Lead and Copper Rule Review of The City of Fresno's Public Water System

I. Introduction

The City of Fresno (the City) operates a large public water system (PWS) serving over 520,000[1] people. Prior to 2004, the City relied on groundwater from approximately 250 wells as its primary source of drinking water. In 2004, the City brought on-line the northeast surface water treatment plant (NESWTP), serving approximately 40,000 people. The City's drinking water distribution system is an inter-connected network of pipes that receives water from all sources (ground water and surface water). This configuration helps to ensure a reliable supply of water at all times, and results in periodic blending of the sources.

Since early 2016, the City has been investigating discoloration and lead in water samples from some residences in northeast Fresno. On August 24, 2016, representatives from the City and the State Water Resources Control Board's Division of Drinking Water (State), the primacy agency for administering the Safe Drinking Water Act (SDWA) in California, met with the U.S. Environmental Protection Agency, Region 9 (EPA) to discuss the City's investigative efforts. On September 2, 2016, EPA sent a follow-up letter to the City summarizing a number of actions EPA would take, including a review of the City's Lead and Copper Rule (LCR) compliance files maintained by the State. This report presents the findings of that review.

In that letter, EPA also committed to providing corrosion control expertise as the City, under State oversight, works to address the discoloration issue. While not the focus of this report, those efforts are described in Section II.b, below.

II. Background

A. The LCR Regulatory Program

The LCR took effect on November 6, 1991.[2] Primacy agencies are required to adopt appropriate statutory authorities and regulations that are no less stringent than the federal SDWA and its implementing regulations. The State of California adopted LCR regulations in September 1996, five years after the effective date of the federal rule. The LCR has subsequently been revised several times and is currently undergoing further revision.

The intent of the LCR is to protect public health by minimizing lead and copper levels in drinking water, primarily by reducing the corrosive effect of water on plumbing materials through corrosion control treatment (CCT). The LCR requires public water systems to identify sampling sites that are most susceptible to elevated levels of lead and copper for subsequent

[1] October 4, 2016 search on California's Safe Drinking Water Information System's online public viewing platform Drinking Water Watch.

[2] 56 Fed. Reg. 26548.

monitoring. The LCR is a treatment technique rule, which requires a water system to take certain actions if more than 10% of tap water samples collected during any monitoring period exceed an action level (AL) of 0.015 mg/L for lead and 1.3 mg/L for copper.

Tap samples for LCR regulatory compliance purposes are clearly defined by regulation. Water systems may collect non-LCR regulatory or "special-purpose" samples for investigations of lead and copper in tap water, among other reasons, but these special-purpose samples are not included in the 90th percentile calculation unless they meet the site selection criteria in the rule.

B. Discolored Water from Taps in Northeast Fresno

Fresno residents notified the City's Department of Public Utilities and the State about discolored water in northeast Fresno.[3] The City, with oversight from the State, has undertaken a broad investigation of the cause and extent of the discoloration and instances of lead in tap samples, including collection of thousands of "special purpose" or non-LCR regulatory tap samples in 2016.[4] With lead detected in a sub-set of the samples and ongoing water discoloration, the City developed an Action Plan to address the concerns. Among the measures documented in its Action Plan, the City is working with home owners to replace old faucet fixtures, and providing lead education and outreach materials to residents, copies of which were provided by the State to EPA.

The City also retained two national corrosion control experts, Dr. Marc Edwards and Dr. Vernon Snoeyink, to evaluate the discoloration issues. The City provided copies of both experts' reports to EPA's Office of Research and Development for review. In addition, representatives from the City and the State participated in an EPA workshop on LCR optimal corrosion control treatment on November 3, 2016.

III. Lead and Copper Rule Compliance Review

A. Scope of Review

EPA's assessment of the City's compliance with the LCR requirements is based on the following materials provided by the State:

[3] Water color is considered a secondary drinking water standard which is not enforceable and does not require additional action under Federal regulation. However, states, such as California, can impose more stringent regulations for addressing secondary standards.

