From: Sygo, Jim (DEQ)
Sent: Friday, October 23, 2015 5:17 PM
To: Busch, Stephen (DEQ);Prysby, Mike (DEQ);Cook, Pat (DEQ);Shekter Smith, Liane (DEQ)
Subject: FW: Flint WTP PH2 SEG4 - Corrosion Control

This is Bob Kaplan's latest note. Let me know if you have any concerns with the highlighted additions.

From: Kaplan, Robert [mailto:kaplan.robert@epa.gov]
Sent: Friday, October 23, 2015 4:23 PM
To: Sygo, Jim (DEQ)
Subject: RE: Flint WTP PH2 SEG4 - Corrosion Control

Jim –

We are very close. I checked with the Task Force on the plan you sent to us incorporating EPA's comments. See annotations below. There are several changes (in red italics) that EPA feels need to be incorporated into the text to reflect our earlier comments (from Mike and Darren) and the subsequent call. Additionally, there is a recommendation at the end that was discussed but not incorporated into the writeup you sent which we also feel should be incorporated.

Please feel free to get back with me if you have any questions. We appreciate the opportunity to provide input and your willingness to address our comments.

- Bob

This will summarize our phone conversation of 10/19 and provide clarification regarding the previous comments.

The City of Flint converted back to purchasing of Detroit Water and Sewerage Department water on Friday October 16, 2015. No indications of upset in the distribution system have been reported to date.

Detroit Water and Sewerage Department (DWSD) has confirmed the use of Innophos "Phosphoric Acid 75% Technical" product which is NSF Standard 60 certified with a maximum allowable feed rate of 13 mg/L as product.

The City of Flint will need to supply a similar phosphoric acid product, NSF Standard 60 approved with allowable maximum dosage.

DWSD supplied water is currently dosed at 0.39 mg/L as P (1.2 mg/L as PO4) slightly above DWSD's OCCT requirement to dose a minimum of 0.9 mg/L as PO4 and have a minimum plant tap residual of 0.8 mg/L as PO4. DWSD plant tap residuals have been shown to consistently be at 0.39 mg/L as P (1.2 mg/L as PO4). In addition water supply entering Flint has been tested and so far shown to contain approximately 0.39 mg/L as P (1.2 mg/L as PO4) as well. *Flint will need to test to ensure that pH is not significantly affected at the PO4 target dosage.*

To achieve pipe passivation Flint will boost orthophosphate dosage to establish a minimum distribution residual of 1.0 mg/L as P (3.1 mg/L as PO4). The chemical feed system will be sized to achieve a dose up to 2.0 mg/L as P (6.1 mg/L as PO4) in case orthophosphate loss is observed.

Flint will continue Water Quality Parameter Monitoring in accordance with the LCR at the same 25 distribution locations used under the Flint River. In addition 10 of these locations also serve as total coliform monitoring sites, including

disinfectant residual, and Flint will be told to, for the purpose of assessing water stability, conduct water quality parameter monitoring *for pH, alkalinity, orthophosphate*, along with turbidity and iron sampling will be at these 10 locations on a weekly basis as suggested. This will also ensure that a minimum recommended pH levels are being maintained throughout the system.

EPA ORD staff will provide instructions to the City of Flint for creating test loops to help confirm effectiveness of the corrosion control treatment. This data will help in rebuilding public trust.

The County Health Department and MI Department of Health and Human Services will be conducting blood lead level testing of children in Flint. Children with elevated blood lead levels will be offered exposure assessments of their homes. These assessments should include the contribution of lead from service line and interior plumbing sources. Such diagnostic testing should help further substantiate the effectiveness of corrosion control treatment. Procedures recommended by EPA should be shared with the Michigan Department of Health and Human Services.

The University of Michigan in Ann Arbor had previously expressed interest in assisting the City of Flint. Both the Department of Civil and Environmental Engineering, and School of Public Health should be contacted to determine if that interest still exists with potential to assist in both test loop construction and monitoring, and exposure assessment monitoring in homes. Any water analysis should occur at a certified laboratory.

The City will be required to complete a 6 month round of lead and copper compliance monitoring in the January – June 2016 period. The City continues to offer all residents a first draw lead sample collection and analysis. Any additional staggered monitoring suggestions should be brought before the City's Technical Advisory Committee.

