, water uses. The gradual replacement of inefficient fixtures and appliances and other water using devices is an excellent way to accomplish this objective.

Even though Aspen has an unusually low percentage of homes with older fixtures due to the high penetration of remodels, Aspen still promotes the replacement of old and inefficient toilets, showerheads, faucets, clothes washers, and dishwashers through its regular education efforts. Aspen also has a series of monetary water efficiency incentives. In response to the 2002 drought, Aspen developed an innovative rebate program to incentivize customers to reduce water use. Over the last decade, the City has offered rebates for water efficient clothes washers, dishwashers, and toilets, and has provided free low-flow showerheads, hose spray nozzles, hose irrigation timers, and soil moisture meters. The City currently provides a rebate of $75 per low-flow toilet, and a maximum of 5 fixtures per residence are currently eligible for the rebate. Senate Bill 14-103, that phases in the sale of only high-efficiency WaterSense labeled fixtures in Colorado starting in 2016, may result in further indoor demand reductions for Aspen in the future.

In the future, Aspen may consider targeted programs to non-residential customers, such as the EPA H2Otel program.

4.2.3.2 Outdoor Water Efficiency

Aspen experiences high summer and late summer peak water demands due in part to the tourism industry, but more significantly due to irrigation demands from customers. The City

implements a variety of programs and pricing mechanisms (described above) to improve irrigation efficiency and reduce outdoor demands, and is considering additional programs to help reduce late summer peaking effects. These measures are intended to complement the City's energy audit and rebate program.

Irrigation Information and Education. The City has taken a number of steps to help reduce irrigation demands starting with customer education and extending through the conservation-oriented water rate structure. The City actively promotes efficient irrigation practices and seeks to reduce excessive use and waste. The City uses the water bill as an avenue for customer communication. In the spring, the City sends a utility bill insert that focuses on water efficiency programs, tips, and special offerings all designed around saving water. The City also has a very robust landing page for utilities on its website that has various water conservation related links and informational topics as well as a water use calculator.

Farmers Market. For many years the City has hosted an educational booth at the popular Saturday Farmers Market. This has proven to be an effective and popular outreach program that provides the opportunity to speak one on one with residents. These programs are expected to continue into the future.

Xeriscape Gardening. The City offers annual xeriscape seminars for Aspen residents.

Slow the Flow. Aspen is an ongoing participant of the week-long "Slow the Flow Colorado" program coordinated by the Center for Resource Conservation that provides free third-party sprinkler irrigation audits. A total of 50 free audits were completed in 2013, and an additional 48 were completed in 2014. The City expanded the 2014 program to include the "garden in a box" program, which is intended to simplify water-wise gardening by providing professional "plant-by-number" designs, a selection of xeriscape plants, and planting and care instructions all below retail costs.

Efficient Parks. Aspen leads by example through the efficient irrigation of parks and other municipal facilities. All City parks, medians, and other irrigated areas that use pressurized water are metered and billed based on their actual consumption. In 2008, the irrigation system at the Municipal Golf Course was completely upgraded with new piping, irrigation heads, and controllers.

Future Efficiency Upgrades to City Facilities. The City will research and evaluate opportunities to continue leading by example by incorporating the use of advanced irrigation system technologies at municipal properties, such as rain shutoff devices, efficient sprinkler heads, and weather-based controllers.

Conservation Oriented Water Rates. The City's rate structure encourages outdoor water efficiency by setting the tier 2 break point at 5,000 gallons/ECU/month, which attempts to distinguish indoor use (tier 1) and outdoor use (tier 2 to tier 4). As noted above, modifications

to the tier thresholds may be needed to limit the tier 1 budget being provided to larger homes with more fixtures.

Land Use Regulations for New Development. Described further below, the City may consider land use restrictions for irrigated landscaping associated with new developments.

Drought Response. While not a long-term outdoor water conservation measure, in the event of a climatological drought that affects the City's supply, Aspen's drought response regulations outline the process for implementing outdoor watering restrictions to reduce demands as required.

4.2.3.3 Commercial, Institutional, and Industrial Water Efficiency

Aspen's water conservation program for commercial, institutional, and industrial (CII) users focuses on education and pricing mechanisms. Pricing water and wastewater services appropriately has been shown to be an effective method for reducing water demands (Mayer et. al. 2008), (Mayer et. al. 2004), (Howe, 1982). In Aspen, CII customers are billed for water using the same rate structure as residential customers, which means that large users pay for most of their water at the higher tier rates.

The hospitality industry in Aspen, the largest block of non-residential water customers, has adopted a number of the best management practices. Guests at many Aspen lodging establishments are encouraged not to change their sheets and towels every day unless necessary. This has become an effective and successful industry-wide best-practice for hotels and motels across the U.S. The City also encourages the replacement of old and inefficient toilet fixtures in CII properties through the use of a rebate program. In 2011, the toilet rebate program was modified to double the compensation for commercial and lodging facilities as compared to residential ($150 vs $75), and allowed for an unlimited number of fixtures when previously capped at 3.