[4] The State provided EPA sampling data taken by the City for 706 homes from January to September 10, 2016. The data set included over 90,000 individual water quality constituent results. This data set showed levels of detectable lead at 201 of the 706 homes sampled as follows: two homes had results of approximately 0.5 mg/L (500 parts per billion (ppb)); five homes had results between 0.1 and 0.2 mg/L (between 100 and 200 ppb); 51 homes had results above 0.015 mg/L but less than 0.1 mg/L (between 15 and 100 ppb); and 143 homes had detectable lead levels at or below 0.015 mg/L (15 ppb). About two-thirds of the samples were collected from taps which people would not typically drink water from such as outdoor hose bibs and bathtub fillers. The remaining samples were collected from taps more typically used for human consumption such as kitchen and bathroom sinks.

- 1992 Final Compliance Order for failure to conduct required monitoring under the LCR beginning January 1992 issued by EPA;
- 1993 Materials evaluation report completed and submitted by the City to EPA;
- 1994 Corrosion Control Study completed and submitted by the City to EPA;
- 1998 Corrosion Control Study completed and submitted by the City to the State;
- LCR Tap Monitoring reports for 1993, 1994, 1996, 1999, 2003, 2006, 2009, 2012, and 2015 completed and submitted by the City;
- June 2005 PWS permit amendment issued by the State;
- 2004 NESWTP operation plan updated in 2011 issued by the City; and
- other correspondences between the City and the Sate.

EPA reviewed the City's compliance with the LCR requirements by considering various regulatory requirements, as discussed below, with respect to the information and data contained in the above-identified materials.

B. Action Level Exceedances

Regulatory Requirements: The LCR does not set a maximum contaminant level for lead or copper; rather, it sets an AL that, if exceeded, triggers actions to be taken by the PWS including source water treatment requirements and lead service line replacement (where applicable), as well as public education and supplemental monitoring. An action level exceedance (ALE) is not, by itself, a violation of the LCR, but failure to conduct the required follow-up actions can be a violation.

The AL is exceeded when the 90th percentile value of lead and copper tap sample results is greater than 0.015 mg/L for lead and 1.3 mg/L for copper. The 90th percentile value is based on lead and copper tap sampling results from plumbing fixtures where people typically consume drinking water (e.g. kitchen and bathroom sinks). The protocol for collecting lead and copper tap samples is clearly defined in regulation[5] and generally does not include special-purpose samples unless they meet the site selection criteria in the rule.

The lead and copper tap sampling protocol prioritizes plumbing configurations based on risk of leaching and subsequent exposure to lead and copper, and establishes tiered site selection criteria. The regulations further specify the minimum number of taps that must be sampled for LCR purposes. For systems serving >50,000 persons, 100 tap samples must be collected for each monitoring period.[6] If there are sufficient such sites, all LCR compliance tap samples must be taken from "Tier 1 sample sites", defined as single-family residences with copper pipes with lead solder that were installed after 1982, or contain lead pipes and/or are served by a lead service line. Tier 2 sites are multi-family residences that otherwise meet the same criteria as Tier 1, and Tier 3 sites are single-family residences with copper pipe and lead solder installed before 1983. The regulations which define Tier 1-3 sample sites do not include galvanized iron pipe among the criteria for inclusion. Where there are insufficient Tier 1-3 sites, samples should be taken

[5] See 40 C.F.R. § 141.86

[6] 40 C.F.R. § 141.86(d)(4) allows PWSs to reduce the frequency and number of sample sites so long as they meet criteria established therein.

from representative sites throughout the distribution system. A "representative site" is a site in which the plumbing materials used at that site would be commonly found at other sites served by the water system, and could include galvanized iron pipe. The LCR requires that any additional samples that are taken must be included in the 90th percentile calculation so long as they fit within the tiers that are actually sampled for compliance purposes.