Criteria for deeming the treatment optimized must be established as the LCR only requires compliance with the lead and copper Action Levels once this determination has been made.

The City of Flint is continuing to digitize service line index card records into a Geographic Information System to confirm the location of lead service lines. EPA can provide additional information to the City regarding a sampling procedure to verify lead service line sites.

The City's engineering consultant will need to evaluate KWA water in conjunction with the City of Flint treatment plant processes to determine any necessary adjustments in optimized corrosion control treatment prior to initiating service to customers. Full scale testing may not be feasible.

Lastly, we discussed additional lead drinking water monitoring Flint should do to better assess lead exposure, determine effectiveness of water source change and corrosion control, and identify lead sources. That discussion does not appear to be captured here.

Robert Kaplan
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Cell: PPI
Fax: (312) 692-2075

From: Sygo, Jim (DEQ) [mailto:SygoJ@michigan.gov]
Sent: Friday, October 23, 2015 11:39 AM
To: Kaplan, Robert <kaplan.robert@epa.gov>
Subject: RE: Flint WTP PH2 SEG4 - Corrosion Control

Sounds Good.

Met with the Mayor today and he seems to be under the impression that the City Administrator is on this task force as well. I told him I would check but this was intended to make sure that the state and EPA are taking consistent technical positions. Let me know if I'm wrong about that.

From: Kaplan, Robert [mailto:kaplan.robert@epa.gov]
Sent: Friday, October 23, 2015 10:37 AM
To: Sygo, Jim (DEQ)
Subject: RE: Flint WTP PH2 SEG4 - Corrosion Control

Jim,

Thanks for the note. There does appear to be agreement. I will confirm that with the Task Force team members today just to make certain we haven't missed anything.

This is good news. I'm glad we're moving quickly, and working together. The Task Force will discuss the "test loops" and make sure we have agreement on the protocol.

I'm setting up a call for next week to discuss this weekend's school sampling effort.

- Bob

Robert Kaplan
Deputy Regional Administrator
U.S. EPA Region 5
Phone: (312) 886-1499
Cell: PPI
Fax: (312) 692-2075

From: Sygo, Jim (DEQ) [mailto:SygoJ@michigan.gov]
Sent: Thursday, October 22, 2015 4:39 PM
To: Kaplan, Robert <kaplan.robert@epa.gov>
Subject: FW: Flint WTP PH2 SEG4 - Corrosion Control

Bob,
There appears to be agreement on the optimization of corrosion control for the City of Flint. This is the note provided to me by staff after a discussion with members of your task force.

From: Busch, Stephen (DEQ)
Sent: Thursday, October 22, 2015 12:58 PM
To: Schock, Michael; Lytle, Darren
Cc: Kempic, Jeffrey; Prysby, Mike (DEQ); kaplan.robert@epa.gov; Krisztian, George (DEQ); Sygo, Jim (DEQ)
Subject: RE: Flint WTP PH2 SEG4 - Corrosion Control

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Stephen Busch, P.E.
MDEQ Lansing District Coordinator
Office of Drinking Water and Municipal Assistance
Lansing and Jackson District Supervisor
517-643-2314
buschs@michigan.gov

From: Lytle, Darren [mailto:Lytle.Darren@epa.gov]
Sent: Monday, October 19, 2015 12:05 PM
To: Prysby, Mike (DEQ)
Cc: Schock, Michael; Kempic, Jeffrey; Busch, Stephen (DEQ)
Subject: RE: Flint WTP PH2 SEG4 - Corrosion Control

Mike,

Thank-you for giving us the opportunity to review the city of Flint's corrosion control plan.

We believe it is necessary that Flint boosts orthophosphate dosage. Given that the distribution system has not received orthophosphate in over a year, we expect that orthophosphate will need to be boosted to 1) meet the demand of the distribution system, 2) reach the service lines and other lead-containing components in premise plumbing, and 3) accelerate lead reduction at the consumer's taps. Orthophosphate should preferably be added in the same form as the Detroit source which is phosphoric acid from our understanding. This is the proposed case here, however, a simple test should be performed to make sure that the pH is not impacted in a significant way at the desired target dose.

