CORRECTIVE ACTION PLAN TO COMPLY WITH AGREED ORDER DOW-150132

City of Ashland, Kentucky

On June 24th, 2015, an administrative conference was held between the City of Ashland and the Division of Enforcement. An Agreed Order that was discussed was sent for execution by the Mayor of the City of Ashland. The Agreed Order was executed in November 2015.

The City of Ashland had multiple violations which are summarized below:

- Failure to maintain a minimum of 0.20 free chlorine residual in all areas of the distribution system
- Elevated disinfection byproducts (TTHM & HAA)
- Installing a 2 inch water main extension without prior approval from the DOW Water Infrastructure Branch.
- Failure to collect and report daily chlorine residual samples.
- Failure to submit OEL report

As part of the Agreed Order, Ashland is developing this Corrective Action Plan (CAP) to address and evaluate the following:

1- Determine if DBPs are being formed in the plant or distribution system.
2- Consider alternative total organic carbon (TOC) removal process
3- Optimized coagulation process
4- Plant chlorination process
5- Tank turnover and system hydraulics
6- Evaluate any booster chlorination operations
7- Ensure point of sale water to wholesale customers is within federal compliance.
8- Consider Performance Based Training or a Comprehensive Performance Assessment
9- Evaluate existing flushing plan.
10- Evaluate cause of cracking in filters at water plant and cause of system's capacity issues.

Item 1.0 Determine if DBPs are being formed in the plant or distribution center

In 2012, the City of Ashland completed a preliminary study of TTHM formation, at the plant and in the distribution system. Table 1 shows the results of this study. The measured by-product levels identified below represent data collected during a Division of Water special study to help determine TTHM formation locations.

Table 1-1
THM Formation During Special Study

Date	Site	TTHM (ppb)
4/11/2012	Top of Filter	11
4/11/2012	Bottom of Filter	12.9
4/11/2012	Clear Well 1	17.1
4/11/2012	Clear Well 2	20.8
4/11/2012	After 3 MG Tank (Remote Clearwell)	19.6
4/12/2012	4130 Winchester (Near Water Plant)	52.9
4/12/2012	Hardees	61.1
4/12/2012	150 Russell Road	59.8
4/12/2012	US 60	63.6
6/6/2012	Top of Filter	7.89
6/6/2012	Bottom of Filter 1-8	23.3
6/6/2012	Bottom of Filters 9-12	20.9
6/6/2012	Clear Well 1	22.3
6/6/2012	Clear Well 2	21.2
6/6/2012	Clear Well 3	16.1
6/6/2012	Clear Well 4	17.7
6/6/2012	After 3MG Tank (Remote Clearwell)	40.6
6/8/2012	Old School	76.5
6/8/2012	Hardees	71.1
6/8/2012	4130 W	52.1
6/8/2012	150 Russell Road	59.9
6/8/2012	KY State Police	60.8
6/8/2012	US 60	70.8
6/8/2012	East Park	120

This data is utilized in conjunction with local operator knowledge and a historical understanding of how the City of Ashland has traditionally seen its levels of TTHM in the system. The results from the study reinforce the empirical observations of the operations staff that a significant portion of TTHM formation occurs in the distribution system after the 3 million gallon (remote clearwell) and this should a primary focus of the proposed corrective actions. More discussion about distribution activities will be provided in subsequent sections of this plan.

Although, the results encountered during this study conducted by DOW staff indicated that the TTHM levels exiting the 3 million gallon tank did not exceed 40.6 ppb, city staff have had results exiting the 3 million gallon tank as high as 59 ppb in other owner initiated system studies, therefore there are some potential opportunities for remediation at the plant or in the 3 million gallon tank (remote clearwell).

Proposed Corrective Action:

The formation of TTHMs in the distribution system is most often attributed to water age, chlorine levels and pH. Ashland has already updated their flushing program to increase the frequency and location of regular flushing, however flushing alone does not seem to have a significant enough effect on the DBPs in the furthest points of the system. An outline of the City of Ashland's proposed corrective actions including an estimated timelines are provided under each item in this Corrective Action Plan.

