



# North Carolina Area-Wide Optimization Program 2019 Annual Report

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March 6, 2020

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NC Area Wide Optimization Program  
2019 Annual Report

## Maintaining the Program

The North Carolina Department of Environmental Quality (NC DEQ), Public Water Supply (PWS) Section has participated in the EPA Region 4 Multi-State Area Wide Optimization Program (AWOP) since 2000. The program's goal is to provide North Carolina's water utilities with needed training and tools that can assist in maximizing the water system operations, thus improving public health.

Data from all surface water treatment facilities is evaluated annually to maintain a status component. Data evaluated includes turbidity, microbial, and disinfection byproduct (DBP) performance information. In 2019, 148 surface water plants operated during the year. The following is a summary report of the 2019 NC AWOP findings and activities.

While North Carolina's AWOP team continues to engage in a number of beneficial activities that support the maintenance of its AWOP, the team also faces challenges.

### Institutional Barriers

The NC AWOP is a volunteer effort for participating systems and the PWS Section's staff. Time dedicated to the implementation of the NC AWOP is limited because of attention to regulatory requirements and other PWS Section activities. While compliance with drinking water regulations is our primary goal, NC recognizes and operates with the understanding that optimization provides an additional level of public health protection and strives to meet the program goals.

### Internal Support

Program support remains high on both the Division and Section levels. Our staff was not restricted from travelling to meetings or from conducting optimization activities in the state. Funding has also been made available in the past for purchasing equipment used to grow the program.

The Drinking Water State Revolving Fund (DWSRF) set-asides are the primary source of funding for the NC AWOP. Continued demonstration of the benefits of the NC AWOP will allow for future staff recruitment to ensure program maintenance and/or enable growth.

### Core Team Structure and Capacity

In 2019, the NC AWOP had thirteen staff participants from the PWS Section who worked to sustain the program by participating in varying activities, such as evaluating system capabilities and providing technical training to systems (Table 1). Four members functioned as the core team and are responsible for ensuring the program's continued viability. The other members are in different stages of certification, technical knowledge, experience, and understanding of the AWOP philosophies, and provide expertise as opportunities present themselves.

**Table 1**

PWSS Staff	Program Activity	AWOP Certified
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Eric Hudson	Core Team Member Program Manager	No (1 Microbial, 1 DS, & 1 DBP CPE)
Rebecca Sadosky	Core Team Member CPE Technical Support Central Office Technical Advisor	Yes
Mark Hahn	Core Team Member Regional Technical Advisor	Yes
Kimberly Barnett	Core Team Member Regional Technical Advisor	No (2 DS CPE)
Clif Whitfield	Regional Technical Advisor	No (2 DS CPE, 1 DBP PBT)
Don Price - left team 1/2019	Regional Technical Advisor	No (2 DS CPE)
Brad Whitman	Central Office Technical Advisor	No (1 DS CPE)
Turner Morrison	Central Office Technical Advisor	No (2 DS CPE)
Tommy Overby	Regional Technical Advisor	No
Lauren Plummer	Central Office Technical Advisor	No
Meredith Guglielmi -joined team 1/2019	Regional Technical Advisor	No (1 Microbial, 1 DS CPE)
Emily Lester -joined team 1/2019	Central Office Technical Advisor	No (1 Microbial CPE)
Nicole Hairston -joined team 5/2019	Regional Technical Advisor	No

DS – Distribution System  
DBP – Disinfection Byproducts  
PBT – Performance Based Training  
CPE – Comprehensive Performance Evaluation

Program Assessment

NC AWOP activities included: participation in the EPA Region 4 quarterly meetings, NC AWOP team meetings, National AWOP meeting, participation in one multi-state microbial comprehensive performance evaluation (CPE), evaluation of system data, and training/evaluation events throughout the year. These activities along with previous DBP performance based trainings (PBTs) have served as valuable training opportunities and have allowed key NC AWOP members to obtain their AWOP certification, while aiding others in their progress towards certification. The NC AWOP is currently a strong and knowledgeable workgroup comprised of both seasoned veterans as well as up-and-coming staff.