We have not been able to obtain comprehensive water quality data for the finished water characteristics of the Detroit water that will be fed to Flint, to assess ranges of major chemical characteristic fluctuations. However, based upon the email trail, Detroit water entering the Flint system appears to only contain around 0.4 PO4/L. This concentration range is entirely too low compared to that needed in studies presented and published in the last 20+ years that have focused on lead released directly from lead pipes, and the solubility of the most likely lead orthophosphate pipes scales. We also strongly feel that targeted dose of 0.8 mg PO4/L is also too low, for the very same reason. We would be glad to share with you numerous standard corrosion control and treatment reference works, best practices guides and published results from US and international lead corrosion control field and pilot studies. Secondly, the basis for that target (other communities using Lake Huron source use the same dose) is not scientifically derived nor does it consider water quality and the current state of Flint's distribution system. We have reviewed the original Detroit corrosion study and have seen some of the LCR monitoring data, and besides the fact that it did not directly pertain to this water source, few dosages were tested in the cited 1994 pipe loop study, and the higher dosage than the one implemented in the field currently was more effective. Based on the limited amount of data on the quality of Detroit water, what we know about the history of Detroit corrosion control, we think an orthophosphate residual of 3 to 4 mg PO4/L should be the minimum starting test target residual for pipe passivation. It is likely that, at least initially a higher dosage will be necessary to reach the far ends of the distribution system and sufficiently reduce lead solubility and release from all lead sources. To allow flexibility, we feel the design of the chemical feed and storage systems should be able to consistently deliver a maximum dose of 5 to 6 mg PO4/L, if substantial orthophosphate loss is observed, if the starting dose is set for the desired residual level of 3 to 4 mg/L as PO4. We suggest that jar tests be performed in advance of orthophosphate addition to Detroit water to evaluate the impact of

orthophosphate dose on turbidity that could result from interactions between orthophosphate and background Detroit water quality parameters (e.g., aluminum, calcium, etc.).

We want to stress that immediately shifting to Detroit water and adding orthophosphate will not necessarily translate to immediate improvements. Furthermore, this is a change, albeit a return to past conditions. Nonetheless, a period of system upset should be anticipated. The need for a communication strategy and a distribution system plan are critical.

Lastly, we see no mention of a water quality monitoring program. Two programs need to be put in place immediately (before return to Detroit water) to 1) identify lead sources, 2) assess treatment effectiveness against lead release from all of the simultaneously operating mechanisms (solubility, particulate release, galvanic corrosion), and 3) assess orthophosphate levels and stability of water quality in the distribution system.

There are multiple sources of lead in the Flint distribution system to the consumers' taps, such as: pipes; leaded brass; leaded solder; accumulations on old galvanized steel pipes; possibly accumulated on copper or some plastic pipes. It is critical that the fate of orthophosphate in the distribution system is understood, and how effective it is against each type of lead source, so dosing adjustment can be properly made. For this purpose, we recommend that a number of residences throughout Flint that meet the following plumbing criteria, be identified for an assessment of the contribution lead from the different potential service line and interior plumbing sources, through detailed mapping of plumbing materials, lengths, sizes, and location and type of inline devices and faucets using profile sampling. For confidence in interpretation, probably at least 5 sites from each of the configurations will be necessary. The configurations we would estimate to be most important (but should be changed or added to if local construction practice indicates it's necessary): Lead service line, galvanized steel interior plumbing; lead service line, copper with leaded solder joints; lead service line, plastic interior plumbing. It is also possible that interior plumbing may differ from the material used for the customer-side service line segment. We would be glad to discuss the specifics of this sampling effort.
For the purpose of assessing stability of water quality in the distribution system and to inform on orthophosphate residual adjustment, we suggest that 8 to 10 locations in the distribution system be selected to measure pH, alkalinity, orthophosphate, turbidity and iron on a weekly basis. These could be collected from TCR sampling locations, or other readily-accessible buildings, should be located at a distribution of locations in the distribution system and should be collected after a flush sufficiently long to assure that "fresh" distribution system water is being measured. Research has shown that over time, orthophosphate can reduce disinfectant demand associated with corroding metallic distribution system materials. These measurements need to be performed in the field and can simply be done with a portable HACH test kit or spectrophotometer.

