Technical Expert Working Group Conference Call

Friday December 4, 2009
10:00 – 11:30 a.m.

CALL SUMMARY

Attendees:

EPA Region 3 and contractors: Jennie Saxe, Laura Dufresne

EPA Office of Research and Development: Jonathan Pressman, Dave Wahman

The Washington Aqueduct and contractors: Tom Jacobus, Lloyd Stowe, Anne Spiesman, Shabir Choudhury, Vern Snoeyink, Vanessa Speight, Tasneem Hussam

DCWASA and contractors: Rich Giani, Maureen Schmelling, John Civardi, Steve Reiber

DC Department of the Environment: Collin Burrell, William Slade

Arlington County: Dave Hundelt

Agenda

There were no changes or additions to the agenda. The meeting agenda is included as Attachment A to this call summary.

Summary of Discussions by Topic Area

1. Washington Aqueduct pipe loop update

Mike Chicoine (Washington Aqueduct) distributed Aqueduct control pipe loop lead monitoring data to the TEWG via email prior to the conference call (Attachment B). Lloyd Stowe reported total and dissolved lead concentrations have continued to decline through the fall and winter of 2009 as compared to 2009 spring and summer values. This is consistent with previous yearly cycles showing a strong correlation between total lead and temperature.

Lloyd reported on the schedule for getting the new flow-through pipe loops up and running at both treatment plants. The pipe loop design for McMillan should be completed by mid-December, and the design for Dalecarlia is expected to be done by the end of December. Construction is scheduled to begin in late January.

2. Update on Washington Aqueduct treatment changes

The Washington Aqueduct contractors gave an update on the schedule for the upcoming treatment changes at both plants (conversion from gaseous chlorine to hypochlorite and the addition of caustic soda for pH control). Treatment changes at the McMillan plant are scheduled to begin in January, with changes at Dalecarlia to follow starting in March. The Aqueduct is assessing training needs and discussing how to phase in the treatment changes. Jennie Saxe noted that EPA approval of the changes (as required by the Lead and Copper Rule), will come soon.

3. DCWASA pipe loop update

Rich Giani distributed nearly 3 years (March 2007 – December 2009) of lead monitoring data from DCWASA's pipe loop to the TEWG via email prior to the conference call (Attachment C). He reported that lead levels in the pipe loops continue to be low, with values hovering around 3 parts per million (ppm).

4. DCWASA LCR update

DCWASA recently completed their latest round of Lead and Copper Rule (LCR) compliance monitoring. The 90th percentile for first draw samples was 7 ppb, with only one first draw sample exceeding 15 ppb. Rich Giani reported that only 8 homes had second draw samples exceeding 15 ppb, one of which was also the home with the first draw sample greater than 15 ppb. DCWASA investigated these 8 homes and found that 5 had galvanized iron pipe and associated high iron levels in the LCR samples.

5. Discussion on nitrification in DC distribution system and possible next steps

The issue as summarized in November 19, 2009 e-mail from Rich Giani, DCWASA

On November 19, Rich Giani e-mailed the TEWG a presentation that was given to the DCWASA board on the issue of nitrification in the DC distribution system (Attachment D). Rich asked the TEWG members to review the data in the presentation in preparation for the December 4 conference call. Rich noted in the cover e-mail that based on the data, DCWASA believes that localized biofilm activity is softening their cast iron main scales via the nitrification cycle. DCWASA has also observed a reduction in ORP levels due to chloramine reduction. Unidirectional flushing does not seem to be working and in many cases, seems to be making things worse by providing more food for the microorganisms as incoming chloramine breaks down rapidly.

The water quality departments from the Washington Aqueduct and its customers met to discuss the issue. Arlington County and the City of Falls Church are in the process of reviewing their data to determine if nitrification issues are also occurring in their distribution systems. One possible approach discussed at the meeting was to increase the

duration of the chlorine burn from one month to possibly 3 ½ months to knock out the biofilm activity and harden the iron scales.

Rich laid out possible benefits of and concerns regarding an extended chlorine burn. Possible benefits include:

- Removal of nitrite and excess free ammonia from the distribution system, starving the bacteria while disinfecting.

- Chlorine will raise the oxidation reduction potential (ORP) and harden the iron scales.

- Chlorine will disrupt the biofilm.

Possible concerns include:

- DBPs will increase; however, they are lowest in the winter and should remain well below EPA's MCLs.