The PWS Section along with participating public water systems have made valuable use of the skills and tools learned through AWOP training. In 2019, the NC AWOP Team conducted special studies at three water systems to provide training opportunities for team members and training and technical assistance to water system staff. The

AWOP Team also developed a contact time (CT) guidance document intended to educate NC PWS Section staff.

### **Plant Status and Rankings for Microbial Contaminants and DBPs**

The PWS Section has maintained a plant status and ranking component since 2001 for microbial contaminants. In 2003, the ranking was modified to include raw water coliform data along with the raw water and plant process turbidities. This ranking was modified again in 2014, removing raw water coliform from the rankings and focusing on violations and finished water turbidities.

The DBP status and ranking component, initiated in 2006, is based on compliance data and identifies the systems where maximum contaminant levels (MCLs) are being exceeded. The DBP status component is a focused tool that was used by the PWS Section to provide technical assistance to systems struggling to comply with the Stage 1 Disinfectants and DBPs Rule. In 2013, the PWS Section adopted more stringent DBP goals, which focus on locational running annual averages introduced in the Stage 2 Disinfectants and Disinfection Byproducts Rule (as described in the Stage 2 Disinfectants and DBP Rule). Achieving these more stringent DBP goals indicates better water quality throughout the distribution system. The adopted DBP goals are used as a benchmark for evaluating water system performance and for identifying opportunities to provide technical assistance.

#### Prioritized List of Facilities - Microbial

The PWS Section's microbial and turbidity plant ranking scores were revised in 2014 to better reflect which systems receive more violations and have higher finished water turbidities (see APPENDIX B). Emphasis was placed on both violations and finished water turbidity, as these two parameters most directly affect public health and, therefore, are of the greatest concern. To calculate the ranking scores, the average monthly finished water turbidity for a system is multiplied by 100, while the average settled turbidity is only multiplied by 3.16, giving the finished water turbidity more weight than the settled water turbidity in the revised ranking scores. Similar to the prior ranking score methodology, the lower the water plant's ranking score, the better their performance on turbidity and microbial indicators. Typically, water plants meeting AWOP finished water turbidity goals year-round have a ranking score of 200 or below.

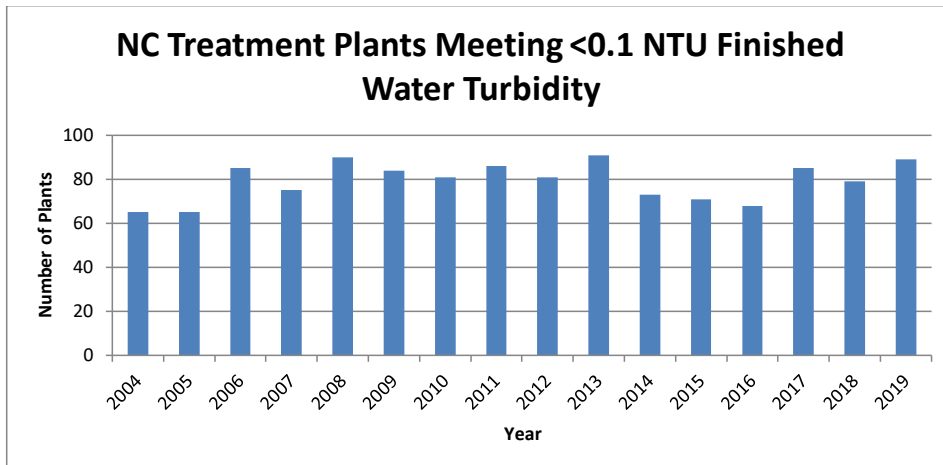
The calculated ranking scores for the facilities with the highest 15 (top 10 percent) microbial/turbidity rankings for 2019 are presented in Table 2 along with the system's 2018 ranking score.

