BEFORE THE PUBLIC SERVICE COMMISSION OF THE STATE OF MISSOURI

Jason Strohm,	)	
	)	
Complainant,	)	
	)	
v.	)	**Case No. WC-2016-0201**
	)	
Missouri-American Water Company,	)	
	)	
Respondent.	)	

STAFF REPORT

COMES NOW the Staff of the Missouri Public Service Commission ("Staff"), by and through undersigned counsel, and submits its Staff Report.

1. On February 2, 2016 Mr. Jason Strohm filed a formal complaint against Missouri-American Water Company ("Missouri-American").

2. On February 3, 2016, the Commission issued its *Order Giving Notice of Contested Case, Directing Respondents to File Answer, and Directing Staff Investigation*. The *Order* directed staff to conduct an investigation under the requirements of 4 CSR 240-2.070(15) and file a report.

3. Staff requested and the Commission granted Staff an extension of the Report filing deadline to May 5, 2016.

4. Having concluded its investigation, Staff offers its *Staff Report*, which details Staff's investigation and analysis, and is attached hereto as Appendix A (Report).

5. In summary, Staff concludes that Mr. Strohm and other Missouri-American customers have experienced and continue to experience calcium scaling issues.

Nevertheless, Staff concludes that there does not appear to be a violation of any tariff, or Commission regulation, or statute.

6. Staff's findings and analysis in the attached *Staff Report* more fully explains the circumstances that led Staff to make these conclusions.

7. Since the matter is not yet resolved, and since Missouri-American continues to study the matter, Staff recommends that Missouri-American submit a report in this case within 90 days of the date of this Staff Report, detailing the status of the issue, and any observed results of chemical water treatment adjustments.

WHEREFORE, Staff hereby tenders its *Staff Report* for the Commission's information and consideration, and respectfully requests the Commission issue an order that Missouri-American submit a report as requested above.

Respectfully submitted,

/s/ Jacob T. Westen
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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing was served electronically on this 5th day of May, 2016**,** to the parties of record as set out on the official Service List maintained by the Data Center of the Missouri Public Service Commission for this case.

/s/ Jacob T. Westen

STAFF REPORT OF INVESTIGATION

TO: Missouri Public Service Commission Official Case File
Case No. WC-2016-0201, Jason Strohm, Complainant v. Missouri-American Water Company, Respondent

FROM: James A. Merciel, Jr., P.E., Utility Regulatory Engineering Supervisor
Water & Sewer Department

Martin Hummel, Utility Engineering Specialist III
Water & Sewer Department

/s/ Jim Merciel	**May 5, 2016**
Water and Sewer Department	Date
/s/ Jacob Westen	**May 5, 2016**
Staff Counsel's Office	Date

DATE: May 5, 2016

Introduction and Background of the Complaint

On February 2, 2016, Jason Strohm (Mr. Strohm or Complainant), who is a customer of Missouri-American Water Company (MAWC or Company) in the Platte County service area, filed a formal complaint against MAWC. Mr. Strohm's complaint alleged an ongoing water quality problem. In his complaint, Mr. Strohm stated that particles of calcium also called "scaling," would build up, in the faucets and water-using devices in his home. This scaling would then cause a disruption of water flow and would interrupt normal use of household appliances. In addition to filing the formal complaint, Mr. Strohm described this problem in testimony at the local public hearing held by the Commission in Case No. WR-20156-0301, on February 1, 2016 in Riverside, Missouri, as did a few other customers. This calcium scaling problem reportedly began in 2011, and the Company has been studying the problem and has attempted to alleviate it, with Mr. Strohm's cooperation for study of his particular home plumbing. However, the problem persists. Staff has not received any informal customer complaints on this matter. Besides the testimony at the local public hearing, MAWC had contacted Staff in July 2015 about scaling problems in Riss Lake, but at the time, according to MAWC, flushing seemed to have taken care of the problem.