- Lead could increase after an extended chlorine burn. DCWASA believes that this is unlikely, however, as two studies (EPA and WRF using DCWASA data) show the addition or phosphates prevents lead dioxide from reforming and therefore no substantial increase in lead.

Rich added that cold water will dampen the taste effects for the first few weeks of converting to chloramines.

Power point presentation for the DCWASA board

During the TEWG call, Rich discussed several slides from the power point presentation. Slide 3 shows total chlorine (10^{th} and 25^{th} percentile) from all hydrants sampled for customer complaints in a given year from 2006 through 2009. Rich pointed out that the total chlorine began declining in 2008 and dropped significantly in 2009. Slide 4 shows nitrite data (75^{th} and 90^{th} percentile) for hydrants sampled for customer complaints each year. Nitrite levels decreased from 2006 to 2008 but rose sharply in 2009, particularly the 90^{th} percentile value. Rich reported that DCWASA has experienced several total coliform (TC) positive results over the last several months. An evaluation of water quality data collected at each TC positive site revealed a trend of declining total chlorine residual levels and increased nitrite compared to the rest of the distribution system (data are shown in slides 6 and 7 of the presentation).

Rich Giani reported that DCWASA experienced many more discolored water complaints in 2009 compared to 2008. They have found high iron and low chlorine residuals in entire neighborhoods. DCWASA responds to discolored water complaints by sending a flushing crew. As shown in slides 11 through 13, flushing was not effective in some of the remote flushing zones and in some cases, made the discolored water problems worse.

Rich reported that ORP has also dropped in these areas of the system from around 450 mV to 350 to 400 mV, which he believes is softening the iron and contributing to the discolored water.

In the northern portion of the system, DCWASA has been experiencing water quality problems in a long 16-inch water main that traverses Rock Creek. The main was designed for fire flow needs, so normal flow through the pipe is very slow and water age is high. DCWASA conducted special flushing of this pipeline twice per week, 4 hours per day for 4 weeks to try to get fresh water into the pipeline. Samples from three hydrants were collected after each flush and analyzed for total chlorine, nitrite, iron, and other parameters. As shown in slides 15 and 16 of the DCWASA board presentation, chlorine levels could not be restored after 9 flushing events, and elevated nitrite persisted throughout the flushing effort. Iron increased after the last three flushing events (shown in slide 17), indicating scale disruption. Rich reported that DCWASA is observing this phenomenon in other areas of the system with low velocities, long residence times, and cast iron mains.

For these reasons, Rich Giani concluded that although nitrite levels are currently declining with the onset of colder weather, DCWASA is very concerned about the impacts of nitrification in their system next spring and summer.

Occurrence of nitrification in Arlington and Falls Church

Jennie Saxe forwarded to the TEWG an e-mail from Matt Jacobi of Falls Church City (no one from Falls Church was available to participate in the TEWG call). Matt reported that they have experienced some iron release issues in certain areas over the last couple of years, which coincides with DCWASA's experience. They have also observed some fairly limited (so far) indications of nitrification that do not appear to be a consequence of internal plumbing system characteristic at sampling taps.

Dave Hundelt of Arlington County reported during the call that although Arlington does not monitor as much as DCWASA or Falls Church, they have found possible indication of nitrification in one storage tank in September based on a comparison of data from the summer of 2008 and 2009. Arlington will be doing additional testing.

Technical discussion

Vern Snoeyink reported that his group has been reviewing the data and believe that the bulk water measurements are consistent with iron oxidizing conditions at the bottom of a nitrifying biofilm.

Jonathan Pressman found the results presented in slide 16 to be unusual, in particular that nitrite was higher after the flush than before the flush. What are the reasons for this? Rich Giani noted that DCWASA was never able to get more than 1.1 milligrams per liter (mg/L) total chlorine at the end of the 16-inch line, compared to between 2 and 2 ½ mg/L

total chlorine at the beginning of the line. Jonathan commented that this is an anomalous result that doesn't look like the classic nitrification event.

Lloyd Stowe and Rich gave the target disinfectant residual and ammonia levels for the system. The target total chlorine residual leaving the plants is 3.5 mg/L with a chlorine: ammonia ratio of 4.25 to 4.5. DCWASA typically sees 0.1 to 0.2 mg/L of free ammonia in the distribution system. DCWASA does not typically measure nitrate because they have never found much (it is typically around 1 or 2 mg/L). In response to a question from the TEWG, Rich noted that the one-month chlorine burn that began in 2006 was initially effective in reducing nitrite and microbial activity (as measured by heterotrophic plate count, HPC) in the distribution system.