Item 2.0 Consider alternative total organic carbon (TOC) removal process

The natural organic matter (NOM) present in the Ohio River is highly variable from season to season. Ashland's actual TOC reduction results for 2012 and 2015 are compared to the regulatory levels in the table below.

Table 1-2
2012 TOC Removal vs. Required Ratios

Month	Actual Removal %	Required Removal %	Ratio
Jan. 2012	36.36	25	1.45
Feb 2012	36.36	35	1.04
March 2012	36.84	35	1.05
April 2012	22.22	25	0.89
May 2012	33.33	25	1.33
June 2012	58.97	25	2.36
July 2012	33.33	25	1.33
Aug 2012	36.00	25	1.44
Sept 2012	26.09	25	1.04
Oct 2012	25.00	25	1.00
Nov 2012	29.63	25	1.19
Dec 2012	46.43	35	1.33
Jan 2015	37.50	35	1.07
Feb 2015	33.33	25	1.33
Mar 2015	36.36	35	1.04
April 2015	28.57	25	1.14
May 2015	25.00	25	1.00
June 2015	19.05	25	0.76
July 2015	45.16	25	1.81
Aug 2015	22.22	25	0.89
Sept 2015	20.00	25	0.80

A review of this table indicates that TOC reduction at the Ashland Water Plant is largely being achieved. Although, the City of Ashland is largely meeting its TOC reduction goals, many experts in the field of DBP removal suggest that percentage reduction is a poor metric to use when remediating DBPs. In a recent workshop training, hosted by KRWA, the speaker from Aulick Chemical suggested that TOC should be reduced to a level below 1.5 mg/l treated to have optimized coagulation and oxidation. The average 2015 treated TOC for the Ashland Water Plant is 1.53 mg/l, however during the summer months, the treated TOC is as high as 2.10 mg/l.

Proposed Corrective Action:

There are a few strategies the City of Ashland are currently implementing (or in process of implementing) in order to try to meet this 1.5 mg/l TOC maximum target. They are as follows:

- Total refurbishment of all 6 filters (12 filter cells); removing Leopold IMS filter caps and replacing with gravel, installing air scour backwash, and replacing all media. These filters have exhibited poor performance since installation in early 2000s and the performance continued to worsen by evidence of media cracking, mud balls, short filter run times, poor filter flow through volume and continual air binding, especially in the winter time. Filter assessments performed last year indicated that our current backwash process of the media was largely ineffective leading to the continuing deterioration in performance. The project is in construction and is expected to be completed in February of 2016. The initial results for the first two completed filters are very promising, therefore our finished TOC removal is likely to improve.
- Change primary oxidizer from Potassium Permanganate to Sodium Permanganate. This will allow us to increase our oxidant feed and residual since our current potassium permanganate feeder is operating near its maximum feed rate. This will also allow us to feed potassium permanganate as a secondary feed if necessary when TOC goals are not being met. This is expected to be completed by February 2015.
- The water plant staff have increased the powder activated carbon feed to nearly our maximum feed rate. Based on discussion with Aulick Chemical, this is likely to help reduce treated TOC as well.

If the proposed corrective actions in this plan fail to result in meeting the TOC goals above, these potential future actions may be pursued as options:

- Change system oxidant to Peroxide or Sulfur Dioxide.
- Granular Activated Carbon bed treatment
- Increase capacity of powder activated carbon feed system

3.0 Optimized coagulation process

Optimization of coagulation is currently practiced by Ashland. As evidenced by the findings of the Table 1-1. The Acti-flo (ballasted flocculation) has a proven record of removing greater amounts of TOC through its process. As previously noted, the results have yielded acceptable TOC removal and relatively low TTHM formation leaving the water treatment plant. While TTHM levels could possibly be lowered by

reviewing the current enhanced coagulation process, priority will be given to the distribution system management.