Aspen started conducting internal water use assessments in 2007 to evaluate the consumption in the City's buildings and the water treatment plant. The findings of this investigation prompted the replacement or upgrading of pumps and piping. In 2009, the City began working with a private consultant to implement $1.2 million worth of energy and water efficiency upgrades in 13 government-owned buildings. This provides Aspen an excellent opportunity to expand into CII water efficiency upgrades through similar programs or through the Center for Resource Conservation which is already implementing several programs for the City.

4.2.4 Ordinances and Regulations

4.2.4.1 Aspen Municipal Code

Aspen Municipal Code includes a number of important provisions related to water Conservation. Section 25.20.020 prohibits the waste of water including indoor leakage and

leaking irrigation system. Sec. 25.20.080 requires consumer education about water conservation. Text from these codes are provided below:

> ***Sec. 25.20.020. Wasting of water prohibited.*** *It shall be unlawful for any person using water from the City water system or any system connected thereto, to waste water. For purposes of this Section, to waste water shall mean any of the following:*
> *(a) The unnecessary running of water, which is not applied to any beneficial use, through or out of any water closet, lavatory, urinal, bathtub, hose, hydrant, faucet or other fixture, appliance or apparatus whatsoever, through the neglect or by reason of faulty or imperfect plumbing or fixture; or*
> *(b) The continuous application of water to lawns, sod, landscaping or amenity resulting in ponding or the flowing of water into drainage or storm drainage facilities; or*
> *(c) Failure to repair an irrigation system unit which is known to be leaking.*
> *(Code 1971, §23-151; Ord. No. 27-1985, §1; Ord. No. 37-1991, §5)*
>
> ***Sec. 25.20.080. Consumer education.*** *The Director of water shall develop a consumer education program to provide water consumers with information relating to water conservation. The consumer education program shall include, at a minimum, periodic distribution to water consumers of brochures on various water conservation topics. In addition, the Director of water may conduct seminars on water management techniques for both residential and commercial irrigation systems.*
> *(Code 1971, § 23-157; Ord. No. 37-1991, § 6)*

4.2.4.2 Regulatory Measures

On June 10, 2014 Governor Hickenlooper signed Senate Bill 14-103 into law, which will phase out the sale of old, inefficient toilets, showerheads, and faucets, and substitute high-efficiency, third party tested products in their place by 2016. This is a significant indoor water conservation provision that has the potential to reduce indoor demands over time in Aspen and across Colorado.

Given the challenge of addressing the late summer peaking issue, the City may consider including limitations on landscaping materials and the amount of irrigated area allowed under future water service agreements. Managing outdoor landscaping demands through land use regulations for new development is being considered throughout Colorado and provides an opportunity to reduce the impact from future demands.

The City has a water conservation and plumbing advisory code component of its Building and Building Regulations, Title 8, of Aspen Municipal Code. Included in this chapter are codes mandating the installation of high-efficiency plumbing fixtures, specific landscape and irrigation system requirements, and soil amendment requirements. This code contains strong water conservation provisions. The soil amendment provision is particularly good. Some of the plumbing fixture components of this code will likely be exceeded by the State-level WaterSense legislation passed in 2014.

Relevant sections of Aspen's municipal code are provided below.

Chapter 8.40
WATER CONSERVATION AND PLUMBING ADVISORY CODE

Sec. 8.40.010. Applicability.
The provisions of this Chapter shall govern the construction and the landscaping of new residential, commercial and industrial structures and the remodeling of existing residential, commercial and industrial structures within the City. (Code 1971, § 7-231; Ord. No. 43-1981, § 1)

Sec. 8.40.020. Installation of high-efficiency fixtures*.*
No building permit shall be issued for the construction of a new residential, commercial or industrial structure or for the indoor or outdoor remodeling of an existing commercial, residential or industrial structure unless the design, construction or remodeling incorporates high-efficiency plumbing fixtures. In the instance of indoor or outdoor remodeling, compliance with this Section shall be limited to that portion of the structure for which a building permit is issued.

High-efficiency plumbing fixtures shall be defined as those fixtures which comply with the following standards for water use:

> *(a) All water closets designed not to exceed a flow rate of one point 6 (1.6) gallons per flush.*
> *(b) Urinals designed not to exceed one point zero (1.0) gallons per flush. The use of automatic time flush devices for urinals shall not be permitted.*
> *(c) Shower heads designed not to exceed a flow rate of (two point five (2.5) gallons per minute.*
> *(d) Lavatory, kitchen and service faucets designed not to exceed a flow rate of two point 2 (2.2) gallons per minute.*
> *(e) All commercial lavatories equipped with spring-loaded faucets that close when not in use or faucets that are equipped with metering valves that close automatically after delivering a maximum of twenty-five (25) gallons, except for required handicapped facilities which may be equipped with faucets designed for the handicapped.*
> *(f) Exceptions. Restaurant kitchen faucets and safety showers shall be exempted from the above flow restrictions.*

Other types of high-efficiency fixtures may be permitted provided that those fixtures are proven to use no more water than those fixtures defined as high-efficiency fixtures. Such proof shall be made to the satisfaction of the Building Department Official reviewing the application for a building permit. (Code 1971, § 7-232; Ord. No. 43-1981, § 1; Ord. No. 37-1991, § 1)

Sec. 8.40.030. Landscaping criteria; grass species, irrigation.
(a) To the extent practicable and consistent with the proposed design and use of the property, landscaping shall utilize, for grassy areas, grasses which have the effect of minimizing the consumptive use of water applied to such grass for irrigation. The Director of Parks shall promulgate an advisory list of drought tolerant grass species and acceptable mixtures of such species. This list shall be updated as research and experience dictate.

