UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:

WG-15J

Eric Oswald, Director
Drinking Water and Environmental Health Division
Michigan Department of Environment, Great Lakes, and Energy
Constitution Hall, 4 South
525 W. Allegan Street
P.O. Box 30817
Lansing, Michigan 48909-8311

Re: Feedback on the Cornwell Engineering Benton Harbor Corrosion Test Plan

Dear Mr. Oswald:

The U.S. Environmental Protection Agency appreciates Michigan Department of Environment, Great Lakes, and Energy's (EGLE's) September 8, 2021, request for technical assistance including review of the Benton Harbor Corrosion Test Plan, which you provided on September 23, 2021. On September 30, 2021 and October 7, 2021, EPA informally summarized feedback based on review by EPA scientific experts and technical staff. Subsequently, Cornwell Engineering provided a revised Corrosion Test Plan, dated October 22, 2021, which EGLE provided to EPA on November 4, 2021.

The attached feedback is in light of information EGLE has provided to EPA, including during our phone call on September 30, 2021. Specifically, EPA understands that EGLE intends to supplement the Cornwell Engineering Benton Harbor Corrosion Test Plan with other sampling and data evaluation to assess the potential for interferences from legacy lead service line (LSL) pipe scale or other underlying causes of elevated lead in drinking water. As such, we are providing some recommendations on how the proposed corrosion control treatment (CCT) study can be supplemented by these important pieces of information. We request that EGLE provide EPA with a written explanation of EGLE's approach to evaluating the CCT study in response to these recommendations by December 31, 2021 or propose an alternate date for a reply.

We look forward to continuing to work with EGLE to support and monitor the development of long-term solutions to water issues in Benton Harbor. If you want to discuss this information further, please contact me at 312-353-2106 or bauer.candice@epa.gov.

Sincerely,

CANDICE BAUER Digitally signed by CANDICE BAUER
Date: 2021.11.23 16:54:25 -06'00'

Candice Bauer
Manager, Ground Water and Drinking Water Branch

Enclosure

cc: Ernie Sarkipato, EGLE [via email]
Brandon Onan, EGLE [via email]

Compiled EPA ORD/Region 5 Feedback on the Cornwell Engineering Benton Harbor Corrosion Test Plan, dated 9/16/2021 and received by EPA on 9/23/2021, and the revised plan dated 10/22/2021 and received by EPA on 11/4/2021.

Coupon study approach – We understand that the fresh metal coupon study approach in this corrosion control study plan will be used by Michigan Department of Environment, Great Lakes, and Energy (EGLE) and the City to confirm findings from the literature and solubility modeling. In particular, the lower pH (7.8) included in the study plan would be expected to result in lower lead release from these fresh surfaces. As noted by EPA's 2016 Optimal Corrosion Control Treatment (OCCT) Evaluation Technical Recommendations (Updated 2019) guidance, orthophosphate is generally most effective when pH is in the range of 7.2 to 7.8, and systems should avoid operating between pH 8 and 8.5, if possible, to control for lead release. The higher orthophosphate tests (above the current dose of 3 mg/L orthophosphate) may also show some benefit in reducing lead release from fresh metal coupons, similar to results expected in the literature and solubility modeling.

As discussed with EGLE on 9/30/2021, this fresh metal coupon study approach may be beneficial in evaluating corrosion control effectiveness for other lead-containing plumbing materials (i.e., leaded brass/solder), which are expected to still be in the system after all lead service lines (LSL) are removed. EPA Region 5 is glad to see that the 10/22/2021 revised plan includes brass coupons instead of only the single metal lead coupons in the original plan. We strongly encourage EGLE to consider requesting the corrosion control study include testing leaded-solder coupons to evaluate corrosion control for other interior plumbing lead sources if possible in light of the study's schedule.

EGLE should also consider how it will determine the sensible and best dosage for minimizing lead from non-LSL sources, while at the same time, performing well with LSLs in place until they can be fully removed. For example, if there is a decrease in lead release for the 4 mg/L dose compared with the 3 mg/L dose, an additional set of coupons testing higher dose(s), such as 5 mg/L, would be appropriate to properly determine the point of diminishing returns.

Coupon studies do not assess impacts of the corrosion control treatment, or any other water quality changes, on existing pipe scales within the distribution system. For example, lowering the pH from the level the premise plumbing and distribution system have been exposed to for many years or even decades cannot be simulated by fresh coupons because they do not contain the scales that naturally build up over time. While pH impacts lead solubility, it also impacts the stability of the scale. As a result, in some water systems, water quality changes such as lowering the pH have caused particulate lead spikes from the destabilization or solubilization of the existing pipe scales. Similar concerns can be raised for changes in other water quality parameters including calcium, inorganic carbon and phosphate. Additional areas of study outlined below are recommended to augment the coupon study and help the City and EGLE determine long-term steps to lower lead levels throughout Benton Harbor.

Underlying cause evaluation – In other water systems, EPA has observed that legacy LSL pipe scales can cause significant lead spikes if the legacy scale is deteriorating, and that legacy pipe scales such as lead(IV) (i.e., PbO_2, plattnerite) or poorly-defined calcium-rich scales containing accumulated lead may interfere with the speed of lead(II) phosphate scale formation and stabilization.