A lead sampling plan needs to be in place to access the effectiveness of water change and treatment boost. LCR monitoring sites with confirmed lead service lines can be in the sampling pool. Sampling should consist of a 1 liter first draw sample (LCR sample without 5 minute pre-flush), followed by an additional flushed sample or two depending on profile sample results which is intended to capture major lead source(s). The specific details of this effort need to be worked out by the technical committee as soon as possible. We would gladly work with Flint on establishing a water sampling program to identity and verify lead service line sites. The plan and initial sampling effort should be performed before the switch so that one baseline sample set is collected.

Lastly, our strength does not fall under full-scale pump and chemical feed delivery systems. We would only say that the systems need to be scaled-up in size to accommodate our suggested dosing needs. Also, there is the some discussion about diverting water to the Dort reservoir and an associated orthophosphate feed system. We are not familiar with the reservoir but are wondering if it is an open reservoir?

Of course this is a lot of information to share and we would gladly be available to discuss the technical and scientific basis for our suggestions.
Let us know if you have any questions and thanks again,

Darren and Mike

Darren A. Lytle, Ph.D., P.E.
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26 West Martin Luther King Dr.
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Phone: (513) 569-7432
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email: lytle.darren@epa.gov

From: Prysby, Mike (DEQ) [mailto:PRYSBYM@michigan.gov]
Sent: Friday, October 16, 2015 1:32 PM
To: Lytle, Darren <Lytle.Darren@epa.gov>; Schock, Michael <Schock.Michael@epa.gov>
Cc: Busch, Stephen (DEQ) <BUSCHS@michigan.gov>
Subject: FW: Flint WTP PH2 SEG4 - Corrosion Control

Darren, Michael

We have received Flint's corrosion control proposal from their consultant. If you have comments, please provide them to me by Monday morning.

Michael Prysby, P.E.
District Engineer
Office of Drinking Water and Municipal Assistance
517 290-8817

From: Matta, Samir [mailto:SFMatta@lan-inc.com]
Sent: Friday, October 16, 2015 12:02 AM
To: Prysby, Mike (DEQ)
Subject: Flint WTP PH2 SEG4 - Corrosion Control

Hi Mike,

Please see attached plans for the Corrosion Control Plan for the City of Flint. I will have the official submittal package to you tomorrow afternoon after I get Brent or Mike's signature on the permit application. I will call you when I get back in Lansing to drop the package. Is three sets of full size plans adequate? Would you like some half size plans? Let me know.

Basis of Design

Given that Flint will require lead and copper corrosion control and given that Detroit utilizes orthophosphate for their corrosion control methodology, and that Flint will be receiving Detroit water for the immediate future, orthophosphate is the appropriate corrosion control methodology for Flint. A

dosage of 0.8 mg/l as PO_4 has been recommended for the Detroit water. Numerous utilities utilizing Lake Michigan water have a target dosage of 0.9 mg/l as PO_4. Therefore, a target dosage in the range of 0.8 to 0.9 mg/l appears appropriate.

It is expected that, at least initially, there will be a significant PO_4 demand in the system. This will require a significantly higher dosage until this demand is satisfied and the target residual can be maintained. We are therefore designing for capability of a maximum dosage of 1.5 mg/l.
The arriving Detroit water will likely have some residual PO_4 when it arrives at Flint. It has been reported that this residual will be approximately 0.4 mg/l. The system must therefore be capable of a minimum dosage of 0.4 mg/l.

Based upon the usage of 75% Phosphoric Acid and a flow range of 4 MGD to 25 MGD, with an average day of 16 MGD, the expected feed rate will be 1.35 to 32 gpd. Average Phosphoric Acid feed is expected to be 10.8 gpd, requiring 30 days storage of 325 gal.

Orthophosphate will need to be applied at two locations. Detroit water will enter the Flint system at Control Station CS2, and supplementary phosphate will be applied there. However, on occasion some incoming water may need to be diverted to the Dort Reservoir, bypassing CS2. This water would then be introduced to the system through High Service Pump Station PS4 and phosphate would be introduced at this location.

Please let me know if the information is adequate or you require additional information.

Thanks.

Samir F. Matta, PE
Team Leader

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