(b) For all outside irrigation, the development proposal shall include, to the extent practicable, an irrigation system which would incorporate only equipment of the most water-conserving type commercially available at the time the proposal is submitted for approval. Additionally, all irrigation shall be undertaken with raw water if possible. At a minimum, irrigation systems shall:

(1) Be equipped with time-activated automatic control clocks and shutoff valves.
(2) Be equipped with sprinkler heads of a type which provide the most uniform coverage feasible and maximum feasible droplets sized to reduce evaporation and wind disturbance of the coverage (pulsating type).
(3) Where the slope gradient of the proposed development so requires, be designed to control flow for the purpose of reducing runoff. (Code 1971, § 7-233; Ord. No. 43-1981, § 1; Ord. No. 37-1991, § 2)

Sec. 8.40.050. Soil preparation.
No building permit shall be granted for the construction of a new residential, commercial or industrial structure unless the design of all landscaping areas primarily devoted to the cultivation of any species of grass for aesthetic purposes and not for agricultural food production, includes proper soil preparation as hereinafter defined.

Soil preparation shall be defined as the addition to existing soils of a minimum of three (3) cubic yards per one thousand (1,000) square feet of organic matter introduced by tilling, discing or other suitable method to a minimum depth of four (4) inches. Acceptable organic matter shall include compost, peat moss, aged manures, aged sawdust or any combination of the above. (Code 1971, § 7-235; Ord. No. 37-1991, § 3)

4.2.4.3 Reclaimed Water and Recycling

Aspen is in the process of implementing a reclaimed water system that will increase the availability of water in Castle Creek by shifting a portion of the diversions for the Aspen Golf Course and other irrigation demands to utilize treated wastewater effluent as a source of supply rather than to rely on delivery of water from Castle Creek. Since the treated water system relies on this same source of supply and because the City wishes to maintain a 13.3 cfs instream flow for aquatic habitat even during critically dry periods, this shift will free up an additional 1.0 million gallons per day of new supply. The Reclaimed Water System will be completed in 2015.

4.2.5 Public Education and Information

A key component of Aspen's water efficiency plan focuses on end-user education and information. Aspen has provided ongoing water use awareness education and conducted customer outreach since as early as 1992 and it is a requirement of Aspen Municipal Code as described above.

Public education and information efforts are ongoing, and Water Department staff regularly attend community events for outreach purposes. The City regularly provides information to customers about ways to conserve water and avoid water waste through flyers and bill inserts and the utility maintains conservation materials and information that are available upon request. Aspen's website includes a webpage with water conservation tips and drought management resources. Aspen's website also features a water calculator where customers can develop an estimate of their water use.

Aspen intends to explore opportunities to expand its education and outreach to target specific customer classes such as peak users and visitors. For example, there may be opportunities to educate visitors by expanding energy efficiency programs that have been implemented in the past with the hotel and hospitality industries, or by exploring other programs such as the EPA WaterSense H2Otel Challenge, which encourages hotels to assess water use and savings opportunities, change products or processes to incorporate best management practices, and track their water-saving progress and achievements.

5. IMPLEMENTATION AND MONITORING PLAN

The City's Water Department staff are primarily responsible for implementation of this plan, and has been successfully implementing the City's water and energy efficiency programs since 2006. The City will continue to budget money and may pursue CWCB water efficiency grants to further achieve its water efficiency goals.

5.1 MONITORING AND EVALUATION

Aspen will review and update this Water Efficiency Plan at least every seven years, or as needed. The City monitors water use on a regular basis and will maintain consumption records. Progress towards meeting the conservation goal can be evaluated when the conservation plan is next updated and into the future using empirical data. This tracking analysis will help determine what (if any) additional conservation program measures are necessary to help Aspen meet its stated goal by 2035.

Beyond tracking water efficiency progress every seven years, water efficiency program impacts are evaluated annually. The annual accounting summarizes total treated water production, the number of accounts in the system, metered deliveries, and estimates of both production and customer meter adjustments. This allows an estimate of annual losses to be made. For its AMI

customers, the City also monitors water use on a weekly basis. Staff prepare reports and personally contact customers with unexpected or abnormal water use, sometimes identifying leaks before the customers are aware of them.

