



## MEMORANDUM

---

To: Honorable Mayor &  
Members of City Council

Date: April 10, 2012

From: Joe King,  City Manager

Subject: March 26, 2012 Boil Water Advisory

A "Boil Water Advisory" like the one issued on March 26<sup>th</sup> is a precautionary measure intended to address a potential water quality threat that can be remedied by boiling water or treating it with liquid household bleach before drinking it. In contrast, "Do Not Drink" and "Do Not Use" alerts are used respectively to address likely or actual contamination. I believe our notification activities were commensurate with the degree of public risk exposure, but that we were not as well prepared as we should have been and fell short in executing notifications and disseminating information to key water users and the general public.

The City has occasionally issued boil water advisories covering areas affected by water line breaks or low pressure events, but never a citywide advisory like the one issued on March 26<sup>th</sup>. It is understood that this caused considerable anxiety on the part of the general public, inconvenience and expense for all, and a loss of business by many restaurants and other commercial establishments. We genuinely regret this and will do our utmost to avoid such events in the future.

Water & Wastewater Treatment Director Barry Dunkley's report on the incident is attached. A combination of factors resulted in reduction of water pressure in higher areas and greater than acceptable turbidity levels in treated water, conditions that required issuance of a boil water advisory. Although several actions will be taken to limit duration of such events in the future, if not to avoid them altogether, it is clear that no water treatment plant inadequacies, facility failures, or operator failings caused this incident. If anything, plant operators and the Virginia Department of Health erred on the side of caution in issuing the advisory.

Danville's water treatment plant draws its water directly from the Dan River, so is subject to widely varying water conditions. Some waterworks, like the one upstream in Eden, North Carolina, first pump river water into a retention pond where sediments can settle out before raw water enters the treatment plant. Danville does not have a retention facility. What gives Danville the time needed to deal with challenging raw water conditions is its large treated water storage capacity. Additionally, the plant is equipped with a sizable waste solids clarifier that can be used for its primary purpose

and as an untreated water storage resource when large volumes of unsuccessfully treated water must be quickly disposed of to make space for newly drawn water.

As Barry Dunkley notes in his report, the Utilities Department should acquire a large-capacity mobile pump that can be used to assist in more quickly drawing water out of the clarifier when its capacity for this purpose is urgently needed. Other than this operating improvement, what the water treatment staff will focus on is a series of improvements that can provide earlier knowledge of changing river water conditions and more quickly detect water quality changes during the treatment process. This will help avoid a future incident like the one experienced last month. In the unfortunate event that a boil water alert must be issued in the future, these and other improvements could shorten the time it remains in effect.

Local news media outlets (particularly the Register & Bee, WBTV/WAKG, and WDVA) did an outstanding job helping get information out on the boil water advisory and how the situation should be handled by the public. However, there were several aspects of the public notification process undertaken by City staff on March 26<sup>th</sup> that could have been improved upon. Lessons learned include the following:

1. My office should have notified City Councilmembers by telephone and e-mail Monday morning, March 26<sup>th</sup> when Utilities staff had reason to believe conditions would require issuance of a boil water alert later that day. City Council did not receive any advance notice and were e-mailed only minutes before the boil water advisory itself was issued late that afternoon.
2. As soon as all Councilmembers were alerted, similar contacts should have been made by Utilities with all large and special needs water users, as well as the City's Emergency Management personnel in the Fire Department. Some of these parties were not notified until the alert was issued late Monday afternoon, if at all. Examples include Averett University, the City jail and detention facilities, hotels, and some medical facilities.
3. The boil water advisory and media release initially sent out should have included consumer information answering the kind of questions that would predictably be asked by the public about such matters as safe preparation of food, washing of dishes, bathing, brushing teeth, feeding pets, making ice, etc. This information should have been repeated in subsequent media releases.
4. Advance information and media releases should have stated that the boil water alert would be in place for at least 48 hours, as this is the minimum amount of time needed to conduct water tests required by the Commonwealth.
5. The physical area affected should have been more clearly described in the advisory and media releases. Many customers served with Danville-treated water by the Pittsylvania County Service Authority were not aware that they were affected.

