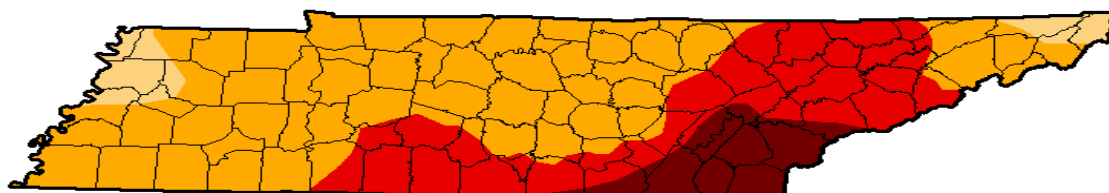


## East Bound, Down, and Out of Water

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The 2016 drought in Tennessee garnered most attention for its relevance to the catastrophic wildfires that destroyed parts of Gatlinburg and the Great Smoky Mountains in late November. Lesser known is the impact that the drought had on water systems in Southeast Tennessee. Although subsequent rains wiped the worst of the drought conditions, they did not erase the story of exceptional measures by state agencies and local municipalities in conjunction with numerous different water professionals to ensure that Tennesseans in Bledsoe County and its environs were supplied with adequate drinking water.



11/15/16 National Drought Mitigation Center Map

### **It all started with two emails...**

Monday, October 24, Tennessee American Water sent out an email asking if anyone knew of a 0.5 MGD portable water treatment system that could be used to help a drought stricken utility. Based on previous experience, SSR replied that both Pall Corporation and GE Water had mobile membrane filtration units that could meet this requirement.

At the same time, an email was circulating internally at SSR asking for assistance with a prison - the Bledsoe County Correction Complex (BCCX) - that was experiencing water shortages. Representatives from the Tennessee Department of Correction (TDOC) were holding a meeting at SSR to discuss

alternatives. One idea, as a last resort, even called for the National Guard to truck in potable water for the 2,500 inmates of BCCX. TDOC indicated that their primary source of water, the City of Pikeville, was having to curtail them because all of their wells were beginning to run dry. Their secondary source of water was the Taft Water Treatment Plant which TDOC owned and operated. Unfortunately, they estimated that the Bee Creek Reservoir that supplies its source water only had 38 days of storage remaining, and debris collecting at the intake had recently dropped their actual raw water pump capacity by about 75%. Additionally, because the water level was so depressed in this reservoir, the water that they were treating was very high in manganese and difficult to treat.

Messages to and from Tennessee American confirmed that this was the water system they were inquiring for the previous day. With the dots connected, the SSR team began to inquire about the potential of treating water using mobile treatment units and asked if there were any suitable sources in the area. A quick Google Earth search identified the Fall Creek Falls State Park (FCFSP) Lake as the largest reservoir in the area. Subsequent discussions also indicated that the Taft WTP supplied water to the park through the Fall Creek Falls Utility District (FCFUD) distribution system, so there was already piping in the ground to convey water from a mobile plant. Further discussions ensued regarding other alternatives including trucking bulk water from neighboring systems. Crossville appeared to be a viable option. The meeting ended with a mandate from TDOC for SSR to evaluate the feasibility and costs associated with both of these alternatives and have a summary ready the next day. It was agreed to use 3 months as the term for the evaluation based upon National Weather Service projections that the drought could last until the spring of 2017.

Several phone calls over the next 24 hours identified an existing connection between the FCFUD distribution system and Crossville treatment facilities via the South Cumberland Utility District (SCUD) distribution system. The connection had been made several years ago, but was never commissioned. Discussions with SCUD and their engineer (Joel B. Spaulding & Co.) indicated that the connection could support up to about 100 GPM. The existence of the connection with FCFUD's was also confirmed with FCFUD's engineer (James C. Hailey & Associates). Both engineers supplied shapefiles of the water distribution systems which SSR used in conjunction with Crossville's data to create a comprehensive system inventory in Google Earth.

Concurrently, budgetary quotes were received from a trucking company who could haul potable water from Crossville and several equipment suppliers who could provide mobile equipment necessary to produce potable water from the FCFSP lake. All of this information was summarized in a brief memo to TDOC. Based on the best information available and the assumption that the emergency supply would have to last three months, it appeared that the mobile treatment alternative was the most economical way to provide water not only to BCCX, but also to supplement the FCFSP and the FCFUD.

