

TOWN OF BEECH MOUNTAIN
ANALYSIS OF FUTURE WATER SUPPLY
NEEDS AND AVAILABILITY

North Carolina Division of Water Resources

Water Supply Planning Branch

September 1, 2015

The Town of Beech Mountain is located in the Blue Ridge Mountains of western North Carolina and has a water supply service area primarily in Watauga County with a small portion in Avery County. The drainage area of the town is nearly entirely within the Watauga River Basin. The town's existing water system serves a full-time permanent residential population of approximately 340; however, during many months of the year it serves a seasonal population of over 5,000 and has short-term maximum populations approaching 10,000 visitors.

Each year the town is required to complete a Local Water Supply Plan (LWSP) that reviews the current status of the water system as well as documenting its plans to meet the future water supply needs of its customers. LWSPs are required by general statute (§143-355(l)) and administrative rule (15A NCAC 02E 0.0600) to be submitted each year to the North Carolina Division of Water Resources (DWR). These LWSPs are an integral tool of the DWR to meet the goals outlined in the DWR mission statement. The mission of the Division of Water Resources is to provide the strategic information necessary to manage the state's water resources for the health and welfare of the public; the continued economic growth of the state; the integrity of North Carolina's surface waters; and the sustainability of its ground waters.

During the evaluation of the 2012 LWSP for the Town of Beech Mountain, it was determined by the DWR that the LWSP could not be approved due to the town's inability to meet the current and long term water supply needs of its customer base. This concern was formally documented in a letter dated, February 20, 2014, from the DWR Director to the Town of Beech Mountain's Mayor, Rick Owen. In response to this letter, the Town of Beech Mountain passed a resolution on March 11, 2014 requesting that the North Carolina Department of Environment and Natural Resources (DENR) enter into an agreement with the town for the identification of water supply needs and the appropriate water supply sources and water storage projects to meet these needs and to conduct associated studies, environmental evaluations, planning and budget estimates for such new water supply project(s).

The first step in this process was for the DWR staff to review the recently received 2013 and 2014 LWSPs submitted by the Town of Beech Mountain. Additional reviews included evaluations of the following documents:

1. Water and Sewer Study prepared for Beech Mountain by Rothrock Engineering dated July 28, 2011.
2. The Buckeye Lake Yield Analysis prepared for the town by West Consultants dated February 7, 2014.
3. The Limited Groundwater Availability Assessment Report prepared for the town by Analytical Services, Inc. dated May 30, 2012.

From this review, six issues were highlighted when considering the future water needs of the town:

1. The documented susceptibility of the existing water supply to localized drought conditions.
2. The extremely small drainage area of the town's existing surface water reservoir (Buckeye Lake).
3. The limited usable storage volume in Buckeye Lake.
4. The required minimum flow releases from Buckeye Lake.
5. The very high finished water losses from the town's water distributions system.
6. Significant potential for future residential growth, especially vacation properties, exists.

EXISTING RAW WATER SUPPLY BACKGROUND

The Town of Beech Mountain operates the highest elevation water system in North America east of the Mississippi River, at a maximum of 5,500 feet above mean sea level (msl). Much of the existing water supply and wastewater system (i.e., water lines) was constructed in the late 1960's and early 1970's by the Carolina Caribbean Company (CCC) who developed the Beech Mountain vacation resort. At the time, Lake Coffey was the water supply source. The CCC went bankrupt in 1974 and the existing Beech Mountain property owners association (POA) temporarily managed and maintained the water/wastewater system. The system was formally purchased from the courts by the recently formed Beech Mountain Utility System, owned by the POA, in 1977. The POA formed a Sanitary District the following year and by 1980 had effectively transferred the water/wastewater system to the Sanitary District through a purchase agreement. To purchase the water/wastewater system, citizens in the Sanitary District voted in

1979 to approve issuance of a \$700,000 sewer bond and a \$1.75 million water supply bond. These monies were also used to institute programs to increase the capacity of existing water/wastewater system to handle the projected 20-year population growth. The resort community subsequently was incorporated as a municipality in 1981 and the POA reorganized as the Beech Mountain Club. At the time of the incorporation, many of the existing lots had already been recorded, surveyed, and platted, with obligations to provide water service. Due to continued growth, it was clear to the leaders and managers of the Town of Beech Mountain that Lake Coffey was inadequate to supply the future water demands. Therefore, Buckeye Lake was pursued as a water supply solution.