Proposed Remedial Action

None at this time

4.0 Plant chlorination process

As a part of a 2012 agreed order, the City of Ashland reviewed and optimized its chlorination process. Chlorination has been moved to the furthest downstream point feasible while still maintaining compliance with CT requirements.

Proposed Remedial Action:

None at this time

5.0 Tank turnover and system hydraulics

The TTHM data from 2012 has shown that elevated levels are primarily a function of the distribution system. There are several ways to minimize distribution system TTHM formation, including reducing water age, aeration, mixing & ventilation.

Proposed Remedial Actions:

Ashland has already started some activities and is committing to others to mitigate TTHM formation in the distribution system:

- A new flushing plan for the fire department was prepared in May 2012. A summary of this includes:
    a. Every May, the fire department will flush each hydrant in Ashland in a programmed manner. Upon completion of the city hydrants, water distribution personnel flush the remainder of system (Westwood, Russell, Catlettsburg, etc.) in a programmed manner. The goal of the flushing is to reduce water age during the highest season for TTHM formation. Additionally, the annual cleaning provides scour velocities that flush out much of the debris and biofilm formations.
    b. Autumn is a transmission system flush by WTP employees. The goal is to obtain adequate flushing velocities in our transmission system to provide a system scour.
    c. The condition of the system will be evaluated quarterly and additional spot flushing may be undertaken based on localized sampling. Since the flushing plan was prepared in 2012, the Water Distribution staff have performed the targeted transmission system flush along with other “key” points on a near quarterly basis.
    d. The flushing plan will be evaluated annually, along with TTHM data. Additional flushing will continue to be undertaken in response to TTHM levels remaining elevated.
- Upgrade of Old Buckley & State Route 5 Booster Station, estimated completion is spring of 2016.

The Old Buckley & State Route 5 booster station was originally designed to supply water to the Summit Tank (low pressure zone) from the end of an 8 mile long large diameter transmission line. The transmission line is a direct feed from the water plant 3 million gallon (remote clear well) with no storage tanks between the plant and the pump station. Currently, Eastpark, the remote area continuously out of compliance on DBPs, is supplied through a waterline with 3 tanks (1.150 million gallons of storage) in between Eastpark and the water plant 3 million gallon remote clear well. Plans have been approved to upgrade and switch the Old Buckley & State Route 5 pump station over from the low pressure system to the high pressure Route 5 system that ultimately feeds the Williams Creek booster station that supplies water to Eastpark. By eliminating 1.150 million gallons of residence time, it is anticipated that the water age will be significantly reduced. In addition to reduced water age, we expect higher chlorine residuals to the supply of the Williams Creek booster station, which may result in reduction or elimination of chlorine boosting operations at the Williams Creek station.

- Elimination of Unnecessary Storage in Eastpark

  Currently, Eastpark, is supplied with water through the Williams Creek Booster Station. The Eastpark pressure zone has two (2) 500,000 gallon storage tanks. Although the two tanks may be necessary to meet future build-out demands, they are not necessary now. The current daily demand for the Eastpark area is 150,000+/- gallons per day, therefore total tank turnover in this zone is nearly 7 days. In late, winter, we intend to take the Log Town Tank offline, leaving only the High Knob 500,000 gallon tank in service for the Eastpark Area. This will reduce tank turnover to 3.5 days. In addition, we will set our SCADA system to only fill to ½ to ¾ full. This will further reduce tank turn over to 1.75 to 2.7 days.

- Tank Aeration (Pilot Study)

  The City of Ashland recently began a tank aeration / TTHM stripping pilot study. The pilot study included the installation of a 3hp aeration fountain in the High Knob tank. The fountain has been in service since September of 2015 and has shown some very promising results. During the winter, our staff will retrofit the fountain with BETE atomizing spray nozzles, made specifically for stripping of volatile organic compounds. Staff is also working on design of a tank blower to force air changes. Both ventilation and aeration are proven to be effective TTHM stripping strategies. These modifications to our pilot project will be complete by spring of 2016. Success of the project should be evident by August 2016.