When the conservation plan is updated, new forecasts will be developed and the adequacy of the City's water supplies will be compared to future demand forecasts. If necessary, the City will adopt additional demand management measures. The evaluation completed for this plan indicates that provided the elements of this plan are successfully implemented, Aspen will have sufficient raw water supply to meet forecast future treated water demands within the 20 year planning period (without factoring in additional climate change impact). However, the supply is vulnerable to streamflow hydrology, particularly in late summer months, and emergencies that prevent access to or use of one or more supply sources. A further provision regarding the adequacy of supply is that existing water supply projects including the reclaimed water project and efforts to increase available supplies from the City's wellfield must be successfully implemented. The City is monitoring hydrology trends and emphasizing demand management to mitigate this vulnerability.

5.2 REVENUE STABILITY

Revenue stability is a critical concern for the City of Aspen as it moves forward with the water efficiency program. The City's focus on water efficiency since the 1990's has resulted in decreased water use; and lower water sales mean reduced revenue. Water rates inevitably must rise to collect sufficient funds to cover fixed costs, which continue rising as aging infrastructure is repaired and replaced, and with inflation, the need to protect water rights and supplies, etc. Nationally, water costs are rising faster than costs for other utilities like energy, telephone, and cable; so water rates are rising (AWE 2013). While conservation is often perceived as the cause of increased water rates, it can actually help reduce the need for expansion of infrastructure and treatment costs.

The City of Aspen's water rate structure is designed to promote revenue stability and efficiency of water use. It includes a variable demand charge component based on the number of ECUs to provide for revenue stability and increasing rate tiers designed to promote efficiency. The City does anticipate a growth in water demand over time as the population grows. Water efficiency as practiced by the City of Aspen and its water customers helps ensure water rates remain as low as reasonably possible for customers, because efficiency is being achieved at a lower cost than procuring new supplies or constructing new infrastructure.

Long-term planning is critically important for revenue stability and anticipating changes in water use. Demand forecasting and quantifying responses to water efficiency programs (including rate changes) provide valuable information for forecasting future revenue and making necessary adjustments in advance of realizing a shortfall. Although such efforts are time intensive and require customer education, experts recommend adjusting revenue collection annually to allow for more immediate response to changes in costs and demand.

6. PUBLIC REVIEW, ADOPTION, AND APPROVAL OF WATER EFFICIENCY PLAN

6.1 PUBLIC REVIEW

The public review process is described in Appendix A. A total of one set of comments were received during the 60 day comment period. To the extent possible, comments were addressed in this updated plan.

6.2 WATER EFFICIENCY PLAN ADOPTION

City of Aspen Utilities staff reviewed this Water Efficiency Plan and made comments, after which the public review period began. The plan was updated to address public comments, and then presented to the City Council during a work session on June 15, 2015. The Water Efficiency Plan was subsequently updated to address comments from the City Council. On September 28, 2015, the City Council adopted the plan with the updates included in this final version. A copy of the City Council Resolution adopting the Water Efficiency Plan is included in Appendix A.

6.3 WATER EFFICIENCY PLAN APPROVAL

The draft Water Efficiency Plan was submitted to the CWCB Office of Water Conservation and Drought Planning on January 5, 2015, during the public review period. CWCB comments were addressed in this updated final version. On [**DATE**], the City received official notification that the plan was approved by the CWCB.

7. COMPLIANCE WITH STATE PLANNING REQUIREMENTS

Colorado Revised Statute § 37-60-126 requires a covered entity to develop, adopt, make publicly available, and implement a water conservation (efficiency) plan that will encourage its domestic, commercial, industrial, and public facility customers to use water more efficiently. According to the statute, a "covered entity" means a municipality, agency, utility, or other publicly owned entity with a legal obligation to supply, distribute, or otherwise provide water at retail to domestic, commercial, industrial, or public facility customers, and that has a total annual demand for such customers of two thousand acre-feet or more.

Key elements that must be fully evaluated in development of the plan are listed as follows:

A. Water-saving measures and programs including:
   I. water-efficient fixtures and appliances;
   II. low water use landscapes, drought-resistant vegetation, removal of phreatophytes, and efficient irrigation;
   III. water-efficient industrial and commercial water-using processes;
   IV. water reuse systems;

V. distribution system leak identification and repair;
VI. information and education;
VII. conservation-oriented rate structures and billing systems;
VIII. regulatory measures designed to encourage water conservation;
IX. incentives to implement water conservation techniques including rebates.

B. Role of conservation in the entity's supply planning.
C. Plan implementation, monitoring, review, and revision.
D. Future review of plan within seven years.
E. Estimated savings from previous conservation efforts as well as estimates from implementation of current plan and new plan.
F. A 60-day minimum public comment period (or other time period based on local ordinance).

The following section of the plan details Aspen's compliance with this statute.

7.1 ASPEN WATER EFFICIENCY PLAN COMPLIANCE

The City of Aspen developed this conservation plan in order to comply with C.R.S. § 37-60-126. Each element of compliance is documented below.

A. Consideration of specific conservation measures.

(I) *Fixture and appliances* – The City actively promotes the installation of water efficient fixtures and appliances through its Water Conservation and Plumbing Advisory code which places specific requirements on new construction. The City has carefully considered and evaluated the costs and benefits associated with give-aways, rebates, and incentives to encourage more rapid adoption of efficient technology, and has offered incentives in the past. Additional expenditures for incentives are economically justified in order to help reduce demand, and because of State regulations mandating WaterSense labeled fixtures in the future, and the resulting benefit-cost analysis.