On February 3, 2016, the Commission issued its *Order Giving Notice of Contested Case, Directing Respondent to File Answer, and Directing Staff Investigation*, in which among other things the Commission ordered Staff to submit a report addressing this matter. This Staff Report complies with that portion of the Commission's Order.

Appendix A

Although Mr. Strohm's formal complaint is the only one filed pertaining to this issue, MAWC reports to Staff that it has identified seven customers who have significant ongoing scaling issues in their homes. One customer lives in a subdivision known as Riss Lake, located about a mile north of the MAWC's water treatment plant; the remaining customers, including Mr. Strohm, live in an area known as Thousand Oaks subdivision, located approximately six miles west of the water treatment plant. MAWC also reports to Staff that fourteen (14) customers have filed damage claims with the Company's insurance carrier. MAWC further reports to Staff that it has recorded 152 customer contacts that pertain to particles. A few such calls are related to main breaks or service turn-off/turn-on, which are events that can cause calcium scaling breakup. A few could also be repeat calls from particular customers. The frequency of particle-related calls ranges from three (3) per year to fifty in 2015. These calls have been from customers in other areas besides Riss Lake and Thousand Oaks. According to MAWC, most customers who have experienced the scaling issues, besides the seven customers identified as having ongoing problems, have had scaling issues that are not as severe, or that have ceased for one reason or another. Since the scaling issue is something that is not unique to Mr. Strohm's residence, and because a system-wide resolution may be necessary to address it, Staff is focusing on the technical issue on a service area wide perspective for this report.

Water Chemistry Overview

Raw water that is taken from some sources, particularly surface waters such as lakes and rivers, and also shallow-well ground water, most often requires combinations of chemical and physical water treatment. Water treatment methods are necessary to remove minerals, remove organic and/or inorganic particulates, and to chemically adjust water characteristics. The final treated water product must be suitable for transportation through water mains and into customers' premises, for use as drinking water and other common uses.

There are two aspects to a determination of whether or not the treated water is suitable. One aspect is that it must meet federal and state regulations for safe drinking water. Missouri's drinking water regulations, reflecting federal requirements, are found in the Missouri Department of Natural Resources (DNR) rules, specifically 10 CSR Division 60. These regulations focus primarily on safety and the prevention of consumers ingesting illness-causing contaminants. The second aspect is a matter of aesthetics, in that the water should have no objectionable tastes, no objectionable discoloration or appearance, and have substantially little tendency to corrode and otherwise damage plumbing and appliances. This aspect is rather subjective because there are no regulations that define these characteristics; although state statutes including §393.0130.1 require utilities regulated by the Commission to provide "safe and adequate" utility service.

Treatment methods, and products to be used, must be selected depending upon the specific source water, along with feasibility considerations. A complete overview of chemical treatment methods including chemicals that might be used, physical treatment methods, and the interrelation of several treatment goals, along with detailed chemical analyses, is beyond the scope of this Staff Report for this pending formal complaint. However, an analysis of any possible cause of the scaling problem addressed in this complaint does require consideration of some fundamental water chemistry points, as follows:

- pH is a measure of acidity or basicity of a liquid, generally on a scale of 0 to 14, with a value of 7 being neutral; neither acid nor base. In water, some of the water molecules, each consisting of two hydrogen atoms and one oxygen atom, break into hydrogen ions with a positive electrical charge, and hydroxide ions (one hydrogen atom and one oxygen atom) with a negative electrical charge. When the pH is below 7, the solution is acid meaning the hydrogen ions are more prevalent; whereas when the pH is above 7, the solution is base meaning the hydroxide ions are more prevalent. The prevalence of hydrogen or hydroxide ions depends upon the presence of other compounds available for reaction to combine with the ions.

- Temperature is an important factor in chemistry, because many chemical reactions occur faster with warmer temperatures. Additionally, since some chemical reactions are both forward and reverse reactions, reaction equilibrium results in different concentrations of reactant and product at different temperatures.

- Total dissolved solids, at the levels found in drinking water, are directly related to electrical conductivity, which in turn is related to the strength of acid and base compounds in the water.