  If the project is successful (25% or greater TTHM removal), we will install similar systems in at least two other tanks in the system. The anticipated total cost after completion is $100,000+/-.

6.0 Evaluate any booster chlorination operations

All booster chlorination stations have the potential to form TTHM at unacceptable levels. Any additional chlorine addition into the system will be minimized by Ashland to ensure compliance for minimal residual levels of chlorine while ensuring excess is not added.

Proposed Remedial Action

Weekly monitoring of chlorine is already occurring at Eastpark, which is the only area in which we boost chlorine. The level of chlorine is adjusted to ensure as low as possible chlorine residuals are kept while still maintaining compliance with the minimum requirements. The city has also purchased a number of auto flushers to install to maintain chlorine residuals more through flushing than through boosting. The estimate date of installation of 4 auto-flushers (2 for Eastpark Area, 1 for Johnsons Fork & 1 for Hoenig Drive) is March of 2016. This is expected to reduce our chlorine feed rate to Eastpark.

7.0 Ensure purchased water does not contribute to excessive DBPs

Ashland does not currently purchase water.

Proposed Remedial Action

No corrective actions anticipated

8.0 Consider Performance Based Training or a Comprehensive Performance Assessment

Ashland is currently working with KDOW on these DBP issues and would reserve additional training for consideration if the corrective actions are not proven effective.

Proposed Remedial Action

No corrective action anticipated.

9.0 Evaluate Existing Flushing Plan

Ashland revised its flushing plan in 2012 to include a full system distribution flush in April / May, and a full tank and transmission system flush every autumn. Staff continually reevaluates the need for flushing each quarter and typically performs the tank and transmission flush in late summer as well as autumn. We are also installing auto-flushers in key points of our system to assist with problem areas. Additional flushing, as from prior experience, seems to have very little effect on the DBP levels.

Proposed Remedial Action

No corrective action anticipated at this time.

10.0 Evaluate Cause of Media Cracks in Filters at Water Plant and Cause of System Capacity Issues

The water plant filters have exhibited poor performance since installation in early 2000s and the performance continued to worsen by evidence of media cracking, mud balls, short filter run times, poor filter flow through volume and continual air binding, especially in the winter time. Filter assessments

performed last year indicated that our current backwash process of the media was largely ineffective leading to the continuing deterioration in performance. Based on all the data, the City began design of the refurbishment of all 6 filters (12 filter cells); removing Leopold IMS filter caps and replacing with gravel, installing air scour backwash, and replacing all filter media. The project is in construction and is expected to be completed in February of 2016. The initial results for the first two completed filters are very promising, therefore the media cracking and capacity issues are expected to be remedied.

Proposed Remedial Action

The proposed remedial action is total refurbishment of all 6 filters (12 filter cells); removing Leopold IMS filter caps and replacing with gravel, installing air scour backwash, and replacing all filter media. The project is expected to be completed in February of 2016.

Summary

The following outlines the corrective actions made or scheduled and the dates to be completed by:

ACTION	Completion Date
Refurbish all 6 filters (12 filter cells) at Water Plant	February 2016
Change primary oxidizer from Potassium Permanganate to Sodium Permanganate.	February 2016
Increase Powder Activated Carbon feed rate (based on recommendation from Aulick Chemical during KRWA DBP training)	Completed
Upgrade of Old Buckley & Route 5 booster station	May 2016
Evaluate flushing plan	Completed
Take Log Town tank out of service	March 2016
High Knob Tank aeration pilot study	Began September 2016
First Modifications to High Knob tank aeration study based on current results	April 2016
Future modifications to aeration pilot study and potential to install in two additional tanks	TBD
Estimated compliance for running annual average for all sites	May 2016
Estimated compliance for 4 consecutive quarters	February 2017