(II) *Water wise landscape* –The City implements a variety of programs and pricing mechanisms to improve irrigation efficiency and reduce outdoor demands, and is considering additional programs to help reduce late summer peaking effects. These measures are intended to complement the City's energy audit and rebate program. Specifically, the City implements an irrigation information and education program, periodically provides in-person efficiency information all summer long at the Aspen Farmer's Market, offers xeriscape seminars, provides free irrigation audits via Slow the Flow, requires efficient irrigation at City parks, and has specific irrigation and soil preparation requirements for new development.

(III) *Commercial, Industrial and Institutional (CII) measures* – Aspen's water conservation program for commercial, institutional, and industrial (CII) users focuses on education and pricing mechanisms. Guests at many Aspen lodging establishments are encouraged not to change their sheets and towels every day unless necessary. In 2011, the toilet

rebate program was modified to double the compensation for commercial and lodging facilities as compared to residential ($150 vs $75), and allowed for an unlimited number of fixtures when previously capped at 3.

Aspen started conducting internal water use assessments in 2007 to evaluate the consumption in the City's buildings and the water treatment plant. The findings of this investigation prompted the replacement or upgrading of pumps and piping. In 2009, the City began working with a private consultant to implement $1.2 million worth of energy and water efficiency upgrades in 13 government-owned buildings. This provides Aspen an excellent opportunity to expand into CII water efficiency upgrades through similar programs or through the Center for Resource Conservation which is already implementing several programs for the City.

(IV) *Water reuse systems* – Treated wastewater effluent from the wastewater plant will be reused for irrigation and possibly snowmaking. The City also provides raw water for irrigation.

(V) *Water loss and system leakage reduction* – System leakage in Aspen is currently estimated to average approximately 4%, which is well below the 10% threshold that is often estimated as the national average. This low rate of system leakage is not an accident, but rather the product of a progressive and ongoing water main replacement and repair program in Aspen. In the future, Aspen plans to implement the AWWA M36 Water Audit annually.

(VI) *Information and public education* – A key component of Aspen's water efficiency efforts is public education and information. The City regularly provides information to customers about ways to conserve water and avoid water waste through participation at community forums, flyers and bill stuffers, and the utility maintains conservation materials and information that are available upon request. The City hosts a booth at the Aspen Farmers Market where citizens can get in-person advice on energy and water efficiency.

(VII) *Water rate structure* – Aspen currently bills most of its customers on a monthly basis using a four-tier inclining block rate structure. Updates strengthening the price signal for high water users in this conservation-oriented rate structure take effect in January 2015.

(VIII) *Technical assistance* – none was requested for development of this plan.

(IX) *Regulatory measures* – Aspen has a number of significant water efficiency regulatory measures include:

- Water waste ordinance
- Consumer conservation education requirement

- Water conservation building code
  - High-efficiency fixtures
  - Landscaping and irrigation criteria
  - Soil preparation

(X) *Incentives* – Due to considerable remodeling and upgrading in Aspen, incentives are not a particularly cost-effective inducement to conservation, given the requirements currently in place for efficient fixtures. Regardless, Aspen has provided a wide variety of incentives for water conservation over the past 15 years and will continue to do so on an "as needed" basis.

B. Role of conservation in Aspen supply planning. This Water Efficiency Plan represents Aspen's most comprehensive effort to integrate water conservation into water supply planning. Through this plan, the City has established that its raw water supply is adequate to meet anticipated future growth, although lack of existing storage means that Aspen remains at risk of shortages when streamflows are low, or when emergency conditions prevent or limit use of one or more sources of supply. Moreover, the demand projections in this plan do not factor in impacts of additional future climate changes.

C. Plan implementation, monitoring, review, and revision. The City monitors water use on a regular basis and will continue to do so. The City produces monthly and annual demand reports for each customer sector and the system as a whole and keeps close track of demand. Aspen will review and update this water conservation plan every seven years or as needed. During this review, progress towards achieving the stated conservation goal will be evaluated.

D. Future review of plan within seven years. Aspen will review and update this water conservation plan every seven years or as needed.

E. Estimated savings from previous conservation efforts and current plan. Over the twenty-year forecasting period under the City's conservation program, annual demand rises from 3,377 acre-feet to 3,597 acre-feet and results in a savings of 583 AF/yr. The impact of past water conservation efforts since 1990 is estimated at 4,238 AF of water savings annually.

F. Public comment period. A 60-day public review process was held from December 24, 2014 through February 27, 2015. During this period, one person submitted written comments. The comments and responses from the City of Aspen are provided in Appendix A. To the extent possible, comments were addressed in this updated plan but did not result in any major changes.