- Hardness refers to the mineral content. Most of the hardness in water is in the form of calcium and magnesium compounds, but other minerals are also present.

- Alkalinity is the ability of other compounds in a liquid to neutralize acid. Alkalinity may also be referred to as a pH buffer or pH stability; however it is notable that even in alkaline water some acids are effective in reducing the pH.

Regardless of the specific chemicals used for treatment, and the chemical reactions that result from any treatment method, the above factors may be measured, analyzed and adjusted to aid in the production of water with acceptable characteristics with regard to corrosion and scaling tendencies. Values for the above points may be used in a formula to determine what is called the Langelier Saturation Index, or LSI. A determination for the LSI starts with water pH, subtracts factors for total dissolved solids and temperature, and adds factors for hardness and alkalinity.[1] The LSI is a commonly used tool when corrosion and scaling is evaluated, whether for drinking water or water used for industrial purposes.

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[1] One commonly used formula to determine the LSI, as shown in information provided by the American Water Works Association among other sources, is as follows:
$LSI = pH – pH_s$ where pH_s is the pH level at which water hardness saturation would occur
$pH_s = (9.3 + A + B) - (C + D)$ and where:
A = (Log10[Total Dissolved Solids] - 1)/10
B = 34.55-13.12 x Log10[temp in Centigrade + 273]
C = Log10[hardness as CaCO3] - 0.4
D = Log10[alkalinity as CaCO3]

Significantly, the LSI number is an indicator, rather than a definitive determination, of water characteristics. LSI values for most drinking water production could be in the approximate range of negative 2 to over 2. Information studied by Staff suggests, generally, that a LSI of less than zero is considered to be indicative of water that is corrosive and non-scale forming; a LSI of slightly greater than zero is considered to be indicative of water that is somewhat corrosive but is scale forming, the scaling deposited on the inside of metal pipe and serving as an insulator; and a LSI approaching and exceeding 1.0 is indicative of water that is non-corrosive and is scale forming. It should be stressed again that these numbers are indicators; there is no specified LSI number that all water utilities should attain; and, any actual LSI number does not definitively determine actual results associated with water characteristics for a given water supply.

Corrosion occurs when the water has the ability to either dissolve material, primarily metal, and/or transform metal to its oxidized state. For iron, as an example, this is rust. A scale forming characteristic could mean that a thin white-colored film of calcium is deposited on inside surfaces of pipes and water-using appliances, which can serve as a protective coating that increases resistance to corrosion. Scaling could also refer to relatively large particles of calcium compounds that form, usually on the inside surface of metal pipes, which can later break off and be captured in screens in customers' fixtures and appliances. From a practical standpoint, almost any water that is used for domestic purposes has some scaling tendency, and customers experience scaling first-hand particularly in devices where heated water is involved, such as water heaters and coffee makers, because heat tends to increase scaling tendencies. This is reflected in the LSI formula, since temperature is one factor, and a higher temperature for any specific water increases the LSI number indicating increased scale-forming properties.

Description of the Platte County Water Treatment and Distribution System

MAWC has a water treatment facility in Parkville, Missouri that produces treated water for service to approximately 5,800 customers in an area north of Kansas City. This treatment facility has been in service since approximately 1942. The raw water source is four shallow wells near the Missouri River. After being pumped from the wells, water is treated at MAWC's plant in the following steps:

1. Water passes through an aeration device, introducing oxygen to oxidize iron and other minerals.

2. Lime, which is a chemical containing calcium compounds that raise pH, is introduced; the increase in pH causes minerals to precipitate out of solution forming particles that are heavier than water.

3. The water then passes through a clarifier, which is a quiescent chamber allowing some of the solid particles to settle; the settled solids are continually removed from the bottom of the clarifier and disposed.

4. The water passes through sand filters to capture some remaining solid particles; each sand filter is periodically backwashed to clean the filter and remove captured solids which are disposed.

5. In addition to the above chemical and physical water treatment, chlorine and ammonia are added to disinfect for bacteria and viruses.