Dave Wahman asked about the consequences of the chlorine burn to lead levels at customer's taps. Rich responded that since the application of orthophosphate, they have not observed any change in lead levels after the 1-month chlorine burn. Jonathan Pressman asked about DCWASA's experiences during previous burns. How long does it take for free chlorine to rise in all areas of the system? It takes about 2 weeks to get above 3 mg/L in the far reaches of the DC system. This is consistent with their maximum water age of about 10 days.

Jennie Saxe relayed comments from Mike Schock regarding the issue. Mike suggested an independent review by experts familiar with distribution system nitrification (Drs. Anne Camper, Montana State; Lutgarde Raskin, Univ. of Michigan; Fran DiGiano, NC State) and unidirectional flushing (Melinda Friedman, Confluence Engineering; Abigail Cantor, Process Research Solutions; and Gregg Kirmeyer, HDR) might be helpful. He also indicated that more practical research was needed related to chloramines and use of phosphates for corrosion control, with respect to microbial growth,

Mike's opinion was that there doesn't appear to be good data to support the idea that you can permanently kill/stop nitrification long-term, once the organisms have colonized the old, complex, porous distribution system scales. Usually, in northern climates, winter is an important part of the "control" cycle, sometimes in conjunction with optimizing NH3:Cl2 ratios and occasional free chlorine burns, however he's not sure to what degree phosphate aggravates this. For a long time, the thought was that the phosphate groups on the iron pipes out-competed nutrient NOM for the surface sites, helping control simple biofilm growth. However, nitrification may be a different and more complicated situation.

Jonathan Pressman stated that he believes that the Washington Aqueduct and its customers are on the right track to extend the chlorine burn. One month might not be long enough because chlorine is initially consumed at the biofilm surface. Based on new laboratory research on nitrifying biofilms using microelectrodes , ORD has found that it takes 3 to 5 days for chlorine to penetrate to the bottom of the biofilm, and this is on a polycarbonate slide. Vern Snoeyink pointed out that the time could be significantly longer in a real system with biofilm growing on an iron surface, which is a much more reducing environment.

Rich Giani asked the group about the possibility of using chlorite for the control of nitrifying biofilms. Jonathan Pressman responded that based on Mike McGuire's research, chlorite is helpful to controlling nitrification prior to an event; however, once the event occurs, it has little effect. Chlorite should be considered on a preventative basis (after a chlorine burn). Jonathan recommended pilot testing in pipe loops or in a small area of the distribution system to test chlorite before full scale application, stating there is just not enough full-scale data available to be confident about its effectiveness. Rich noted that he would prefer to start with an extended chlorine burn and consider chlorite later.

Anne Spiesman asked if there were other approaches they could use to prevent nitrification in the DCWASA system. Vern responded that other than removing more precursors at the plant and switching back to free chlorine, the only thing DCWASA could do on a preventative basis is to try to keep water moving at the ends of the system to reduce excessive water age. Vanessa Speight added that based on utility experience in Florida, flushing has been more helpful than chlorine burns. Rich noted that DCWASA unidirectionally flushes about 50 percent of its system every year. The group discussed lining and pipe replacement efforts. Although DCWASA prioritizes pipe lining and replacement projects based on water quality, much of the system is unlined cast iron pipe and it is impossible to line or replace it quickly.

Recommendations from the TEWG

Rich and Jennie Saxe concluded that in general, the TEWG supported the extended chlorine burn.

Rich discussed starting the burn in mid to late January, 2010. Dave Hundelt requested starting in mid-February and extending the chlorine burn into May, 2010 so that Arlington County can more easily flush their system during the burn period. Rich said that he would check DBPR data for May, but that he was generally OK with the burn starting in February.

6. Schedule for next year's calls

Jennie Saxe will set up another TEWG call in early January in case the TEWG needs to meet again before the extended chlorine burn begins. Jennie will also set up regular quarterly TEWG calls for 2010.