As of 2015, the existing, single water supply source for the Town of Beech Mountain is Buckeye Lake, located on Buckeye Creek. Inflows into Buckeye Lake are small due to the small drainage area of Buckeye Lake (3.7 square miles). Buckeye Creek, above Buckeye Lake, is estimated to have an average daily flow of 7.0 cubic feet per second (cfs) (4.52 million gallons per day (mgd)) and an estimated average 7 day, 10 year low flow (7Q10) of 0.700 cfs (0.452 mgd). This estimation was conducted by the United States Geological Survey (USGS) and based upon flow data from nearby surface waters with significant stream gage records, coupled with Buckeye Lake drainage area information. This is an accepted methodology; however, it should be noted that recent modeling investigations conducted by the DWR suggest that correlations between Buckeye Creek and nearby gaged surface waters on an estimated flow per square mile basis are questionable.

Buckeye Lake was constructed in 1985/1986 and was at operational water levels by 1987. The 20-year safe yield for Buckeye Lake was reported by the then-Director of Public Works, Mr. Joe Perry, for the Town of Beech Mountain to be 2.0 mgd in the 1989 DWR Water Supply System Report, precursor to the LWSP. The basis for this estimate is unknown. A DWR water supply review engineer commented, in 1990, during the evaluation of the 1989 report that the accuracy of this value was questionable. Since construction, the actual available safe yield of Buckeye Lake has been found to be significantly less than the originally reported 2.0 mgd estimation.

According to February 2014 Buckeye Lake Yield Analysis document by West Consultants, the safe yield of Buckeye Lake is approximately 0.3 mgd; however, this value is only valid under specific qualifying conditions. The most important condition is that this value does not include the existing minimum release requirements set forth in the United States Army Corps of Engineers (USACE) Permit (i.e., Section 404-Clean Water Act) for construction of the Buckeye Lake dam. The permit, issued November 1984, requires a minimum flow release from the dam of 2.8 cfs (1.8 mgd) through October, November and December, intended to provide needed flows during the native brook trout spawning period. The remainder of the year (i.e., January through September), the required minimum release is 1.5 cfs (0.97 mgd), intended to maintain the existing water quality of Buckeye Creek. The 2014 Yield Analysis report makes it clear that

when including the required minimum releases, as dictated by the USACE permit, the safe yield should be considered zero under low flow conditions or in times of drought. It should also be noted that similar to the Buckeye Creek flow estimations, the safe yield calculations used USGS gage data from the Watauga and Elk Rivers. In light of recent DWR modelling difficulties regarding Buckeye Creek, use of these values should be considered questionable, even though this methodology is the only available means to make such estimations.

In the late 1980's, it became apparent that there was inadequate flow in Buckeye Creek to support the water supply needs of the Town of Beech of Mountain while complying with the minimum release requirements. Town representatives first contacted the DWR on July 1, 1988 shortly after the construction of the dam was completed to request approval to reduce the required minimum flow releases from Buckeye Lake dam. To avoid a pending water supply emergency, the DWR granted the temporary waiver on July 1, 1988. No specific time table was issued for the waiver and the Town of Beech Mountain never resumed the required minimum flow requirements, except for times in which the water flowed over the dam. The waiver specified that for a temporary period of time the minimum flow would be a volume equal the smaller volume that was entering the lake from Buckeye Creek. According to town representatives, this volume has never been accurately measured; however, it is estimated that this volume does not exceed 0.5 mgd during drought conditions.

The most feasible means of discharging water from the reservoir is via the existing release pipe beneath the dam. However, representatives from the town have stated that the valve for this discharge pipe remains closed, with any flows from the pipe comprised of seepage and leakage. Therefore, it is doubtful that an equivalent flow of inflow into the lake has ever been discharged during low flow conditions.