8. ROARING FORK REGIONAL WATER EFFICIENCY PLAN

The development of the City of Aspen Water Efficiency Plan was a collaborative effort funded by a Colorado Water Conservation Board grant as part of the Roaring Fork Watershed Regional Water Efficiency Plan. The Regional Water Efficiency Plan is published under separate cover and focuses on regional opportunities to increase municipal water efficiency. The City's Water Efficiency Plan has potential to directly impact flows in the Roaring Fork River, although Aspen cannot guarantee that water it saves through conservation efforts will benefit the entire reach of the Roaring Fork to the extent that other downstream water users may divert that water out of the river.

The City is interested in regional partnership to improve water efficiency and is committed to assisting with the implementation of the Regional Water Efficiency Plan. Examples of Aspen's previous participation in regional activities include:

- Helped fund the Ruedi Water and Power Authority for its first 20 years;
- Partnered with Roaring Fork Conservancy on educational programs and tours;
- Has a board member on the Roaring Fork Watershed Collaborative;
- Partnership with Aspen Consolidated Sanitation District on reuse/reclamation project;
- Agreement with Colorado Water Conservation Board for use of Aspen's senior water right to protect decreed flow on Hunter Creek and agreement with Colorado Water Conservation Board for protection of decreed instream flow on Castle Creek;
- Colorado Water Trust pilot program involving a forbearance agreement that enhances streamflows in the Aspen reach of Roaring Fork River; and
- Cooperative agreements and projects with Colorado River Water Conservation District, Twin Lakes Reservoir & Canal Company and others to provide streamflow protection for the Roaring Fork River in connection with operation of transmountain diversion projects.

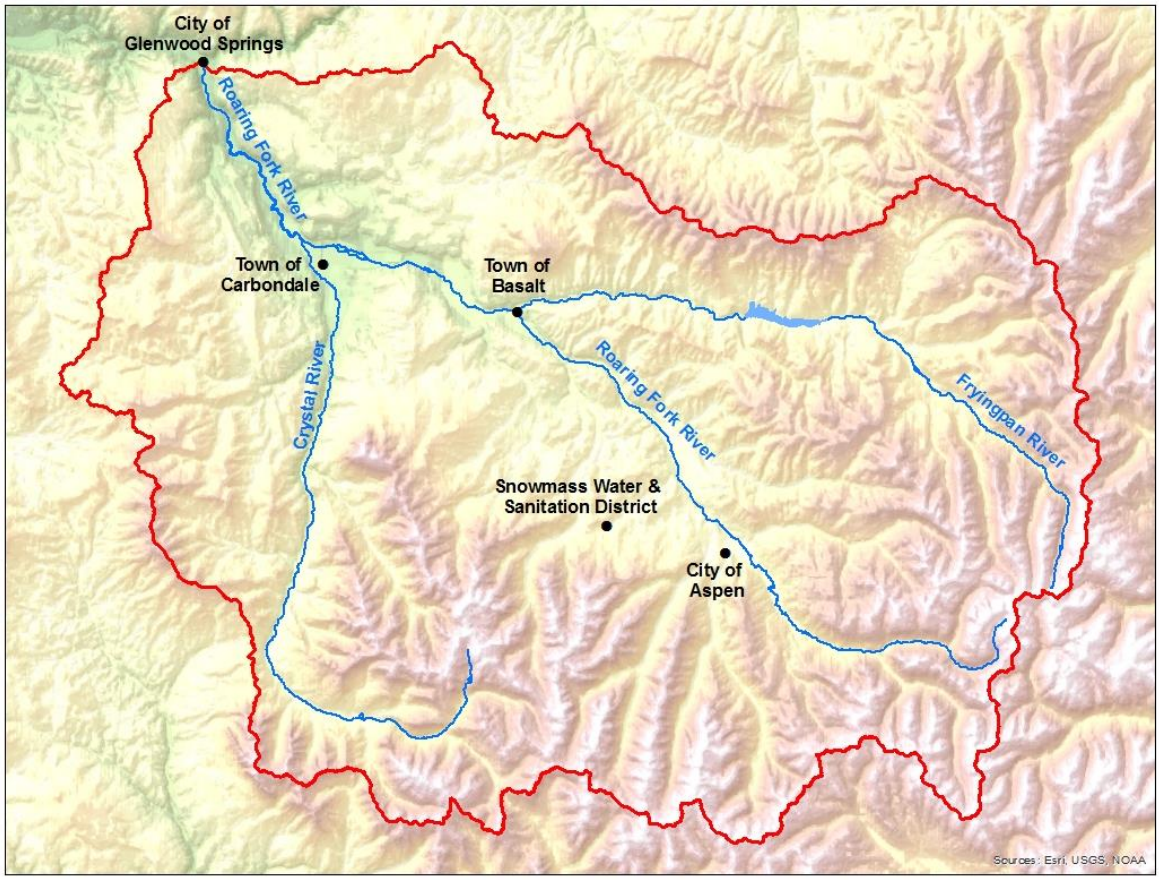

Figure 12. Water Providers Participating in the Roaring Fork Regional Water Efficiency Plan.