6. Important, but time-consuming tasks associated with providing informational updates to large and special needs water users, the news media, and the general public between issuing the alert Monday evening and lifting it Thursday morning should have been delegated to Utilities staff rather than being undertaken personally by the director of Water & Wastewater Treatment.
7. A call center should have been activated to handle telephone calls from the public about the water situation. The volume of calls overwhelmed municipal offices.
8. Daily media conferences should have been scheduled to handle numerous requests for interviews with the director of Water & Wastewater Treatment.
9. The City's "Reverse 9-1-1" system should be replaced with one capable of handling citywide calls and use of social media. The current system works well for small area alerts but is not effective for larger events.
10. The City's Emergency Operation Plan should be updated to more fully cover boil water advisories and utility service disruptions and emergencies. There are excellent resources available from the Commonwealth, federal agencies, and waterworks associations to better prepare for drinking water problems.
11. Scheduled programming on River City TV should have been interrupted with informational broadcasts on the boil water alert. Text scrolled across the TV screen was helpful, but not as comprehensive as needed.

Attachment: *"Water Treatment Plant Problems during March 25 – 29, 2012"*  
Prepared by Barry T. Dunkley and Jeff Hawkins

# *CITY OF DANVILLE*

## *Water Treatment Plant Problems during March 25 – 29, 2012*

*Prepared by Barry T. Dunkley and Jeff Hawkins*

*April 10, 2012*

### INDEX

- I. Event Summary
- II. Brief Overview of Plant
- III. Water Plant Staff Evaluation
  - A. Planning for Significant Storm Events
  - B. Actions Taken During Storm Event
  - C. Future Considerations

### **I. Summary**

The City has two large finished water storage tanks in Ballou Park. One is four (4) million gallons (MG) and one is eight (8) MG. All treated water is pumped to these two tanks which provide about two (2) days storage for the entire system along with nine (9) system storage tanks. The Ballou Park large storage capacity had provided sufficient time in the past to allow the operators to adjust to the difficult water quality (usually referred to as highly turbid water) while the plant was shut down. In the case of the high turbid raw water that occurred during March 24<sup>th</sup> to March 26<sup>th</sup>, the large storage capacity fell short and no water (zero pressure) was available at the higher elevations of the gravity flow zone. Thus the water pressure (zero in some areas) and the failure to meet filtered water turbidity limits was the cause for the Boil Water Advisory.

A strong weather system developed and passed through the area on Friday, March 23<sup>rd</sup> and continued through the following Saturday dumping a lot of rain and hail in the Danville area and more significantly in the Dan River watershed west of the City. This system followed another rainfall event that occurred on Tuesday, March 20<sup>th</sup>. The water plant had to shut down on March 21<sup>st</sup> for part of the day as the water from the Dan River was difficult to treat. This resulted in more water than normal being discharged into the waste solids clarifier.

Several things made the March 23<sup>rd</sup> weather system create problems for the treatment of the water from the Dan River, such as saturated soils, heavy down pours (rainfall intensity), high

turbidities (a measure of the particles in the water) and a lot of rainfall in the water shed west of the City that lasted for a long period of time. Saturated soils resulted in anything trapped in the soil floating to the top and being readily washed off. The heavy down pours intensified the surface runoff both in the urban and agriculture settings. Due to the warm winter and warm spring, agricultural activities had begun which would include preparing the fields for the spring planting. Even agricultural best management practices would not have contained the farm runoff in many instances. In the residential and commercial sector, yard work (fertilizers, herbicides, etc.) and beautification efforts had already begun. Due to these activities and the rainfall event that occurred, the water quality in the Dan River deteriorated and was difficult to treat.

The Danville water plant staff could not treat the water on Saturday night, March 24<sup>th</sup>, to acceptable turbidity levels and shut down. All water in the plant had to be drained out and tools used to determine how best to treat the water. These tools were a jar test machine, Zeta meter, streaming current meter and physical observation. After using these tools the plant was started up with the dosage of chemicals that the tools indicated was needed. Again the water could not be treated. More testing and dumping of water was done until the waste solids clarifier was full and could not be used to dump any more water into. On Monday, additional pumps were brought in from Public Works, the wastewater plant and Water and Gas Distribution. Once the waste solids clarifier was pumped down, the water plant was started up to filter to waste (waste solids clarifier) in order to get the filtered water turbidity down to an acceptable level. Before this could be done, there were services at the higher elevations of the gravity flow zone in the City that lost water pressure. This loss of pressure required issuance of the Boil Water Advisory which remained until Thursday morning when sufficient satisfactory bacteriological sample results were obtained and the advisory lifted.