During the summer of 2010, the Town of Beech Mountain experienced some of the most significant drought conditions since construction of the Buckeye Lake dam. It was a localized drought concentrated primarily on the Buckeye Creek area, not the larger Watauga River basin, and presented the town with a dangerous water supply emergency. At its worst, the water level in the lake was a mere 8-10 inches above the lowest of the three intakes with less than 20 days of water supply estimated to have been available. During this time, as well as previous to the drought, very little, if any, water was being released to maintain required minimum downstream flows. After this precarious situation, local water supply managers and town leaders were left with serious concerns that their existing water supply source was no longer adequate.

In the 2014 Buckeye Lake Yield Analysis developed by West Consultants, the recommended long-term available water supply withdrawal by the town from Buckeye Lake was projected to be only 0.300 MGD and only if the releases from the dam are limited to the lake inflows. The report also concluded that if the releases were at the rate required by the USACE Permit, Buckeye Lake would have no available yield in times of drought or low flow conditions.

EXISTING WATER TREATMENT PLANT CAPACITIES

The Buckeye Water Treatment Plant (WTP) was granted a permitted capacity of 1.0 MGD in 1984 by the North Carolina Department of Health and Human Services - Public Water Supply Section. It should be noted that at the time of this approval, North Carolina Administrative Rules did not require the same level of scrutiny given to approval of proposed WTP capacities as they currently do, particularly with regards to the available raw water supply. The contract to replace the original equipment within the plant with in-kind 1.0 mgd equipment is expected to be executed in 2015. However, under low flow or drought conditions water service to the Town of Beech Mountain could become compromised at or prior to peak demands of 1.0 MGD. As demonstrated during the 2010 drought, without near normal inflows the reservoir is expected to be unable to sustainably meet the water demands for the Town of Beech Mountain.

According to the 2014 LWSP, The Buckeye WTP currently processes and delivers into the water supply system an annual average daily demand of 0.364 mgd and a maximum day demand of 0.934 mgd.

PROJECTED ANNUAL AVERAGE DAILY DEMANDS

Projected average daily demands on 10-year increments are provided in LWSPs out approximately 50 years. As with other information in the LWSPs, projected demands are provided by the water system. The 2014 LWSP for the Town of Beech Mountain estimates the 2040 projected average daily demand to be 0.401 and 0.471 mgd in 2060. The 2060 projected demands represent an increase of approximately 30% from the reported 2014 actual daily demands.

These values are particularly difficult for the Town of Beech Mountain to estimate because it is primarily a retirement and vacation destination. Therefore assumptions must be made in how the economy will grow over the next 45 years to allow for new retirement homes to be built and purchased and for additional customers to be able to visit the area to take advantage of the recreational opportunities that the area offers.

As of 2010, there were 5,434 platted building lots in Beech Mountain. Of these lots only approximately 1,750 (32%) are currently built upon. Of the remaining 3,650 lots, the town estimates that as much as 85% (3,100) could be reasonably built upon. The likelihood that any portions of these lots are developed drives future increases in water supply demand. These predictions feed into the demand projections generated.

In addition to any projections of future water demands, under current permit requirements an additional 1.8 mgd is needed to comply with the required minimum release from Buckeye Lake Reservoir through October, November and December (0.97 mgd from January through

September). Under these sets of conditions the projected water supply demands on Buckeye Lake would be 2.271 mgd during the autumn and 1.441 mgd during the rest of the year.

Another key factor in projecting meaningful future water needs for the Town of Beech Mountain relies on the success of their efforts to reduce the volume of water that is lost from the water system due to leakage from the distribution lines. Through the town's efforts, the percentage of unaccounted-for losses through leaks has been reduced from 68% in 2010 to 55% in 2014. In the 2014 LWSP, the percentage of unaccounted-for losses in 2060 is projected to be reduced to 34%. To achieve that goal, the town is committed to continuing their leak detection and repair programs, as well as significant distribution system upgrades and replacements where critically needed. However, it should be noted that it is infeasible for most water systems, especially one the size of the Town of Beech Mountain's, to replace the entire distribution system over a short period of time. The 2011 Water and Sewer Study conducted by Rothrock Engineering estimated this cost to be \$15,990,000. This cost would be prohibitive over a short time scale without significant outside financial assistance.