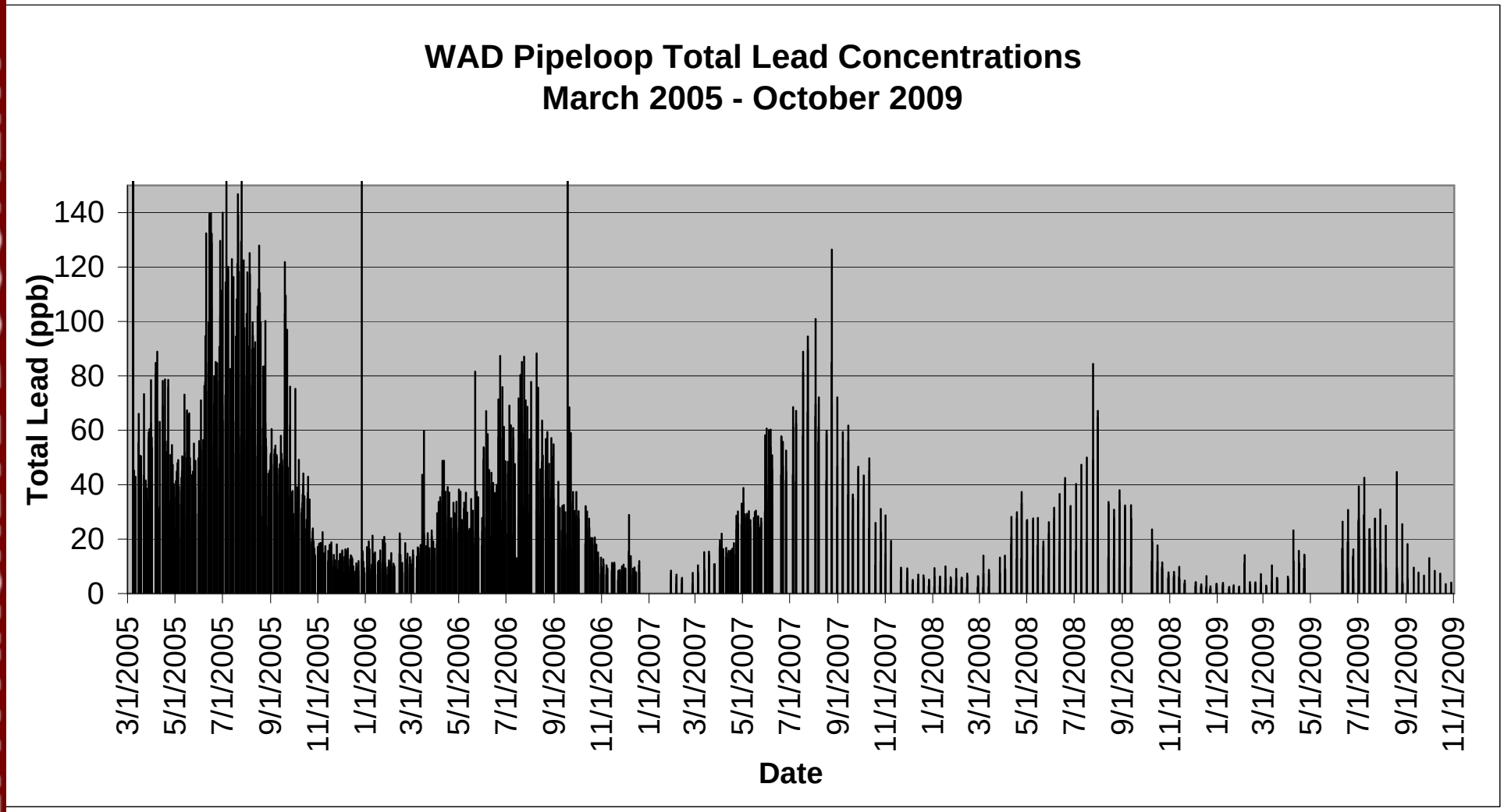
List of Attachments

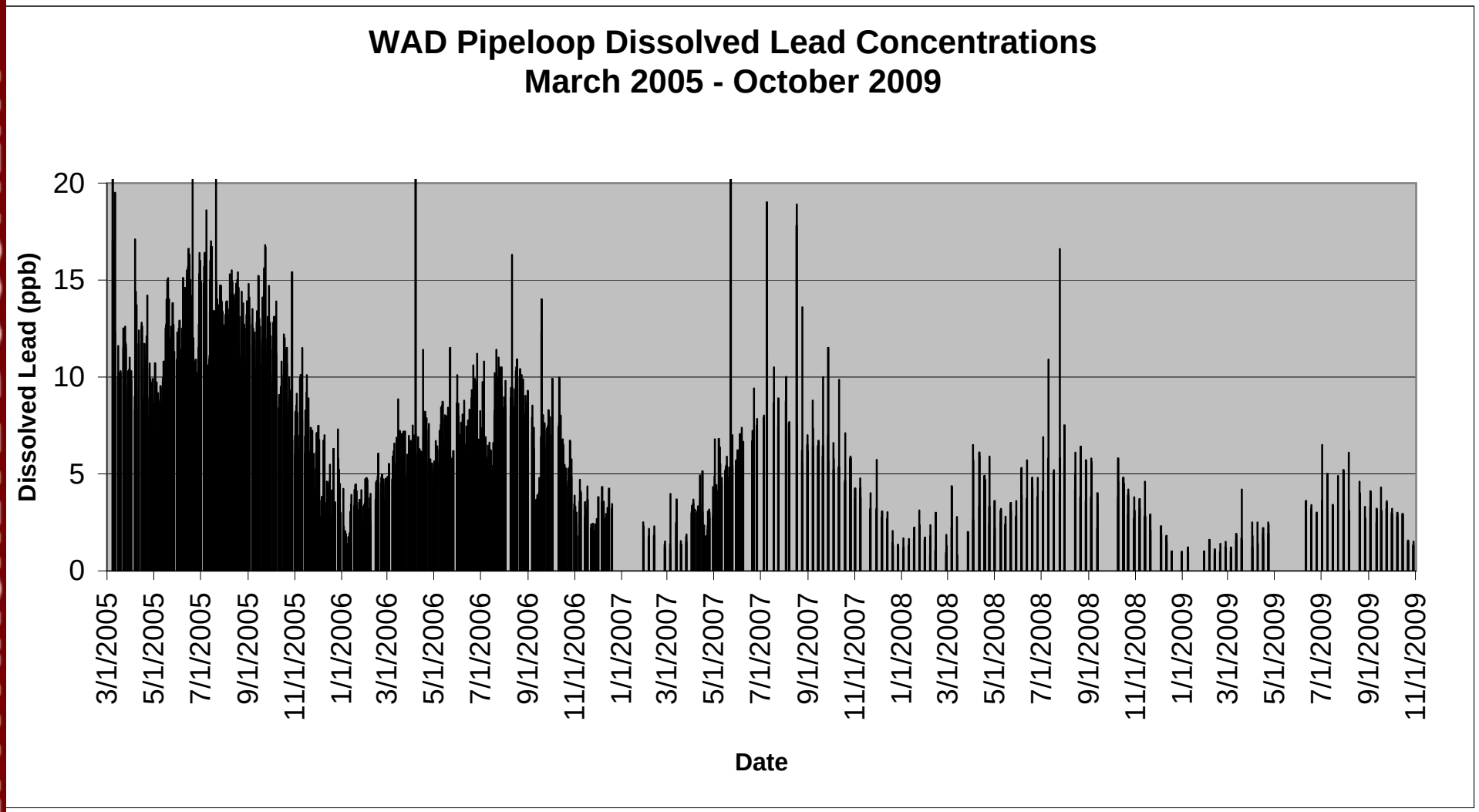
Attachment A: Call Agenda
Attachment B: Washington Aqueduct Pipe Loop Data
Attachment C: DCWASA Pipeloop Data
Attachment D: Nitrification Analysis Presentation 11-19-09