6. A phosphate chemical, actually a blend of polyphosphate and orthophosphate[2], is added as a corrosion inhibitor, and to reduce scale formation on the sand filters.

Treated water is stored in a tank called a clearwell at the plant site, from which it is pumped to the distribution system.

MAWC's distribution system is comprised of various types of pipe, up to 16-inch diameter in size, that extend several miles to the north, east and west from the treatment plant. Several electric-powered booster pump stations and five water storage tanks are located throughout the service area.

Besides its own production capacity, MAWC has several connections with the City of Kansas City (KC) water system at the east end of its service area, which are used periodically to supplement production during peak times, or when production components or storage tanks are out of service for maintenance.

Water Characteristics Specific to the Platte County Water System

Water produced at the MAWC's treatment facility in Parkville, in the past, has had an average LSI of 2.19, indicating that the water was well into the scale forming range. This is the way this plant had been run for many years. Although MAWC started receiving scaling complaints in 2011, a few months after MAWC began using a different phosphate product, a return to the product that was used in 2011 did not cause the scaling to cease; and so it is unknown why scaling problems actually began. Among its efforts to reduce the scaling tendency, MAWC during the past year has reduced the pH of treated water from what was approximately 10.0 to a level of approximately 9.2, by adjusting the lime chemical feed. This reduces the LSI from an average of 2.14 to approximately 1.4. In reality pH, hardness, and alkalinity vary somewhat from hour-to-hour and the LSI in turn varies from less than 1.4 to over 1.5.

MAWC's Observations and Actions Addressing Scaling

In addition to adjusting pH by adjusting the lime treatment, MAWC has also made other attempts to address scaling. MAWC has modified its application of the phosphate chemical by trying variations on products and dosing. It has conducted its own testing and consulted with product

[2] Polyphosphate and Orthophosphate are two different compounds of phosphorus, and have different effects on water treatment and scaling properties. Phosphate products of various blends are available for water treatment use.

suppliers. MAWC has also conducted distribution system flushing, storage tank flushing and modifications to tank fill rates, and installed test loop piping within its system and in some customers' homes to observe scaling on different types of pipe.

MAWC has consulted with DNR, has consulted with KC, and conducted testing on KC's water as supplied to the MAWC's system as well as studied any affects resulting from blending water from the two different supplies. KC water also has a pH of 10.0, similar to MAWC's pH, but its LSI is 1.02, less than MAWC's current LSI of 1.4 and considerably less than the 2.14 that MAWC had previously maintained. KC reports to MAWC that it has no scaling issues. MAWC, after studying water from both supplies, has concluded that water from both supplies is compatible when blending. Further, the KC connections are not in the vicinity of where the severe scaling is being observed in MAWC's customers' homes. Finally, while flushing its distribution system, the most scaling particles observed during flushing from fire hydrants are not in the vicinity of where customer issues are occurring, although particles have been observed to an extent in various portions of the service area at times.

MAWC has had plumbers flush the internal plumbing on some customers' homes. Some of these customers, but not all, report the internal flushing has alleviated the problems. MAWC installed internal home filters in some of its customers' homes in an attempt to catch particles entering from the distribution system. Some customers with such filters, however, still have scaling problems, indicating the problem is occurring within the house plumbing since such a filter would capture calcium particles if they were flowing with water from the distribution system. Some customers have had scaling problems related to hot water, some related to cold water, and some to both.

Any one identifiable cause of this problem, and the location of problematic scale formation, has been elusive. MAWC states to Staff that it has studied many aspects of customers' plumbing configurations as ideas pertaining to the scaling issue arose, including checking for stray electrical currents that could disrupt water stability. The only obvious common factor that MAWC has observed is that customers that have the persistent scaling problem all utilize an internal plumbing product known as PEX pipe. The PEX piping system is a type of plastic pipe with brass fittings, and is used in addition to or in place of more commonly used poly vinyl chloride (PVC) and copper. It is unknown at this time how PEX could introduce any factor that would increase scaling. PEX piping is the newest of various plumbing systems, and has been used increasingly in new construction and replacement plumbing for several years. Mr. Strohm, however, states to Staff that he gets particles in his lawn sprinkler system, which he says is connected to the house plumbing near where the water service line enters the house and does not involve flow through PEX pipe. This would seem to indicate particles are entering the house through the service line, seemingly inconsistent with observations at other customers' homes with filter devices installed, indicating particles are not entering the house through the service line, as stated above.