A meeting was held that same day at the State Capitol that included Governor Haslam and representatives of the Governor's Office, the State Legislature, TDEC, TDOC, TEMA and the affected municipalities/utilities. After a brief summary of the issues, alternatives were discussed. Many of these alternatives focused on lengthy line extensions to neighboring utilities that could take six months or more to construct. At that point, Governor Haslam stated that a solution that could be implemented in under a month was required. It was at that time that the alternative of an emergency water treatment plant at FCFSP was advanced. "Can this be operational in under three weeks?" Governor Haslam asked. SSR agreed that if TDEC and TDOC could work through the procurement and the legalities, we believed it

could be running that quickly. After a brief executive discussion the decision was made to move forward with the emergency treatment plant.

### **Long Way to Go and a Short Time to Get There...**

SSR immediately went to work. There were an incredible number of details associated with such an undertaking and not much time to ponder on them. The very next day, SSR and TDEC met at Fall Creek Falls State Park to determine a suitable location for the facility, and to collect the required samples for TDEC to issue a Source Water Approval. The park's marina was selected due to its proximity to the arterial waterline through the park, its suitable access road, and its distance from the Inn and cabins due to concerns with security and noise. The balance of the first week was spent obtaining both engineering information and rental agreements from the various equipment suppliers.

The second week was dedicated to engineering the hydraulics, chemical feed, and site work associated for the treatment system. A great deal of this was done in Google Earth with a comprehensive computer hydraulic model because of the lack of record drawings of both the site and the water distribution systems. A number of assumptions had to be made given the lack of information and the fact that months of design work was being compressed into a week. Most of the raw water quality wasn't even available from the lab during this period, and only one sample could be analyzed in the time allotted.

Numerous conference calls were held with TDEC to determine the appropriate treatment. It was determined that pretreatment prior to membrane filtration would not be included. The raw water test results indicated low turbidity, low manganese, low alkalinity, low hardness, and low conductivity. It was unlikely that traditional coagulation would even work for this water and this was later proven at Murfreesboro's Stones River Water Treatment Plant lab. Another concern with coagulation was that the residual chemicals in the sludge could cause issues for the small lagoon wastewater treatment plant operated by the Park. It was also decided to include UV disinfection to provide an additional barrier to pathogens because so little source water data was available. Finally, a system to add both hardness and alkalinity was included in the treatment scheme to prevent corrosion from the extremely aggressive source water. All of this information was summarized in an Engineering Report that was sent to TDEC for approval. That approval took less than one day due to the close coordination TDEC had with the project team.

At the beginning of the third week, coordination of construction began onsite. The first hurdle was grading the site for the mobile equipment since the membrane train had to be relatively level. Over the next nine days, the Park staff continually stepped up with their resourcefulness and willingness to help make this plant a reality. Within 24 hours of being onsite, the Park staff had constructed a retaining wall, coordinated gravel and sand deliveries, and leveled out the area that we needed for the mobile equipment.

That grading work was completed literally minutes before the first piece of equipment, the plant clearwell, arrived on the back of a TDOT lo-boy. That clearwell was a 12,000 gallon HDPE coagulant storage tank supplied by the City of Alcoa. The City took it upon themselves to utilize their TDOT connections to have the tank delivered to the site within a few days.

Shortly after the arrival of the clearwell, the biggest hurdle of the process was faced. Because of the number of emergencies across the southeast related to Hurricane Matthew, the original pipefitter was not going to be able to make it to the site that week. SSR quickly prepared a rough inventory of what would be required to connect the equipment, and a rudimentary request for proposals was sent out to local contractors at 4:00 PM. Two proposals were received that same evening, and by 9:00 AM the next morning, the Park's procurement department had Garney Construction under contract.

Early the next morning, the Pall mobile treatment unit arrived behind a tractor trailer rig. Unfortunately, pipe wouldn't show up until the following morning so the day was spent strategizing how to make things go as fast as possible when the supplies showed up. This paid off, as Garney completed all of the piping work in under three days. By the end of the day on Sunday November 13, all systems had been installed and disinfected and bacteria sampling had been collected for TDEC's approval. Monday morning, all of the field service representatives for the various equipment showed up to test out the systems and train the operators. TDEC representatives also were onsite to provide guidance and talk with the operators. The permitted operation of the emergency water treatment plant was established using the existing operation permit held by TDOC and the Taft plant. Operators for the plant were assembled from numerous other facilities across Middle and East Tennessee via an emergency contract established by TDOC with Hailey Management Services.