**Table 2**

<b>2019 Rank</b>	<b>System Name</b>	<b>2018 Rank</b>
1	Anson County Water System (Anson County WTP)	1

2	Town of Yanceyville (Yanceyville WTP)	4
3	City of Winston-Salem (Thomas WTP)	35
4	Montgomery County Water System (Montgomery WTP)	61
5	Cape Fear Public Utility Authority (Sweeney - Wilmington WTP)	83
6	Maggie Valley Sanitary District (Maggy Valley WTP)	135
7	City of Hamlet Water System (Hamlet WTP)	143
8	Town of Beech Mountain (Beech Mountain WTP)	81
9	Town of Ramseur (Ramseur WTP)	10
10	Town of Mount Pleasant (Mt. Pleasant WTP)	11
11	Town of North Wilkesboro (North Wilkesboro WTP)	17
12	City of Graham (Graham-Mebane WTP)	32
13	Town of Jefferson (Jefferson WTP)	25
14	City of Rocky Mount (Tar River Reservoir WTP)	26
15	Pilgrim's Pride Water System (Pilgrim's WTP)	13

The number of facilities that averaged <0.10 NTU finished water turbidity in each year from 2004 to 2019 is presented in Figure 1. The number of plants meeting this goal has fluctuated from a low of 65 plants in 2004 to a high of 91 plants in 2013. In 2019, 89 plants met the goal.



**Figure 1**

**Microbial Ranking Score Criteria**

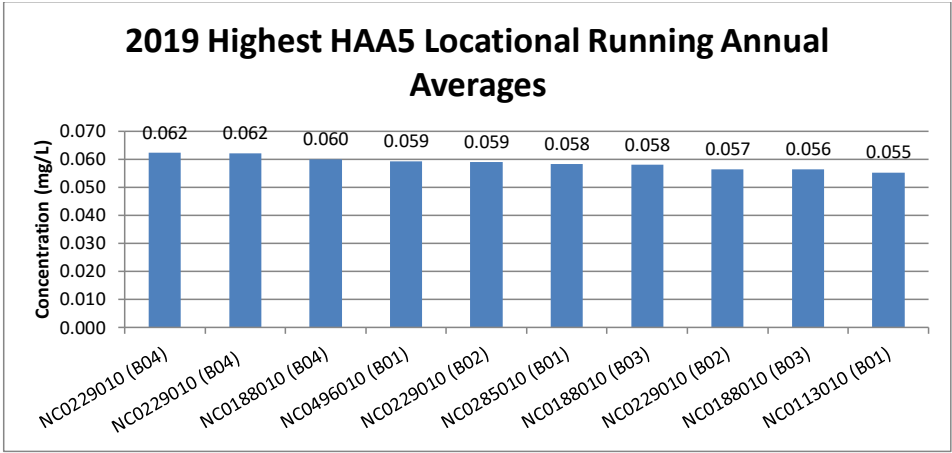
The NC AWOP Microbial/Turbidity Ranking Score is used to identify and prioritize surface water facilities for technical assistance in optimizing microbial performance. The ranking score criteria uses violations issued and daily maximum raw, settled, and finished water turbidities to calculate a ranking score (see APPENDIX B). A multiplier is applied to the monthly turbidity averages and annual maximum levels. These values are then summed at the end of the year to obtain the year-end total ranking score.