The frequency of lead and copper tap sampling is dependent upon the 90th percentile concentrations of lead and copper results. Standard lead and copper tap sampling is to be completed during 6-month monitoring periods, January to June, or July to December. A PWS may request to have their monitoring frequency reduced if their 90th percentile results for lead and copper is below the AL. Reduced monitoring frequency can be either annually or triennially with monitoring to be performed during the summer months (June-September). The specific criteria for being placed on reduced monitoring is established in the LCR regulations.

EPA Review: In 1993, the City identified a sample pool of approximately 130 homes within the service area that met the Tier 1 sampling site criteria[7] and were willing to participate in the lead and copper tap sampling activities. With a few exceptions, all lead and copper tap sampling has taken place at homes identified in this sample pool. Considering the introduction of the NESWTP in 2004 and potential changes to water quality in the distribution system, the sites selected may no longer be sufficiently robust to meet the targeted sampling site requirements of the LCR or represent the highest susceptibility to lead and copper leaching.[8]

EPA reviewed LCR tap sample data for 1993-2015 to determine whether the City has exceeded the lead AL of 0.015 mg/L requiring additional actions to minimize lead exposure.[9] The LCR data indicated that the 90th percentile results for lead and copper did not exceed the AL for any of the City's household tap monitoring periods.[10] The highest calculated 90th percentile value was 0.008 mg/L[11] (8 ppb) for the second 6-month monitoring period in 1993. Calculated 90th percentile lead values have otherwise consistently remained at < 0.005 mg/L (5 ppb). In 1996, the City was granted reduced monitoring (triennial) because they had not exceeded the action

[7] The Tier 1 sites selected consisted of residences containing copper pipes with lead solder, as the City was not able to identify any lead pipes as service lines or household plumbing being served by the PWS.

[8] For a fuller discussion of when to reconsider the LCR sampling site selection, see EPA Memorandum, Implementation of the Lead and Copper Rule Provisions Related to Sample Site Selection and Triennial Monitoring, Peter Grevatt, Director of the Office of Groundwater & Drinking Water (Oct. 13, 2016).

[9] EPA has not identified any of the 2016 special-purpose samples performed by the City as meeting the Tier 1 site selection criteria, hence they were not used for the 90th percentile calculation.

[10] EPA's examination of individual samples from 1993 to 2015 showed only eight of approximately 700 individual lead and copper tap samples exceeded 0.015 mg/L for lead. The most recent triennial tap sampling results from all homes tested for lead and copper in 2015 were reported as non-detect.

[11] Note: The 2003 results reported in Drinking Water Watch for lead are a data entry error resulting from a mistake in the form 141AR. Review of the narrative report and the residential lab slips verify that the 90th percentile for lead should have been reported as 0.0025mg/L.

level. The next scheduled round of tap samples for lead and copper will be collected in the summer of 2018. EPA's recommendations below include additional sampling in 2017.

Summary of Findings

- The City identified sufficient Tier 1 sampling sites for lead and copper tap samples, however, the sample site selections have not been updated since 1993 and may not adequately represent the portion of the service area served by the NESWTP.
- The City is in compliance with the AL for lead 1993-2015.

C. Optimal Corrosion Control Treatment

Regulatory Requirements: Optimal corrosion control treatment is treatment that minimizes the lead and copper concentrations at users' taps.[12] To help public water systems minimize lead and copper, the LCR establishes corrosion control treatment steps,[13] which all large public water systems are required to complete unless lead and copper concentrations are sufficiently low.

The corrosion control treatment steps require that a system undertake initial monitoring for lead and copper and water quality parameters (WQPs), submit to the State a corrosion control study, install and operate optimal corrosion control treatment once designated by the State, undertake follow-up sampling (lead and copper, and WQPs), and comply with the State-specified WQPs on a continuing basis. Optimized corrosion control treatment will vary depending upon the nature of the source water.