The final day of construction involved getting the online instruments and lab ready for duty. The boat ramp's Men's Bathroom was repurposed to house an online turbidimeter and chlorine analyzer. The Bait Shop was adapted to be a wet lab and operator office. Hailey Management provided most of the analyzers and equipment in the lab. Columbia Power and Water Systems, Hach Instruments and MR Systems also pitched in equipment that the operators would need.

I don't believe I have ever seen a better representation of Tennessee's "Volunteers" in action in my career. The way that multiple state and municipal agencies, multiple engineering firms, multiple contractors, and multiple vendors came together to make this happen in a week was inspiring.



View of the Emergency WTP from the FCFSP Inn

### **We did what they said can't be done...**

Final checkout and authorization by TDEC to begin producing water came on November 16, and potable production began at approximately 11:30 PM that night. With the help of so many, a 500,000 gallon per day treatment plant was designed, permitted, procured, constructed and commissioned in just under three weeks. It wasn't the prettiest or the easiest plant to run, but it functioned well and produced potable water. The most significant snag hit during operation came the night before Thanksgiving when the motor on the high service pump failed. Xylem showed up late that night, but determined that it could not be repaired and would have to be replaced the following Monday.

On Monday, November 28 Xylem arrived to replace the motor. Weather forecasts indicated strong winds and heavy rains over the next several days. It was decided to measure the water levels of both the Fall Creek Falls Lake and the Bee Creek Reservoir to see how much they gained if we did get rainfall. Two of Taft's three intakes were above the water, and there was only approximately 8 feet of water left in the reservoir. Whatever debris had clogged one of the raw water pumps had partially cleared, so at least one of their pumps was nearly back to capacity. The Pikeville WTP was getting by and was able to keep BCCX supplied with water primarily because of a farmer who had volunteered to use his irrigation equipment to pump about 300 GPM from the Sequatchie River to the treatment plant. To say things were held together with a wing and prayer would be an understatement.

### **And then it rained...**

Over the next two days, it rained between 4 and 5 inches at Fall Creek Falls State Park, at the Taft plant and reservoir, and in Pikeville. Winds immediately preceding these rains averaged 40 miles per hour, with gusts clocked at over 70 miles per hour. This would prove to be one of the largest reported contributors to the rapid progression of the wildfires in the Smoky Mountains.

On December 1, TDEC convened a meeting of all interested parties to discuss regional water supply alternatives to prevent future water shortages during droughts in the future. The meeting was scheduled several weeks in advance of the rains, but as Deputy Commissioner Hill indicated “It’s tough to talk about drought after five inches of rain just fell.” During a break, we texted TDOC/Taft WTP personnel to see how much the Bee Creek Reservoir level had increased. We had measured the FCFSP lake that morning, and the water level had only increased six inches, and almost five of that had fallen on the lake. The Taft operators texted back that the reservoir was full and overflowing the spillway. Therefore after the conference, we drove out and confirmed the levels ourselves. The reservoir was in fact full! They plant personnel were in disbelief and assured us that they had never seen such a thing. Over the next week, the groundwater levels in Pikeville also replenished to normal levels. While the National Weather Service still officially states that the area is experiencing Severe Drought, the water supply emergency for FCFSP, FCFUD, and BCCX appears to be over, at least for the moment. All parties agreed to decommission the emergency water treatment plant immediately after the first of the year and send the equipment back to their manufacturers.



Emergency WTP at Fall Creek Falls State Park Marina

**Was it worth it?**

You can only make the best decision based on the information you have at any given moment. We all made the best calls that we could with the data we had at the time. The Pikeville WTP was essentially out of water. The Bee Creek Reservoir was lower than anyone had ever seen before, and the raw water pumps were at 1/3 of capacity. Multiple weather agencies believed the drought would continue until spring because of La Nina. Based on this information and our expeditious evaluation of available alternatives, producing water at FCFSP was the most reasonable and economical solution to the impending water supply crisis.

In hindsight, mandatory water restrictions coupled with the activation of the supply from Crossville through South Cumberland UD, along with the farmer's supply of surface water to the Pikeville WTP mitigated the need for the emergency plant at the park. In all, the temporary emergency facility only treated 1 million gallons of water. TDEC & TDOC officials commented, "We now know that we can do this if the need ever arises again. This effort was not wasted." While we agree with the sentiment, the recommendation to all who read this is to prepare for the next drought while it's still raining. An ounce of prevention...