During the period of July 1, 2007 to April 6, 2012, there have been 127 days when the maximum turbidity in the Dan River has equaled or exceeded 100 TU which is considered much higher than normal (20 to 40 TU) . During this time all water pumped from the river has been treated to meet drinking water standards. However there were eight (8) instances when the water plant had to shut down for short periods of time (2 – 12 hours) as the water was difficult to treat. The highest raw water turbidity treated during this time period was 925 TU.

## **II. Brief Overview of Plant**

The Danville water treatment plant consists of five major processes – rapid mixing, flocculation, sedimentation, filtration and disinfection. Rapid mixing is where the coagulant chemicals (aluminum sulfate and polymer) are added and mixed very quickly to get the chemicals in contact with all particles in the water. Next the water goes to the flocculators to mix the water and coagulant slowly to get the floc to get larger so it will settle well. The sedimentation basins provide much longer detention times to allow as much of the larger floc as possible to settle. The idea is to apply as low turbidity water (<2.0 TU) as possible to the filters thus allowing the filters to work longer and more efficiently. Disinfection is the last process to make sure the water is safe to drink. From the treatment plant, finished water is pumped to the two Ballou Park reservoirs where they provide water to the gravity flow system and the five (5) higher elevation systems north and south of the Dan River to which water is pumped into by nine (9) booster pump stations. Other chemicals used in the treatment processes are lime (pH and alkalinity adjustment, corrosion control), sodium hydroxide (pH and alkalinity adjustment), polymer

(coagulant and filter aid), hydrofluosilicic acid (fluoride addition), corrosion inhibitor and chlorine (disinfection).

### III. Water Plant Staff Evaluation

#### A. Planning for Significant Storm Events

Accurate planning must be done when weather predictions indicate that a significant rainfall event will happen or occur in the area west of Danville in the Dan River watershed. Listed below are some of those actions that are taken to adequately plan for rainfall events.

- **Backwash filters** – Filters are routinely washed at about 100 hours. If any of the filters are nearing their maximum run times, then these filters need to be washed prior to the rainfall event.
- **Chemicals** – Inventory is taken daily on chemicals and orders are placed to be sure that a minimum of 30 days supply is always on hand and no deliveries would be needed during a rainfall event.
- **Ballou Park Reservoir** – The reservoirs must be kept as full as possible at all times.
- **Distribution System Storage Tanks** – All distribution system tanks should be kept near full at all times prior to a rainfall event. Manual operation of the booster pump stations may be needed in order to accomplish this task.
- **Weather Conditions** – Updates on the storm should be kept up with at least every two hours.
- **Sample Lines** – Sample pumps are provided to collect water and pump it to the sample sink in the laboratory from each of the processes in order that adequate testing can be done of each particular process. These sample lines at times can clog and it needs to be checked to make sure that they are flowing freely.
- **Valves and Equipment** – All valves should be checked that will be needed to be utilized to be sure that they can be opened and closed and in the correct position before, during and after the rainfall event. Make sure that all equipment such as sump pumps, generators, etc. are in good working condition.
- **Clarifier** – The water level in the waste solids clarifier must be pumped down to the lowest level possible to make room in the clarifier for filter backwash waste and sedimentation basin water that has to be drained.
- **Mental Conditions** – Everyone should prepare themselves for the approaching storm and be ready to respond and use all tools available to determine adequate chemical dosages and call for additional assistance if needed.
- **Existing Issues Noted at the Plant During the Subject Event** – It is realized that in some cases equipment that is normally available may not be available while a significant

event is occurring. However, all such equipment should be checked prior to the storm or the turbid water arriving at the Danville raw water intake. Some of the issues that the operation and maintenance staff had to face during this time that occurred are listed below.