The LCR states that a PWS may be exempt from the corrosion control treatment steps if the system demonstrates that it has conducted activities equivalent to the corrosion control steps, or if for two consecutive 6-month monitoring periods, the 90th percentile results for lead tap samples that represent the relative contribution from the corrosion of plumbing is equal to or less than 0.005mg/L.[14] A system meeting either of these criteria must continue to operate any optimal corrosion control treatment in use and notify the State of any planned long-term change in treatment or the addition of a new source so that the State may take appropriate action to ensure corrosion control remains optimized. The system could be triggered to follow additional corrosion control treatment steps if it no longer meets the standard of optimized corrosion control treatment.

[12] See 40 C.F.R. § 141.2 – Definitions. For systems with elevated lead, the process of optimizing seeks to minimize lead and copper concentrations without violating other national primary drinking water regulations.

[13] See 40 C.F.R. § 141.81(d)

[14] A system meeting this standard is "deemed optimized" for corrosion control technique purposes. See 40 C.F.R. § 141.81(b)(3). The relative contribution from the corrosion of the plumbing is determined by the difference between the 90th percentile results for lead tap samples and the highest source water lead result. 40 C.F.R. § 141.81(b)(3)(i) further states that if the source water lead level is below the method detection limit, the 90th would need to be 0.005mg/L or less in order for the PWS's corrosion control to be deemed optimized.

EPA Review: The City conducted initial monitoring for lead in household tap water during two 6-month monitoring periods, in April and in July of 1993. The 90th percentile lead result for the first 6-month monitoring period was 0.0025mg/L and the highest source water concentration was <0.001 mg/L. The difference between the 90th percentile and source water lead concentration for the first 6-month monitoring period was <0.0015mg/L. The 90th percentile lead result of the City's second 6-month monitoring period was 0.008mg/L, and the highest reported source water lead concentration for that period was 0.0025mg/L.[15] The difference of between the 90th percentile and source water lead concentrations for the second 6-month monitoring period was 0.0055 mg/L, just slightly greater than 0.005 mg/L. As a result, the City did not meet the benchmark standard of two consecutive 6-month monitoring periods with 90th percentile lead concentrations <0.005mg/L to be deemed optimized based on the second 6-month monitoring period results. Regardless, in a letter dated March 4, 1996, the State determined that the City's corrosion control was optimized.[16]

In 1998, the City submitted to the State a corrosion control study for the planned introduction of surface water into its distribution system. In 2004, the City began using the NESWTP after notifying the State prior to its installation and operation. Moreover, the State issued to the City a permit amendment in June 2005 for the NESWTP requiring the City to "operate the new surface water treatment plant in accordance with the plant operations plan, dated June 2004." This operations plan, updated in 2011, identified corrosion control treatment performed at the NESWTP including pH adjustment and the addition of corrosion inhibitors.

Since 1994, the City has consistently reported 90th percentile values for lead below 0.005 mg/L,[17] which, regardless of source water lead concentrations, would meet the benchmark standard for continuing to be deemed to have optimized corrosion control.[18]

Summary of Findings

- The State's determination that the City was operating under optimized corrosion control in 1996 was inconsistent with the criteria set forth at 40 C.F.R. § 141.81(b)(3).
- The City's sampling results since 1993 demonstrate that the 90th percentile values for lead have consistently been below 0.005 mg/L, which is the benchmark standard for an ongoing determination for optimized corrosion control.

[15] The City's July 1993 Technical Memorandum containing the results of the 1993 sampling identifies the highest reported source water lead concentration as between 0.001 mg/L and 0.049 mg/L, and the laboratory identified the midpoint as the reported value (0.0025 mg/L). It is important to note that a small change up in this reported value would significantly change the finding of whether the system was deemed optimized for corrosion control.

[16] The State's determination was based on California's LCR provisions embodying 40 C.F.R. § 141.81(b)(3), which are set forth at 22 C.C.R.§64674(c)(2).