**Prioritized List of Systems - DBPs**

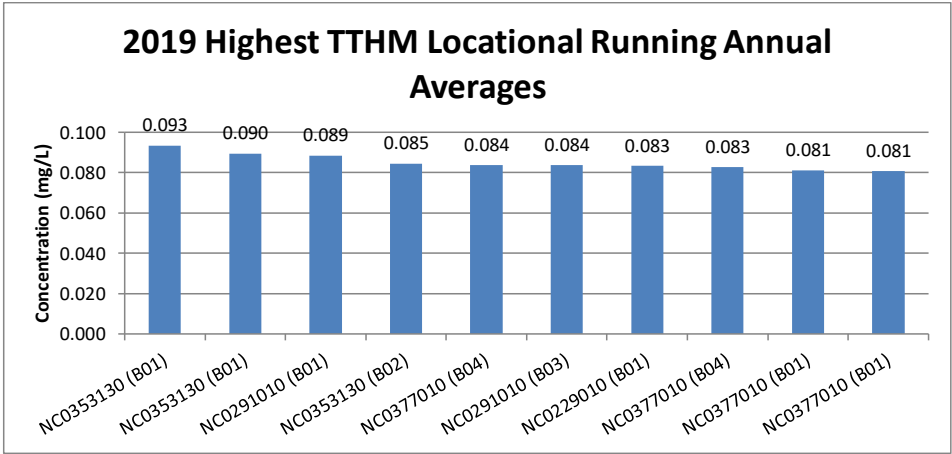
Maintaining compliance with disinfection byproduct regulations present a significant challenge to water systems in North Carolina. The NC AWOP bases its prioritization for DBPs on locational running annual averages (LRAAs) of total trihalomethanes (TTHMs) and 5 haloacetic acids (HAA5s), which is consistent with Stage 2 Disinfectant and DBP Rule requirements. Figure 2 and Figure 3 below display the ten highest LRAAs from 2019 for surface water systems. Two systems had two sampling sites exceed the HAA5 MCL (0.06 mg/L) based on the LRAA. Five systems had ten sampling sites exceed the TTHM MCL (0.08 mg/L), while other systems had concentrations approaching the MCL.

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**Commented [HE2R1]:** I added "for surface water systems" for clarification.

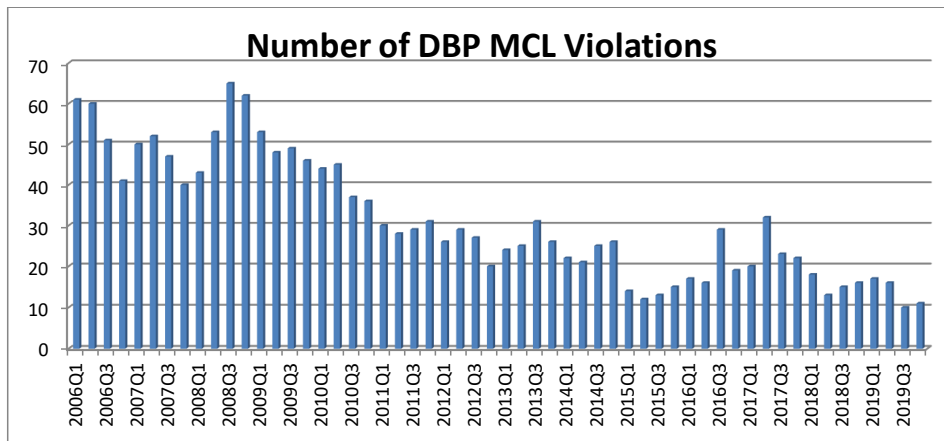


**Figure 2**



**Figure 3**

Figure 4 below displays the number of DBP MCL violations that have been issued since 2006. TTHM MCL violations account for approximately 65% of the total and HAA5 MCL violations accounting for approximately 35% of the total.



**Figure 4**

DBP concentration data was evaluated for surface water and surface water purchase systems required to sample for DBPs. In 2019, 91 out of 127 surface water systems, serving a population of 4,592,986 customers, and 240 out of 335 surface water purchase systems, serving a population of 843,140 customers, met the NC DBP distribution system goals (provided in APPENDIX A).

Commented [MTA3]: I updated these numbers, no further editing needed

### Targeted Performance Indicator (TPI) Implementation

#### Running List of Activities

The NC AWOP activities include participation in EPA Region 4 quarterly meetings, assimilating/evaluating system data and training/evaluation events. The following is a list of North Carolina activities for 2019 (Table 3).