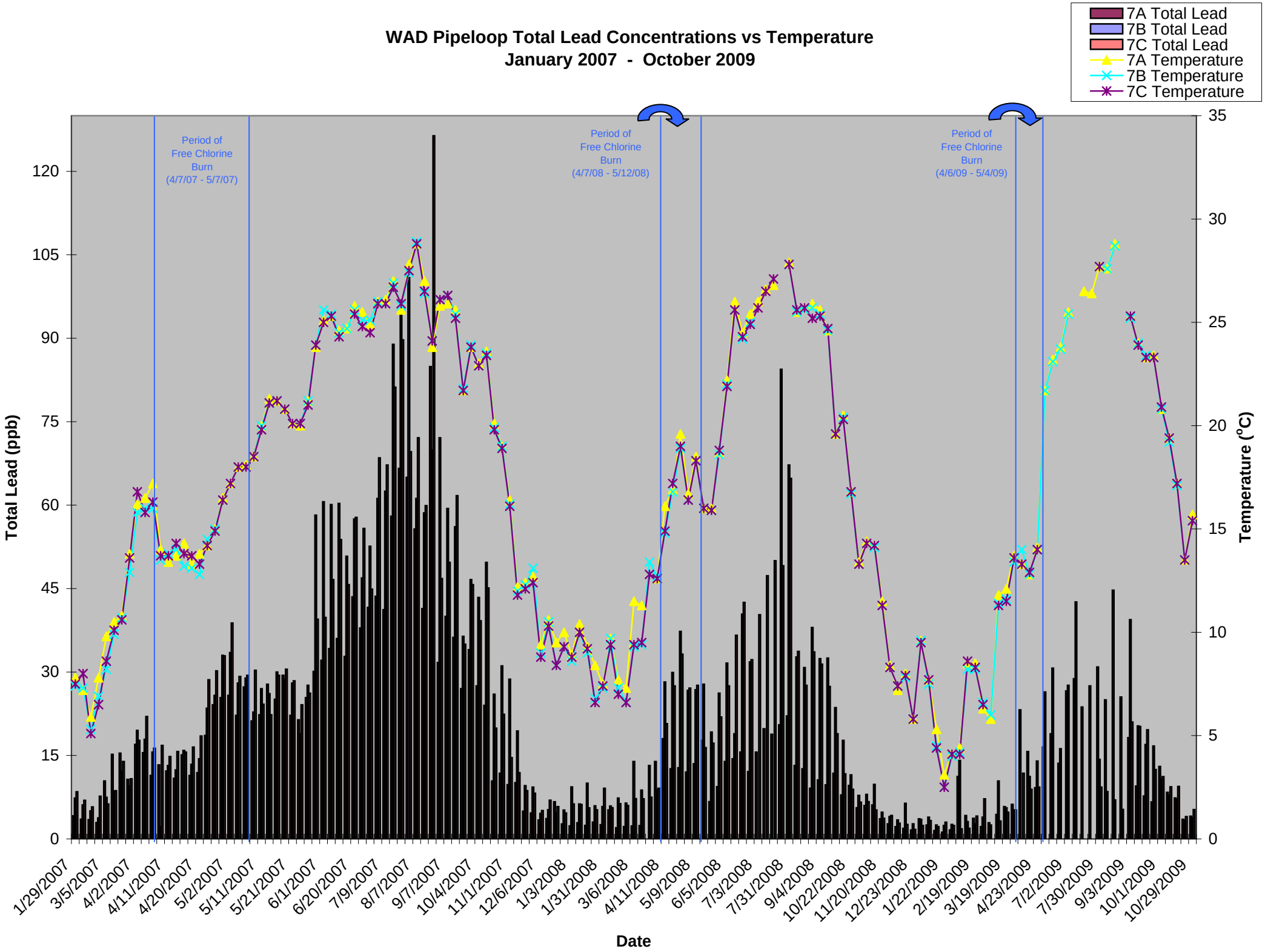
Attachment A: Call Agenda

* Washington Aqueduct pipe loop update
* Update on Washington Aqueduct treatment changes
* DCWASA pipe loop update
* DCWASA LCR update
* Discussion on nitrification in DC distribution system and possible next steps
* Schedule for next year's calls