SYSTEM'S ABILITY TO MEET FUTURE WATER DEMANDS

As presented, the existing water supply for the Town of Beech Mountain is not adequate to meet its current or future water supply needs during drought conditions. This issue remains with or without compliance with the minimum release requirements.

POTENTIAL FUTURE WATER SUPPLY OPTIONS

A. No Action

This is not a viable option since Beech Mountain has already experienced water shortages with its water supply at existing usage levels while not complying with the minimum release requirements. This option does not support the purpose and need demonstrated by the Town of Beech Mountain.

B. Reduce Water Losses from the Town's Distribution System

Regardless of its future water supply source(s), Beech Mountain is committed to reducing the high volume of water losses from its water distribution system and has already made significant progress. Even if all the water losses were eliminated, the town would still not meet its current and projected water supply needs.

C. Reduce Customer Usage

Regardless of its future water supply source(s), Beech Mountain is committed to reducing the per capita daily consumption through a water conservation program of incentives and

ordinances. Some progress has been; however, even with further reductions, the town would still not meet its current and projected water supply needs.

D. Purchase Water from Other Nearby Water Systems

The Town of Beech Mountain is located in an extremely mountainous section of North Carolina with all nearby water systems including, Banner Elk, Elk Park and Seven Devils, utilizing groundwater as their water source, due to their relative small service populations. According to their LWSPs, none of these systems are projected to have a sufficient excess water supply in 2060 to meet the needs of Beech Mountain.

The nearest water system that potentially could supply the needed volume of water to the Town of Beech Mountain would be the Town of Boone. The distance and topographic challenges of a water line from the Town of Boone to Buckeye Lake would likely entail significant environmental impacts and would be cost prohibitive. This alternative would also result in the transfer of water between major river basins, necessitating issuance of an Interbasin Transfer Certificate. This option is not considered practical, due to the significant environmental impacts and financial burden.

E. Increase Water Storage by Expanding Buckeye Lake

According to the Water and Sewer Study conducted by Rothrock Engineering, raising the height of the dam on Buckeye Lake by 10 feet would increase the storage volume of the lake by approximately 21 to 22 million gallons. The low flow conditions of Buckeye Creek have been shown to provide unreliable inflows to sustain the water supply demands of Buckeye Lake. Therefore, an expansion of the Buckeye Lake reservoir capacity would not sustainably meet the projected water demands for the Town of Beech Mountain.

F. Develop Groundwater Supplies

In the Limited Groundwater Availability Assessment Report prepared for the town by Analytical Services, Inc., low to moderate well yields are typically encountered in the area of Beech Mountain. The likelihood of low yielding wells would make this option not practical.

G. Intake on the Watauga River

The Watauga River is the largest and most reliable water source in the region. A specific intake location has not been identified; however, at the Guy Ford Road crossing of the Watauga River has an average annual flow of approximately 245 cfs (158 mgd) and a 7Q10 low flow of approximately 25.6 cfs (16.6 mgd).