9. REFERENCES

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APPENDICES

APPENDIX A

CITY OF ASPEN MUNICIPAL WATER EFFICIENCY PLAN PUBLIC NOTICE ANNOUNCEMENT, PUBLIC COMMENTS, AND OFFICIAL PLAN ADOPTION RESOLUTION

A1. PUBLIC NOTICE ANNOUNCEMENT

A Public Notice (reprinted below) was published on December 24, 2014, through the City of Aspen website: http://www.aspenpitkin.com/Departments/Utilities/Water. Public comments on the Municipal Water Efficiency Plan for City of Aspen were requested via email by February 27, 2015 to: WaterAdmin@cityofaspen.com.

Press Release

Public Input Requested for Aspen's Draft Water Efficiency Plan

PUBLIC SERVICE ANNOUNCEMENT

Public Input Requested for Aspen's Draft Water Efficiency Plan

Contact: Lee Ledesma, Finance and Administrative Services Manager, Utilities Department, City of Aspen, 429-1975 or lee.ledesma@cityofaspen.com.

Aspen, Colorado – December 24, 2014 – The City of Aspen has completed a draft of an updated water efficiency plan and is requesting public input. The plan is being updated as part of the City's participation in a Roaring Fork Watershed Regional Plan, which is a partnership between Aspen, Snowmass Village, Basalt, Carbondale and Glenwood Springs. The report is designed to look at future demand and efficiency measures with the goal of benefiting and enhancing the stream flow in the upper Roaring Fork River basin. To read the report and get information on how to comment go to www.aspenpitkin.com and click on Water Department. The deadline for comments is February 27, 2015.

###

Posted on Wednesday, December 24, 2014

A2. PUBLIC COMMENTS

The 60-day public review process was held from December 24, 2014 through February 27, 2015. During this period, one person submitted written comments. The comments and responses from the City of Aspen are presented below.

A2.1 COMMENTS RECEIVED

The comments received are reprinted below, as received.

> Thank you for accepting my feedback in response to the **City of Aspen's Municipal Water Efficiency (WE) Plan**. I welcome the opportunity to discuss my notes with your team in-person should that help inform Plan refinements. While it appears the report is focused primarily on **Water Quantity**; there is excellent opportunity to illustrate the parallel benefits of improved **Water Quality**. Too, the topics listed below are primarily focused on **outdoor water conservation** as informed by my professional practice—registered Landscape Architect.
>
> **Opportunities for additional WE activities/education** (page 40):
> Climate—reduce contributors to increasing temperatures
> Reduce risk of catastrophic events—slides, fires, etc
> Temperatures (reduce heat island effect)
> Restore/protect aquatic systems
> Require or incentivize for preservation/protection of native, undisturbed areas of soil/plants
> Soil/vegetation work together, protect together—reduce disturbance + protect
> Existing Veg/Soil/Water—protect
> Proposed Veg/Soil/Water—xeric, organic
> Consider solar exposure and effect on irrigation/water needs
> Manage precipitation on site—reduce hardscape, mimic nature/treatment train, direct roof and other runoff into planting beds, future possibility to manage/collect/store runoff
> Functional stormwater features as amenities—integrate functional stormwater features (review as Plan may complement and/or conflict with *City Engineering* regulations)
> Reduce water use in landscape/reduce irrigation/xeric/drip—mandate limitations
> Require irrigation be non-potable if available to property
> Reduce outdoor water use—pools, spas, water features, snowmelt (evapo loss), etc
> Provide detailed xeric plant list as informed by appropriate elevation/aspect/precipitation/etc
> Consider wind exposure (impact to water needs, irrigation inefficiencies)
> Landscape maintenance standards

Detailed inventory of City of Aspen parks, open space and similar public lands, inventory to consider:
Use of treated water for irrigation
Use Kentucky Bluegrass (define acreage)
Maintenance plan
Planting plan (xeric versus non)
Irrigation plan (drip versus spray)

Detailed inventory of Districts/School, as relevant
Same as above

Consider acknowledgment:
City Engineering standards—high quality guidelines and regulations
City code—aquatic systems currently protected (riparian buffers, wetlands, streams)

Despite **Colorado Water Law**, integrate a wish-list for future implementation opportunities such as
Rainwater harvesting, graywater reuse, etc.

Education/awareness—opportunities for field-demonstrations of vision implemented by City at City owned parks and open/space, such as:

Zoned irrigation, drip, temporary for establishment versus permanent
Turfgrass species location appropriate
Consider 'natural' swimming pools
Low-impact, aesthetically awesome stormwater design
Green roofs
Detention/retention

Consider pilot projects:
http://water.state.co.us/SurfaceWater/SWRights/Pages/RainwaterGraywater.aspx

A2.2 Responses from City of Aspen

Thank for you for taking the time and effort to prepare these useful comments. Below is a summary of how these comments were addressed in the Water Efficiency Plan. Please understand that it is not possible to incorporate all of the recommendations submitted.