**Table 3**



<b>Date - 2019</b>	<b>Activity</b>	<b>Attendee(s)</b>
Jan. 9	NC AWOP Team Meeting at WSRO	NC AWOP Team
Jan. 15-16	Special Study – City of Morganton	NC AWOP Team
Feb. 18-23	Special Study – City of Lexington	Eric Hudson, Turner Morrison
Mar. 12-14	Region 4 AWOP Planning Meeting – Cherokee, NC	Eric Hudson, Kimberly Barnett, Brad Whitman
Mar. 13	Contact Time Disinfection Presentation at NCWOA Western Section Meeting	Kimberly Barnett
March	Sent AWOP Technical Assistance Letters to Water Systems	NC AWOP Team
May 8	NC AWOP Team Meeting at WSRO	NC AWOP Team
May 29	Special Study– Martin County Water District 2	Eric Hudson, Clif Whitfield, Emily Lester
June 13	Optimized Performance Goals – Why Optimize? Presentation at NCWOA North Piedmont Section Meeting	Eric Hudson
July	Wrote article “Contact Time Disinfection” for July 2019 NCWOA Go with the Flow Publication	Kimberly Barnett
July 24	NC AWOP Team Meeting at WSRO	NC AWOP Team
Aug. 6-7	AWOP National Meeting – Cincinnati, OH	Eric Hudson, Kimberly Barnett
Aug. 19-23	Participated in Multi-State Microbial CPE – Pikeville, KY	Eric Hudson, Meredith Guglielmi, Emily Lester
Oct. 9	NC AWOP Team Meeting at WSRO	NC AWOP Team
Oct. 9	Created CT Guidance Document for PWS Section Staff	Lauren Raup-Plummer, Mark Hahn, Meredith Guglielmi
Nov. 5-7	Region 4 AWOP Planning Meeting - Charleston, SC	Eric Hudson

Date - 2019	Activity	Attendee(s)
May – June	Presented AWOP Awards to Water Systems attending regional NCWOA meetings.	NC AWOP Team
May – Dec.	AWOP Team members presented AWOP Turbidity Optimization Awards to water system governing bodies if so requested.	NC AWOP Team

The NC AWOP microbial awards reflect the number of years that a plant has achieved optimized status and may also include special recognition for plants that have received the award for 10 consecutive years or more.

#### Site Selection Process

Facilities are selected for CPEs and PBTs based on their priority rankings (microbial and DBP), their regional proximity, and by request. It is important that NC AWOP efforts are evenly distributed throughout the state. This approach allows for a more diverse program that still serves the most in-need facilities.

#### Building Awareness & Recognition

Participation in the N.C. Waterworks Operator Association and N.C. American Water Works Association and Water Environment Association activities has been instrumental in introducing AWOP tools and concepts into routine operator training. In conjunction with the NC AWOP events, these activities have been instrumental in the noted overall improvement in North Carolina's facilities.

Additional effort to facilitate and educate North Carolina's water systems about the benefits of the AWOP has led to the production of NC AWOP flyers and posters. These flyers contain basic information about the program along with the AWOP goals. The flyers have been provided to water treatment facility staff and discussed during routine inspections. NC AWOP staff distributed AWOP posters with water resistant printing to each plant. More work is needed to develop innovative approaches that will reach additional facilities and provide the necessary technical assistance to achieve their goals.

The PWS Section issues annual certificates to facilities that meet the AWOP optimization goals for settled and finished water turbidity. The PWS Section also issues a press release listing the facilities that received the annual certificates. In many communities the achievement of the AWOP goals and certificate award has been reported by the local media. DEQ has also posted pictures of the award presentations on Facebook and Twitter.