- **Streaming Current Meter (SCM)** – Streaming current meter had become clogged with the turbid water and had to be cleaned before it could be utilized.
- **Raw Water Sample Pump** – The sample tap had become clogged and thus was giving false readings to the operators when samples were collected from the tap in the sample sink in the laboratory.
- **Waste Solids Clarifier Pumps** – One of the two pumps in the waste solids clarifier was found not to be working during the event.
- **Flocculation Basins** – The mixing mechanism in one of the seven flocculator basins was out of service due to a broken shaft. It is not felt that this hampered treatment that much as sufficient flocculation time was provided even with the mixing in one tank not working.
- **Waste Solids Clarifier Water Level** – The water level in the waste solids clarifier had reached its maximum point due to the dumping of the sedimentation basin contents and some filter backwashing. In addition, after filters are backwashed they have to be filtered to waste in order to settle the media down and meet turbidity limits before they can be put on line. The previous rainfall event on Tuesday, March 20<sup>th</sup> also created some problems as untreatable water had been discharged into the waste solids clarifier and all of the water had not been pumped out of the clarifier before the next rainfall event hit.

It should be noted that when the raw sample pump was discovered to be clogged, samples were collected from the river for testing to get accurate results. Also it is not uncommon for the streaming current meter to clog due to the high turbidity. Jar testing and Zeta meter equipment were available for use in determining proper coagulant dose along with pH and alkalinity adjustment. With only one pump available to pump liquid out of the waste solids clarifier, additional portable pumps had to be obtained. Two pumps were obtained from the Department of Public Works and one from the Northside Wastewater Treatment Plant along with one from the Division of Water and Gas Distribution. The water treatment plant personnel also installed another submersible pump in the basin.

- **Staffing Needs** – In times of crisis, one of the most important things to determine is what additional staffing may be needed. In the particular event that occurred, no additional staffing was called in at any particular time; however, the plant was manned 24 hours per day in order that testing could be done to determine proper dosages and lend assistance with draining basins, backwashing filters, etc. During this time it was noted that the following issues needed to be addressed.
  - **Staffing Issues** – Additional staffing needs to be brought in when it is determined that sedimentation basins will have to be drained and additional filters need backwashing. This would allow two operators to do jar tests and Zeta meter

readings to determine coagulant doses while the others would be draining basins and backwashing filters.

- **Assistance from other Departments** – Pumps were obtained from the Department of Public Works, Division of Water & Gas Distribution and the Northside Wastewater Treatment Plant. These were high volume, low head portable pumps which were used to dewater the waste solids basin quickly.
- **Information Requests** – Better arrangements need to be made to provide information to the general public, customers, commercial establishments, industry, etc. The volume of phone calls was difficult to handle with the staff at the water treatment plant who had assigned duties of treating the water and getting the plant back on line.
- **Assigned Duties** – All staff should be assigned duties to be done during such a critical event occurring. This would allow a more efficient operation and allow the treatment plant to be placed back in service more quickly.

#### **IV. Determining Treatability of Raw Water**

Treating very turbid water with a lot of surface runoff and varying turbidity as occurred during this event is very difficult. There are several pieces of equipment that the operators use to assist them in determining proper coagulant dose as well as chemicals to be used for pH and alkalinity adjustment. This equipment consists of jar test machine, Zeta meter, streaming current meter, turbidity meters, pH meter, visual observations, past history and training.

- **Jar Test** – The jar test apparatus consists of six one-liter jars to simulate the full scale water treatment plant. With the machine, rapid mixing, coagulation and the settling are simulated and then testing done along with visual observations of the water after the floc has formed and settled.
- **Zeta Meter** – The Zeta meter measures the charge on the particles to determine whether the negative particle charges have been neutralized by the coagulant.
- **Streaming Current Meter** – The streaming current meter also measures the charge on the particles to see that they have been neutralized.
- **Turbidity Meters** – Turbidity meters are located throughout the treatment plant to monitor the water from each process to the next. There are continuous turbidity monitors on the raw water, settled water, each filter effluent and finished water (all chemicals added). In addition a bench top turbidity meter is available for grab samples as needed to determine the results of jar testing and grab samples of any portion of the treatment process.
- **Flow Rate Through Plant** – In heavy rainfall events the flow rate through the plant can be decreased which will increase the detention times in all of the unit processes and thus improve treatment. This is used quite frequently when an upset has occurred in order that additional time is provided for floc formation and settling.