A2.2.1 Treated Water Supply

The City understands that reducing irrigation runoff has the potential to reduce nutrient flows into local streams and rivers and is an additional benefit of this water efficiency plan, with its focus on outdoor

watering and irrigation efficiency. As noted in the comments, the City of Aspen Water Efficiency Plan is focused entirely on water quantity and does not touch on water quality. Aspen's plan was carefully prepared to comply with State of Colorado planning requirements and legislation, which does not currently include water quality as part of the legal planning requirement.

The City hopes to incorporate ideas for reducing runoff and improving water quality in the coming years through the consideration of a model landscape ordinance, which is further described in the Regional Water Efficiency Plan for the Roaring Fork Watershed.

A2.2.2 Water Efficiency Activities and Education

The City of Aspen actively promotes water efficiency through a variety of informational and educational efforts described in this plan. In addition, the City plans to research and develop a local landscape ordinance that will help ensure new and remodeled landscapes and irrigation systems incorporate best practices for water efficiency. This will provide an opportunity to incorporate some of the recommendations from the comments on solar exposure and landscape maintenance standards.

Some of the items listed in the comments such as "reduce risk of catastrophic events – slides, fires, etc." are not directly linked to existing or proposed water efficiency activities and may be considered for inclusion in a future plan update, or in a different context such as a regional plan or climate resiliency plan.

Aspen has provided ongoing water use awareness education and has conducted customer outreach since as early as 1992, and it is a requirement of Aspen Municipal Code as described above. Public education and information efforts are ongoing, and Water Department staff regularly attend community events for outreach purposes. The City regularly provides information to customers about ways to conserve water and avoid water waste through flyers and bill stuffers and the utility maintains conservation materials and information that are available upon request. Aspen's website includes a webpage with water conservation tips and drought management resources. Aspen's website also features a water calculator where visitors can develop an estimate of their water use.

A2.2.3 Inventory of City of Aspen Parks and School Properties

All City parks, medians, and other irrigated areas that use pressurized water are metered and billed based on their actual consumption. In 2008, the irrigation system at the Municipal Golf Course was completely upgraded with new piping, irrigation heads, and controllers. Irrigation systems on selected parks and open spaces have been converted to the alluvial groundwater supply system, which frees up treated water for other municipal purposes.

The City of Aspen Parks Department manages the City's parks. This management includes landscaping, irrigation and water management. School landscapes are designed and maintained by the local school district. Maintaining landscape inventories and irrigation system information are tasks that are accomplished by other departments and staff. Working with the Parks Department and school district to identify potential for additional water demand management may be considered in future plan updates.

A2.2.4 Acknowledgement of City Codes and Standards

The City does have regulations on riparian buffers and wetlands related to stormwater runoff. As stormwater runoff is outside the purview of this plan, these regulations are not explicitly discussed. Aspen does, however, provide stormwater quality treatment.

A2.2.5 Wish List "Despite Colorado Water Law"

While the City did not incorporate a "wish list" related to Colorado water law as part of its plan, this topic is addressed and included in the Roaring Fork Regional Water Efficiency Plan. The Regional Plan was made available for public review on March 10, 2015.

A3. OFFICIAL PLAN ADOPTION RESOLUTION

City of Aspen Utilities staff reviewed this Water Efficiency Plan and made comments, after which the public review period began. The plan was updated to address public comments, and then presented to the City Council during a work session on June 15, 2015. The Water Efficiency Plan was subsequently updated to address comments from the City Council. On September 28, 2015, the City Council adopted the plan with the updates included in this final version. A copy of City Council Resolution 081-15 adopting the Water Efficiency Plan is attached.

RESOLUTION NO. 81
Series of 2015

A RESOLUTION OF THE CITY OF ASPEN, COLORADO, ADOPTING THE CITY OF ASPEN MUNICIPAL WATER EFFICIENCY PLAN.

WHEREAS, the City of Aspen has demonstrated a long-term commitment to wise water stewardship and responsible and efficient use of its water resources; and

WHEREAS, the City of Aspen carefully developed a City of Aspen Municipal Water Efficiency Plan, attached hereto as Exhibit A and incorporated by this reference (the "Aspen Water Efficiency Plan"), in accordance with the Colorado Water Conservation Act of 2004 so that it meets or exceeds all statutory requirements according to Colorado Revised Statute § 37-60-126; and

WHEREAS, the Aspen Water Efficiency Plan was created to identify opportunities for further efficiencies in the Aspen water system; and

WHEREAS, the City of Aspen has been successful in implementing a number of indoor water conservation measures and has now identified future measures that focus on outdoor water efficiency to reduce water demands and provide reasonable cost savings for water utility customers.

NOW, WHEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF ASPEN, COLORADO, THAT:

Section One

The City Council of the City of Aspen hereby adopts the City of Aspen Municipal Water Efficiency Plan.

INTRODUCED, READ AND ADOPTED by the City Council of the City of Aspen on the 28th day of Sept, 2015.

Steven Skadron, Mayor

I, Linda Manning, duly appointed and acting City Clerk do certify that the foregoing is a true and accurate copy of that resolution adopted by the City Council of the City of Aspen, Colorado, at a meeting held on the day hereinabove stated.

Linda Manning, City Clerk