[17] Drinking Water Watch reports the 2003 90th percentile for lead as 0.015 mg/L. This is a data entry error. EPA has confirmed by reviewing the actual analytical results that the 90th percentile for 2003 is actually 0.0025 mg/L.

[18] 40 C.F.R. § 141.86(d)(4)(vii) allows a state to require a PWS to return to standard lead and copper tap monitoring following a long-term treatment change or source water change which could help to re-establish that corrosion control treatment remains optimized.

D. Monitoring and Reporting

EPA has identified potential monitoring and reporting concerns associated with both lead and copper tap and WQP monitoring requirements.

1. Water Quality Parameter Monitoring

Regulatory requirements: Water quality parameters (WQPs) such as pH, alkalinity, calcium, and conductivity affect water corrosivity. All PWSs subject to corrosion control treatment must conduct WQP monitoring, unless the State determines that ongoing WQP monitoring is not required. Water quality parameter monitoring under the LCR is necessary for determining a corrosion control strategy and if a PWS is providing continuous treatment that reduces lead and copper corrosion. Systems must monitor for WQPs in the distribution system and at all entry points to the distribution system (after treatment). All large water systems must also conduct initial WQP monitoring. Distribution system samples must be representative of water quality throughout the system, taking into account the number of persons served, the different sources of water, the different treatment methods employed by the system and seasonal variability. Systems subject to corrosion control must conduct ongoing WQP monitoring. See generally 40 C.F.R. § 141.87.

EPA Review: The City's April 1993 Lead and Copper Sampling Plan limited their initial WQP monitoring to the service area where lead and copper tap sampling was being conducted, which accounted for seven entry points and a limited scope of distribution system samples. As a result, the City did not sample per the initial WQP monitoring requirements, as the City did not sample at all 200+ entry points into the distribution system and only sampled within a small area of the overall distribution system.

The State determined that the City's corrosion control is optimized in its March 4, 1996 letter. WQPs were not established and ongoing or continuous WQP monitoring was not required for the City's distribution system. As such, the City did not perform ongoing WQP monitoring. When the NESWTP came online in 2004, the City started actively treating the water from the NESWTP for corrosion control. Once the City began treating the NESWTP water, it became obligated to continue doing so to maintain optimal corrosion control. Establishment of WQPs by the State and ongoing WQP monitoring by the City are important components of monitoring for corrosion control. However, the State did not establish WQPs for WQP monitoring.[19]

Summary of Findings

- The City did not collect initial WQP samples in 1993 at all entry points into the distribution system pursuant to 40 C.F.R. §§ 141.87(a) and (b)(2).
- The City's initial distribution system WQP monitoring in 1993 was not representative of water quality throughout the distribution system pursuant to 40 C.F.R. § 141.87(a)(1).
- In 2004 (when the NESWTP came online), the State should have designated WQPS and required ongoing WQP monitoring because the plant was actively treating to control corrosion.

[19] 40 C.F.R. § 141.81(b)(3)(iii) allows the State to require additional monitoring and take action that ensures corrosion control treatment remains optimized. Action may include establishing enforceable WQPs.

2. Monitoring Schedule

Regulatory Requirements: The required monitoring schedule for large PWSs to collect lead and copper tap samples, should have begun in January 1, 1992.

EPA Review: Based on the data provided to EPA, the City was one year late for the 1992, 1995, and 2002 tap monitoring periods. The City has met every other scheduled lead and copper tap monitoring period since 2003. The next scheduled triennial round of tap sampling is in 2018.

Summary of Findings

- The City did not properly follow the required monitoring schedule for the years 1992, 1995, and 2002.

3. Number of Samples

Regulatory Requirements: 40 C.F.R. § 141.86(c) specifies the minimum number of samples a public water system is required to collect for lead and copper testing for tap sampling.