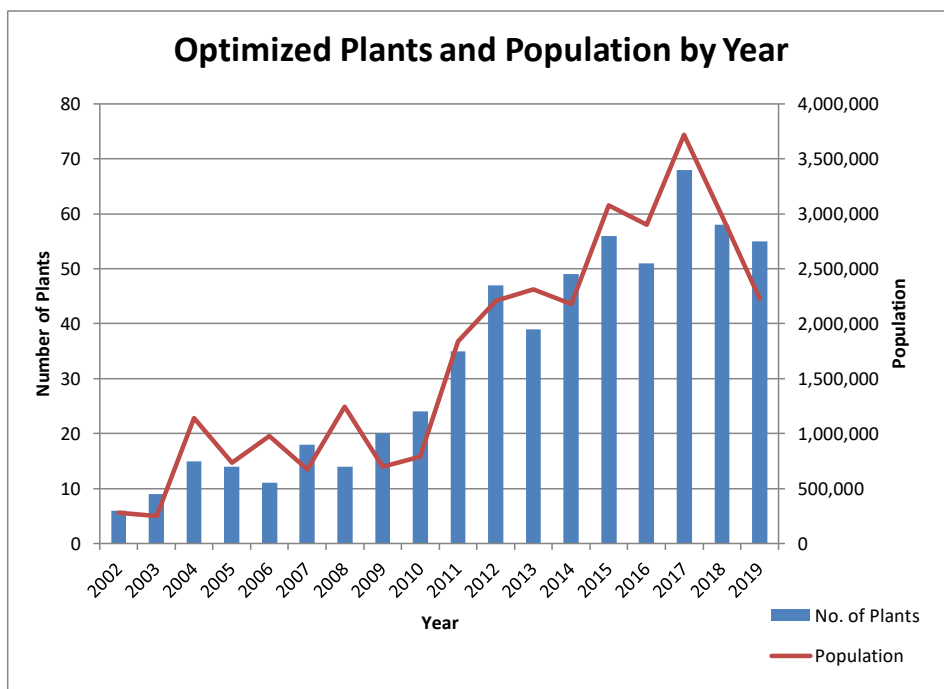
### **AWOP Impacts**

The total number of systems that met the optimization goals for finished water and settled water turbidity since 2002 and the population serviced by these systems are presented in Figure 5. In general, there has been an increase in the number of

optimized plants and in the population; however, there has been a recent decrease in 2018 and 2019. In 2018, there were 57 optimized water treatment plants that served a population of 2,980,608. Year 2018 was the wettest year on record for North Carolina with an average precipitation of 71.77 inches. This historic rainfall included precipitation from two major hurricanes and created challenging raw water quality across the state. In 2019, there were 55 optimized water treatment plants that served a population of 2,227,355. This represents a 25% decrease in population from 2018. This decrease is because the largest water system in the state and several medium size water systems did not get the award in 2019.

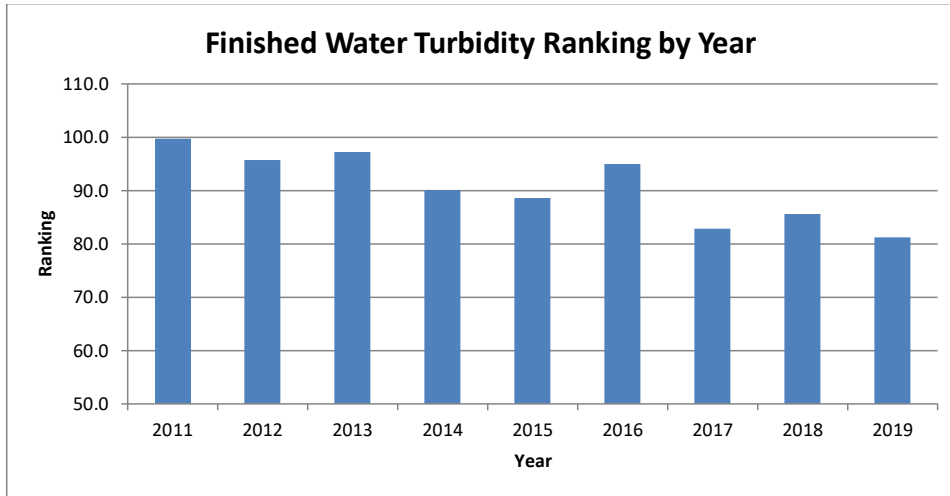
**Commented [MTA4]:** Can be accounted for because Charlotte (population > 1 million) had no WTPs that got the award last year. Several other medium sized systems did not get the award in 2019 that had in the past.