Future plans to address the scaling issue include installation of an additional chemical treatment step: to introduce carbon dioxide after water is treated. Carbon dioxide results in the creation of carbonic acid in the water, and as such reduces pH. MAWC expects the installation to be done in

May of this year. The goal for this treatment is to reduce treated water pH further from the current target of 9.2. MAWC has not yet determined the revised target pH number that should be sought after carbonation treatment begins. If, as an example, the revised pH target were to be 9.0, the LSI would be reduced to approximately 1.2, which is lower in the scale-formation indication range.

Summary and Conclusion

After the scaling problems and complaints surfaced, it appears that MAWC took steps to study the matter, has made multiple attempts to seek resolution, and continues to seek a resolution. The Complainant does not believe the Company has been straightforward with him regarding the widespread severity of the scaling issue, nor does he believe the Company has addressed this issue in a timely manner.

There does not appear to be any violation of any tariffs, or PSC rules, regulations or statutes.
MAWC is moving forward with an additional water treatment step, the introduction of carbon dioxide to reduce pH, which involves construction and equipment resulting in substantial capital expense, and which seemingly according to chemical analysis indicators is likely to improve the scaling problem. Staff notes that it could take some time, perhaps weeks or months, to “ramp-up” the carbonation treatment, to adequately study the effect this treatment will have on scaling, and to make a determination whether or not this will have any improvement to or unintended adverse consequence on water characteristics.

Since the matter is not yet resolved, and since MAWC continues to study the matter, Staff recommends that MAWC submit a report in this case within 90 days of the date of this Staff Report, detailing the status of the issue, and any observed results of chemical water treatment adjustments. Staff will also follow up and provide further reports if necessary.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

Jason Strohm,	)	
Complainant,	)	
v.	)	**Case No. WC-2016-0201**
Missouri-American Water Company,	)	
Respondent.	)	

AFFIDAVIT OF MARTIN HUMMEL

State of Missouri)
) ss.
County of Cole)

AFFIDAVIT

COMES NOW Martin Hummel and on his oath declares that he is of sound mind and lawful age; that he contributed to the attached *Staff Report* and that the same is true and correct according to his best knowledge and belief.

Further the Affiant sayeth not.

Martin Hummel

Martin Hummel

JURAT

Subscribed and sworn before me, a duly constituted and authorized Notary Public, in and for the County of Cole, State of Missouri, at my office in the City of Jefferson City, on this 5th day of May, 2016.

Dianna L. Vaught

NOTARY PUBLIC

DIANNA L. VAUGHT
Notary Public - Notary Seal
State of Missouri
Commissioned for Cole County
My Commission Expires: June 28, 2019
Commission Number: 15207377

BEFORE THE PUBLIC SERVICE COMMISSION OF THE STATE OF MISSOURI

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v.	)	**Case No. WC-2016-0201**
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Missouri-American Water Company,	)	
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Respondent.	)	

AFFIDAVIT OF JAMES MERCIEL

State of Missouri)
) ss.
County of Cole)

AFFIDAVIT

COMES NOW James Merciel and on his oath declares that he is of sound mind and lawful age; that he contributed to the attached *Staff Report* and that the same is true and correct according to his best knowledge and belief.

Further the Affiant sayeth not.

James Merciel

JURAT

Subscribed and sworn before me, a duly constituted and authorized Notary Public, in and for the County of Cole, State of Missouri, at my office in the City of Jefferson City, on this 5th day of May, 2016.

Dianna L. Vaught
NOTARY PUBLIC

DIANNA L. VAUGHT
Notary Public - Notary Seal
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My Commission Expires: June 28, 2019
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