- **Alkalinity Testing** – Alkalinity of the water is very important in that if alkalinity is not sufficient for the coagulant, the pH of the water will be depressed and adequate floc formation will not occur. Therefore, alkalinity checks are made periodically on the treatment process to make sure that sufficient alkalinity exists to handle the heavier dosage usually required of the coagulant.
- **pH Meter** – Continuous monitoring of pH meters are available through the treatment process as well as a laboratory pH meter. pH again is very important in determining adequate coagulant dose. This is a much quicker test than the alkalinity test. Therefore, it is handy for quick assessments of water quality.
- **Past History** – Past history of similar events is very helpful. However, each particular rainfall event is different based on the time of year, the intensity of the rain, whether the soils are saturated, etc. It is very helpful in evaluating chemical dosages; however, no two storm events are alike.
- **Training** – All operators are required to take a minimum of 20 professional development hours every two years to keep their license current. Training is always stressed by the City and all operators have always met the minimum 20 hours required with most having more than the minimum 20 hours required.

## V. Actions Suggested to Address Future Heavy Rainfall Events

It is always necessary to evaluate each incident in which the raw water was difficult to treat. This better prepares everyone for the next event that may occur. In addition there may be other things that could be done to help reduce the time required to determine the treatability of the water as well as other tools which would be helpful to address such situations. Listed below were some of the ideas that came about as a result of the meeting held at the water treatment plant on Thursday night, April 5, 2012 with most all water treatment plant staff present.

1. **Raw Water Impoundment** – The City has had studies in the past to determine the size and location of a raw water impoundment. A raw water impoundment would allow water from the river to be pumped into the impoundment during low turbidity conditions and then the water in the impoundment used when the river becomes turbid. A raw water impoundment was evaluated in 2001 by Dewberry with an estimated cost of \$6 to \$7 million dollars. Raw water impoundments built along the river, which is the most suitable and economical location, would be difficult to build due to the destruction of natural wetlands. Due to the size of the raw water impoundment that would be needed for the future or for the ultimate plant capacity a considerable amount of land would be needed. To locate a raw water impoundment away from the river where wetlands would not be impacted would increase costs even more. At this time, a raw water impoundment is not considered economically feasible.
2. **Portable Pumps** – The City will purchase a high volume, low head portable pump for dewatering the waste solids clarifiers or settling basins if needed.

This pump could be used for other purposes and/or other City departments as needed.

3. **Sample Taps** – Several present suggested that additional sample taps are needed to better monitor the processes throughout the plant. Additional sample taps will be provided at locations that the staff identifies.
4. **Upstream Monitoring** – One suggestion which drew a lot of discussion was the installation of raw water monitoring station several miles upstream of the City's raw water intake which would give the City more time to prepare for the incoming turbid water.
5. **Different Chemicals** – There are other chemicals which may work better than the aluminum sulfate that is currently used when turbid and cold water conditions are encountered.
6. **Testing** – The water treatment plant only has one jar test machine. Each jar test takes approximately 45 minutes to run. Therefore, a second jar test machine may be needed in order that more jar tests could be done simultaneously in order that quicker results could be obtained to determine coagulant dosage as well as pH adjustment addition.
7. **Particle Counter** – There are several additional types of monitoring equipment that could be purchased to assist with determining coagulant dosage. One such piece of equipment is a particle counter which has been used by many localities for some time now. The City will evaluate purchasing particle counters to evaluate the benefit of this piece of equipment for monitoring of the raw and finished water. At the same time, the City staff will look into other monitoring equipment that may be helpful particularly for evaluating treatability of very turbid water.

The information in items III through V above were all obtained during a meeting of most of the water treatment plant staff on Thursday, April 5, 2012. Additional assessments will be made of the operation to determine if there are other equipment needs, process changes, etc. that need to be implemented. For the present, the staff will implement the suggestions above to better enhance the ability to treat high turbid waters from heavy rainfall events.