FINDINGS

1. The current water supply for Beech Mountain is not adequate to meet its current needs as well as its projected needs for 2060. Therefore, not seeking an additional water source or conducting water efficiency and conservation efforts does not meet the purpose and need of the project.
2. The existing water supply, Buckeye Lake Reservoir, is inadequate to provide a consistent water supply to the Town of Beech Mountain. During low flow or drought conditions the inflows from Buckeye Creek have been shown to be inadequate to sustain Buckeye Lake and its water supply demands. Minimum release requirements from the dam set forth in the Clean Water Act permit coupled with the existing water supply demands will effectively drain the lake during drought periods.
 - a. The Buckeye Lake Yield Analysis prepared by the town's consultant recommends that 0.300 mgd be used as the long-term available safe yield from Buckeye Lake. This is only if the release from the lake is no more than the inflow into the lake. Should required minimum releases resume, Buckeye Lake essentially has no available yield in times of drought.
 - b. The inadequacy of the existing water supply sources was documented in July 2010 when the available water supply in Buckeye Lake was almost exhausted while the town was essentially not releasing any water from the lake. It is clear that if the town had released the required volume of water from the lake, even equal to inflows from Buckeye Creek, the water supply would have been completely exhausted.
3. This report presented six potential water supply options for the Town of Beech Mountain to avoid water shortages during periods of low inflows from Buckeye Creek into Buckeye Lake. The selected additional water supply source would presumably not be needed on a continual basis, but only when Buckeye Lake cannot support the water supply demand. It should be noted that the minimum flow requirements in Buckeye Creek below the Buckeye Lake dam may necessitate the additional water source to be used to maintain downstream flows in Buckeye Creek.
 - a. Increased water efficiency and conservation are always early considerations to any water supply issue. The Town of Beech Mountain must continue to address the high percentage of water loss from its distributions system. The town must continue to work with its customers to reduce their per capita daily usage through voluntary and ordinance driven initiatives. Even if the town were able to reduce all water losses from its distribution system and significantly reduce the per capita water usage by its customers, it would still not have an adequate water supply during drought conditions to meet the water supply needs of its customers. This situation would be present with or without honoring the required minimum release requirements.

- b. The options of an interconnection with another water system, installing groundwater wells or increasing the volume of storage in Buckeye Lake would not meet the long term water supply needs of the town.
- c. An intake on the Watauga River appears to be the most practical solution to providing a supplementary source of water for the Town of Beech Mountain. The exact volume of water that would be needed from the Watauga River at any time is unknown since it would be dependent on drought conditions in the Buckeye Creek drainage basin. For planning purposes, a conservative volume would range from 2.0 to 3.0 mgd. Even at a rate of 3.0 mgd, the withdrawal would be less than 2% of the river's average flow and only 18% of the 7Q10 low flow.
 - i. The proposed Watauga River intake would be comprised of an infiltration gallery that would have a small, unobtrusive footprint with withdraws limited to an acceptable quantity to avoid potential environmental impacts to the Watauga River.
 - ii. It is expected that withdrawals from the intake would only be conducted when necessary to meet the needs of its customers and minimum release requirements. This will reduce pumping costs to the service population, provide redundancy within the water system should the water in Buckeye Lake become unusable, and reduce any impacts to flows in the Watauga River.
 - iii. A significant portion of any water withdrawn from the Watauga River would be released downstream of Buckeye Lake to maintain required minimum releases within Buckeye Creek. The released water would flow from Buckeye Creek to Beech Creek ultimately back into the Watauga River at a point less than one mile downstream from the proposed intake.
 - iv. Prior to any intake installation on the Watauga River, the river would need to be reclassified for drinking water purposes to a water supply classification; likely WS-IV. The river, near Beech Mountain, is currently classified as B (primary recreation, including frequent or organized swimming) and HQW (High Quality Waters). Should a reclassification be imposed, the river would retain its current B and HQW designations and the protections that go along with these designations with additional required protections for water supply designated waters.
 - v. Before an intake could be installed on the Watauga River, approval for the intake would have to be obtained from the Tennessee Valley Authority (TVA) in accordance with Section 26a of the TVA Act, and the USACE through a Clean Water Act authorized permit.
 - vi. Plans for the construction of the intake and the water lines to Buckeye Lake would have to be approved by the DWR prior to any construction activities.

CONCLUSIONS

1. The Town of Beech Mountain's current water source of Buckeye Creek and Buckeye Lake is not adequate to meet the town's current and future water supply needs. Therefore, Beech Mountain's current water source does not provide for the health and safety of its customers during drought conditions.
2. In order to meet the town's current and future water supply needs, the best solution will be a combination of the options previously discussed. They include continued efforts to reduce water loss from the water distribution system, continued efforts to reduce the water use by the system's customers and a supplemental water intake on the Watauga River.