EPA Review: In 2003, the City initially collected the correct number of samples but had one household sample that should have been invalidated and resampled. In this instance, the City failed to collect the required minimum number of valid samples. The 2003 LCR monitoring report submitted by the City included forms titled "Directions – Resident Tap Sample Collection Procedures" that were provided by the City to be completed by the residents. The forms are useful for providing sample collection instructions and help ensure that the sample was collected properly. In one instance, however, sample site #61 indicated that the water had only stagnated within the household plumbing for 4 hours, which is less than the minimum 6-hour stagnation required by the LCR. Since the short stagnation period renders the sample invalid, the City only collected 49 valid LCR lead and copper tap samples instead of the required minimum of 50 samples for that year. [20] Nonetheless, a replacement sample would have had no effect on the 90th percentile for the monitoring period.

Summary of Findings

- The City did not collect the minimum number of samples in 2003, as required by the LCR regulations.

[20] 40 C.F.R. § 141.86(d)(4) allows PWSs to reduce the frequency and number of sample sites so long as they meet criteria established therein.

IV. Recommendations

Based upon the findings in this report, EPA recommends the State implement the following actions to ensure the City's LCR compliance:

- **Revise the lead and copper tap sampling strategy to identify more representative samples of water quality in the distribution system within 60 days of the date this report is issued**. EPA recommends that the lead and copper tap sampling strategy:
    - include schedules that are representative of periods when the surface water supply is in use and represents normal operating practice for that supply;
    - consider distribution system operational water quality data, initial WQP data, and knowledge of distribution system hydraulics to identify areas predominantly served by the principal water sources in addition to mixing zones; and
    - identify sampling sites within the areas mentioned above that meet the tiering criteria, unless there are no such sites within those areas (in which case the sampling sites should be representative of the plumbing materials used in those areas).

- **Return to initial lead and copper tap sampling frequency**. EPA recommends that the State require the City to return to initial lead and copper tap sampling frequency[21] to confirm that the City meets the benchmark standard of optimal corrosion control.[22] The monitoring should be scheduled such that the first 6-month monitoring period will end on June 30, 2017. EPA also recommends that any time the City implements a long-term treatment change or adds a new source, such as another surface water treatment plant, the State should require the City to return to initial monitoring to confirm that corrosion control treatment remains optimized. Upon completion of the two rounds of 6-month monitoring, the City may request a return to reduced monitoring if they meet the provisions.[23]

- **Conduct initial WQP monitoring at entry points and within the distribution system**. If the City cannot demonstrate WQP values for each entry point to the distribution system that meets the intent of the initial WQP monitoring requirements, EPA recommends that the State require the City to conduct initial WQP monitoring to remedy the failure to properly conduct initial WQP monitoring in 1993.[24] Further, the State should:
    - ensure that all entry point sample locations are representative of each source after treatment; and
    - ensure that all distribution system sample locations are representative of water quality throughout the distribution system taking into account the number of

[21] See 40 C.F.R. § 141.86(d)(4)(vii)

[22] 40 C.F.R. § 141.81(b)(3)

[23] 40 C.F.R. § 141.86(d)(4)

[24] 40 C.F.R. §141.87(b)

persons served, the different sources of water, the different treatment methods employed by the system, and seasonal variability.

- **Establish WQPs for the NESWTP.** To ensure that continuous optimized corrosion control treatment is being provided, EPA recommends that the state establish WQPs for the NESWTP and any other entry point to the distribution system that requires corrosion control treatment.[25]

- **Initiate corrosion control requirements if the system fails to be deemed optimized for corrosion control.** If the City fails to be deemed optimized for corrosion control based upon the results of the two 6-month monitoring period for lead and copper tap sampling events recommended above, EPA recommends that the State require the City to comply with the corrosion control requirements of the LCR by:
    - completing the corrosion control treatment steps);[26] or
    - submitting information for the State to make a determination that the City's corrosion control is optimized.[27]

[25] 40 C.F.R. §§ 141.81(b) & (b)(3)(iii)

[26] 40 C.F.R. § 141.81(d)

[27] 40 C.F.R. § 141.81(b)(2)