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**Figure 5**

Figure 6 demonstrates the continued improvements made by surface water facilities in North Carolina. This graph illustrates the reduction of average finished water turbidity.



**Figure 6**

Special Study – City of Morganton

The City of Morganton operates a surface water system that serves a population of approximately 38,000. On January 15 and 16, 2019, the NC AWOP Team conducted a special study at the water treatment plant. The team used the Microbial Comprehensive Protocol Evaluation manual to conduct the special study that focused on an evaluation of Contact Time (CT) and Major Unit Processes (MUP). The study provided a training opportunity for the NC AWOP Team and provided technical assistance to the water system. MUPs were deemed adequate for peak flow. Errors in the plant’s CT methodology were discovered, and the NC AWOP Team provided the water plant staff with CT guidance and a spreadsheet to calculate daily CT. Water plant staff are now using the spreadsheet to evaluate daily CT.

Special Study – City of Lexington

The City of Lexington operates a surface water system that serves a population of approximately 18,900. On February 18-23, 2019, the NC AWOP Team conducted a special study at the water treatment plant. The team conducted hold studies on entry point water, demonstrated the hydrant sampler, evaluated elevated storage tanks and reviewed historical DBP sample results. The study provided a training opportunity for the NC AWOP team. The system has a history of elevated DBP concentrations in the distribution system. Following the special study, system management changed plant operations to prevent water from sitting [stagnant in the clearwell for periods], forced elevated tank drawdowns to promote better mixing and tank turn over, increased system flushing at auto flushers, and required a municipal golf course irrigate with potable water. The system also had a consultant evaluate the WTP to optimize coagulation and chemical feed points. DBP sample results collected in August and

Commented [MTA6]: Fixed spelling error

Commented [HE7R6]: Thanks.

Commented [MTA8]: Stagnant(?)

Commented [HE9R8]: Correct. I made the change.

November 2019 were below the DBP MCLs and dramatically lower than samples collected in August 2018.

#### Special Study – Martin County District 2

The Martin County Water & Sewer District 2 system is a surface water purchase system that serves approximately 2,500 people. On May 29 and June 3, 2019, the NC AWOP Team conducted a special study to evaluate water quality in the distribution system. The team utilized hydrant samplers and gathered water quality data to evaluate TTHMs concentrations and to determine if potential nitrification was occurring in the chloraminated system. The study provided a training opportunity for the NC AWOP team. Overall, TTHM concentrations do not appear elevated in the distribution system, but the team did identify areas where nitrification had likely occurred. A report was provided to the water system explaining the study results and included guidance to mitigate nitrification.

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Commented [HE11]: Per Clif

#### CT Guidance Document

NC AWOP Team developed a CT Guidance Document intended for NC PWS Section staff. NC AWOP Team will host a WebEx knowledge sharing session in 2020 to introduce the document to PWS Section staff. The document will provide a foundation for staff to better understand CT methodology and promote consistency when reviewing water treatment plant CT calculations.

### **Lessons Learned**

Participating water system management and staff have learned that notable change in performance will take both time and consistent effort. Significant improvement requires a concerted data collection effort, application of available tools and diligent individuals who are willing to explore new approaches to old processes. System management must be willing to allow the needed changes to be made as well as maintain adequate operational staff to accommodate data collection and evaluation. Basic understanding of AWOP concepts and approaches helps water operators and management make informed decisions to accomplish improvements in plant and system operations.

The experience, skills and knowledge gained with the participation in AWOP benefit both water system and state staff. It provides both insight into the functional aspects of water treatment as well as improved knowledge, skills, and ability that allow staff to make more informed evaluations and provide valuable technical assistance, which further contributes to protecting public health in North Carolina.