- Historical water quality data review – EGLE has indicated that it has closely reviewed historical water quality data for the years prior to the first lead action level exceedance (ALE) in summer/fall 2018, compared with recent water quality, and has not identified any significant water quality changes. The historical water quality data review portion of

the CCT study should consider available water quality data prior to 2018 (as early as available: e.g., chlorine, pH, alkalinity, total organic carbon, and as available: chloride, sulfate, fluoride, nitrate/nitrite, conductivity, hardness, calcium, magnesium, aluminum, iron, manganese, or other metals).

- Plumbing sources evaluation – EGLE and Michigan Department of Health & Human Services (MDHHS) have an existing dataset of approximately 46 homes where sequential sampling has been conducted (approximately 40 in 2019, 8 in 2020, and 12 in 2021). Resampling many of these homes, particularly where variables such as stagnation time and any seasonal impacts can be controlled, would be beneficial to understand the effectiveness of the current corrosion control treatment and improvements over time. EPA is working to conduct sequential sampling at up to 25 homes, based upon our current planning, and we understand EGLE/MDHHS is interested in such an evaluation; this could focus on sites where LSLs remain and/or high lead results have been previously found. Visual inspection of the home interior plumbing and private-side service line materials would help this evaluation, so that relative contributions of lead solder, leaded brass, galvanized pipes, and LSLs can be better understood. The plumbing sources review portion of the CCT study should consider available field notes from MDHHS sampling in Benton Harbor in 2019-2021 and available field notes from the City's LSL inventory and replacement activities, as well as any information gathered by EPA and shared with Michigan.
- Particulate lead evaluation – EGLE and MDHHS have an existing dataset of approximately 18 homes where total and dissolved [<0.45 µm] sampling has been conducted in 2020 and 2021. EGLE, MDHHS, and EPA are planning additional data collection efforts, including to assist with understanding if lead release is primarily soluble or particulate; having such a data set will be instrumental in making recommendations for corrosion control moving forward.

Lead service line pipe scale analysis – Given the relatively short time (relative to mineral formation timelines) that phosphate corrosion inhibitors have been used in Benton Harbor, legacy pipe scale layers are likely still present to some extent and quality LSL pipe scale analysis can be another useful tool to understand corrosion control effectiveness. The 9/16/2021 Cornwell Engineering Corrosion Test Plan includes, for an additional fee, pipe scale analysis including X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) /Energy Dispersive Spectroscopy (EDS) and Scanning Electron Microscopy (SEM) /Wavelength Dispersive Spectroscopy (WDS). As discussed with EGLE on 10/8/2021, EPA Office of Research and Development (ORD) has offered to provide assistance to the City and state by providing analysis of the pipe scale. Scale analysis is not mentioned in the 10/22/2021 Revised Test Plan. We strongly recommend that EGLE work with the City to send pipe samples to ORD in an expedient fashion so that results of this analysis can be used to inform the CCT study as it proceeds. ORD can provide additional information about site selection and pipe extraction and transportation.

Reliance on phosphoric acid for both pH control and corrosion inhibitor – Careful evaluation is needed to understand what range of doses of phosphoric acid will be needed to meet the appropriate pH target or range in Benton Harbor. For example, care must be taken to ensure addition of phosphoric acid to achieve the required orthophosphate dose would not bring the pH below the optimal range and/or potentially affect pipe scale. Additionally, if the Benton Harbor water quality would require significantly variable phosphoric acid doses to achieve the appropriate pH range (e.g., pH 7.2-7.8), EPA strongly recommends the City implement alternatives (e.g., infrastructure changes to allow multiple chemical feeds) to achieve consistent

water quality that meets pH as well as orthophosphate objectives. Fluctuations in water quality could lead to deposition or dissolution issues.

Implementation Plan - As noted during the 9/30/2021 call, for the corrosion control study and any add-on pipe scale analysis to be useful to Benton Harbor, the City will likely need assistance in developing an implementation plan for any recommended adjustments in the water plant and/or water distribution system operations. EPA is glad to see the 10/22/2021 revised plan includes technical interpretation and recommended next steps for the consultant's deliverable(s). We recommend the consultant include rationale for assuming the lead coupons reflect distribution system conditions, as well as practical concerns such as setup of chemical feeds and any improvements needed in flow-paced pumps. In addition, the City should carefully consider a transition plan for conversion from blended phosphate to phosphoric acid, if selected, or for implementing other pH adjustment.

Monitoring Plan – EPA strongly recommends the development and implementation of a plan to monitor CCT effectiveness in Benton Harbor over time. This would include monitoring of distribution system water quality, follow up monitoring of lead in a subset of locations including both homes with LSLs and other leaded plumbing materials, and potentially bench or pilot-scale testing to address specific issues. This type of monitoring would ensure that the expected effects of CCT occur and are documented, the correct information is available if the CCT needs to be adjusted, any changes in water quality are identified quickly, and actions can be taken quickly to address any problems that arise.