Effort is needed by the NC AWOP team members familiar with local facilities and the AWOP program to maintain and increase the participation of all surface water facilities. Development of innovative training approaches and partnerships would promote the program and ultimately benefit additional systems.

Participating in a multi-state CPE is a great way to get AWOP experience. In addition, it facilitates discussion with colleagues to share experiences on improving water treatment and water quality.

Conducting special studies provides training opportunities for staff to gain experience using AWOP tools and allows the NC AWOP team to provide technical assistance to participating water systems.

Providing a professional printed and framed AWOP award instills pride and may motivate surrounding water systems to seek the award. Posting pictures of award presentations on agency social media is a great way to build awareness and provides positive publicity that is important to many water systems.

## APPENDIX A

### North Carolina's Optimization Goals

Category	Goal	Description
Microbial	Minimum Data Monitoring Requirement	<ul style="list-style-type: none"> <li>▪ Daily raw water turbidity.</li> <li>▪ Settled water turbidity from sedimentation basins at four-hour increments.</li> <li>▪ On-line, continuous turbidity from each filter.</li> </ul>
Microbial	Individual Sedimentation Basin Performance Goals	<ul style="list-style-type: none"> <li>▪ Settled water turbidity &lt; 2 NTU in 95% of readings when the annual average raw turbidity is &gt; 10 NTU.</li> <li>▪ Settled water turbidity &lt; 1 NTU in 95% of readings when the annual average raw turbidity is ≤ 10 NTU.</li> </ul>
Microbial	Individual and Combined Filter Performance Goals	<ul style="list-style-type: none"> <li>▪ Filtered water turbidity of less than 0.10 NTU in 95 percent of the maximum turbidity samples recorded each day (excluding 15-minute period following filter backwash).</li> <li>▪ Maximum individual filtered water turbidity of 0.3 NTU.</li> <li>▪ Filter backwash initiated before effluent turbidity exceeds 0.1 NTU.</li> <li>▪ Filter to waste until turbidity is less than 0.1 NTU.</li> <li>▪ Maximum filtered water measurement of less than 10 particles (in the &gt; 2 micron range) per milliliter (if particle counters are available).</li> </ul>
Distribution System	Disinfection Byproducts Performance Goals	<ul style="list-style-type: none"> <li>▪ Individual Site Goal: Quarterly Maximum Locational Running Annual Average TTHM/HAA5 values not to exceed 70/50 ppb.</li> <li>▪ Long-Term System Goal: Average of Maximum Locational Running Annual Average TTHM/HAA5 values not to exceed 60/40 ppb (the average of the last 8 quarters cannot exceed 60/40 ppb).</li> </ul>



**APPENDIX B**

### NC AWOP Microbial/Turbidity Ranking Score Calculation

$$\begin{aligned} &1000 * \text{Total Number of Tier 1 Acute MCL Violations per Year (Fecal)} \\ &+ \\ &750 * \text{Total Number of Tier 2 MCL Violations per Year (TC / Turb.)} \\ &+ \\ &500 * \text{Total Number of Tier 3 Monitoring and Treatment Technique Violations per Year (CT /} \\ &\text{Turb.)} \\ &+ \\ &100 * \text{Average Monthly Finished Water Turbidity} \\ &+ \\ &10 * \text{Max Monthly Finished Water Turbidity} \\ &+ \\ &3.16 * \text{Average Monthly Settled Water Turbidity} \\ &+ \\ &0.316 * \text{Max Monthly Settled Water Turbidity} \\ &+ \\ &0.1 * \text{Average Monthly Raw Water Turbidity} \\ &+ \\ &0.01 * \text{Max Monthly Raw Water Turbidity} \\ &= \\ &\underline{\text{Total Ranking Score}} \end{aligned}$$

\*\*Note that raw water coliform is only considered in the rankings if two systems have the same score using the calculation above. The raw water coliform will be used as a “tiebreaker” in this case.\*\*