Attachment B: Washington Aqueduct Pipe Loop Data






WAD Pipeloop Total Lead Concentrations vs Temperature
January 2007 - October 2009
7A Total Lead
7B Total Lead
7C Total Lead
7A Temperature
7B Temperature
7C Temperature
Period of Free Chlorine Burn (4/7/07 - 5/7/07)
Period of Free Chlorine Burn (4/7/08 - 5/12/08)
Period of Free Chlorine Burn (4/6/09 - 5/4/09)
Total Lead (ppb)
Temperature (°C)
Date
0
15
30
45
60
75
90
105
120
0
5
10
15
20
25
30
35
1/29/2007
3/5/2007
4/2/2007
4/11/2007
4/20/2007
5/2/2007
5/11/2007
5/21/2007
6/1/2007
6/20/2007
7/9/2007
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7/3/2008
7/31/2008
9/4/2008
10/22/2008
11/20/2008
12/23/2008
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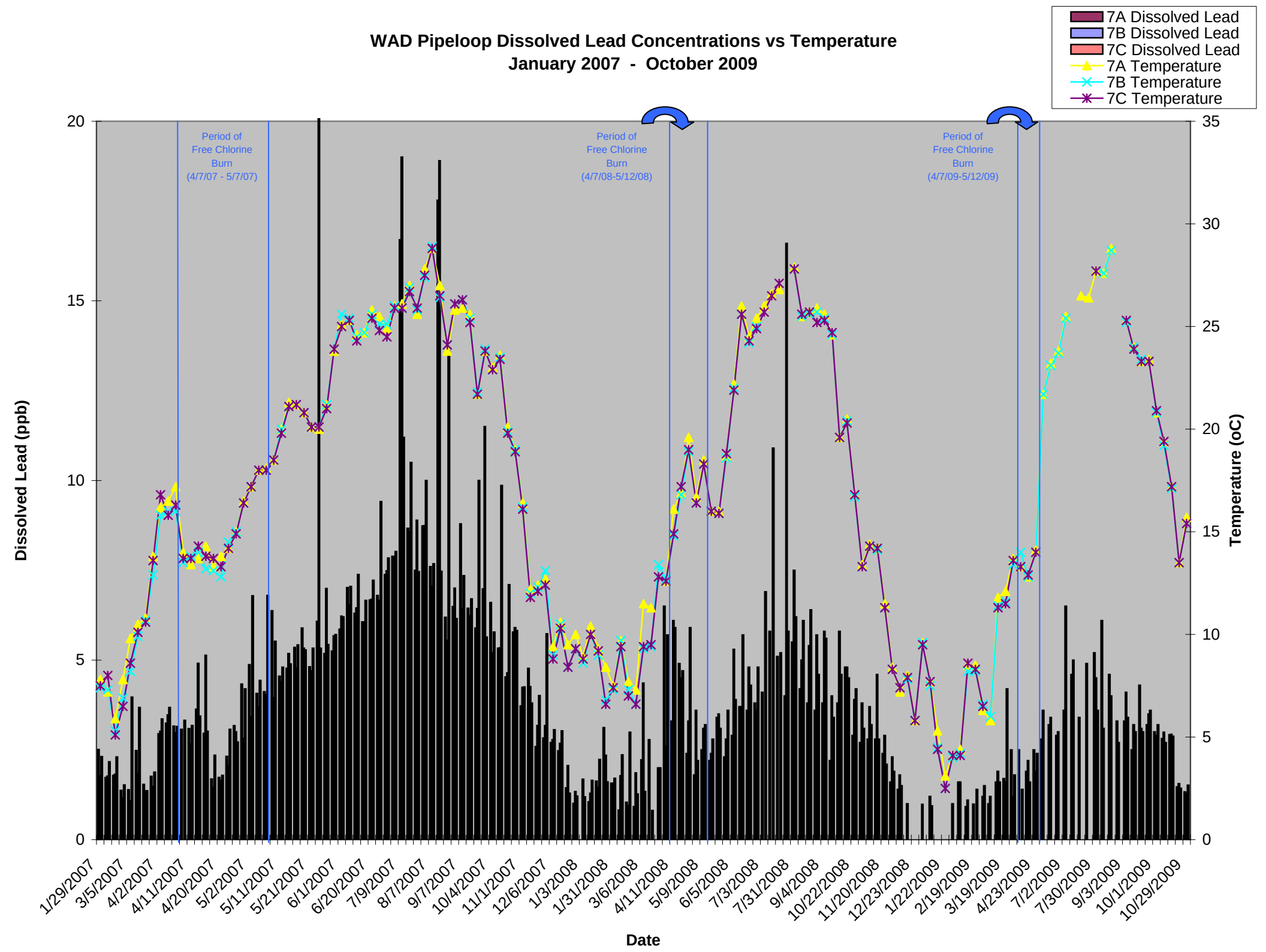
9/3/2009
10/1/2009
10/29/2009


WAD Pipeloop Dissolved Lead Concentrations vs Temperature
January 2007 - October 2009
7A Dissolved Lead
7B Dissolved Lead
7C Dissolved Lead
7A Temperature
7B Temperature
7C Temperature
Period of Free Chlorine Burn (4/7/07 - 5/7/07)
Period of Free Chlorine Burn (4/7/08-5/12/08)
Period of Free Chlorine Burn (4/7/09-5/12/09)
Dissolved Lead (ppb)
Temperature (oC)
Date
0
5
10
15
20
25
30
35
1/29/2007
3/5/2007
4/2/2007
4/11/2007
4/20/2007
5/2/2007
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11/20/2008
12/23/2008
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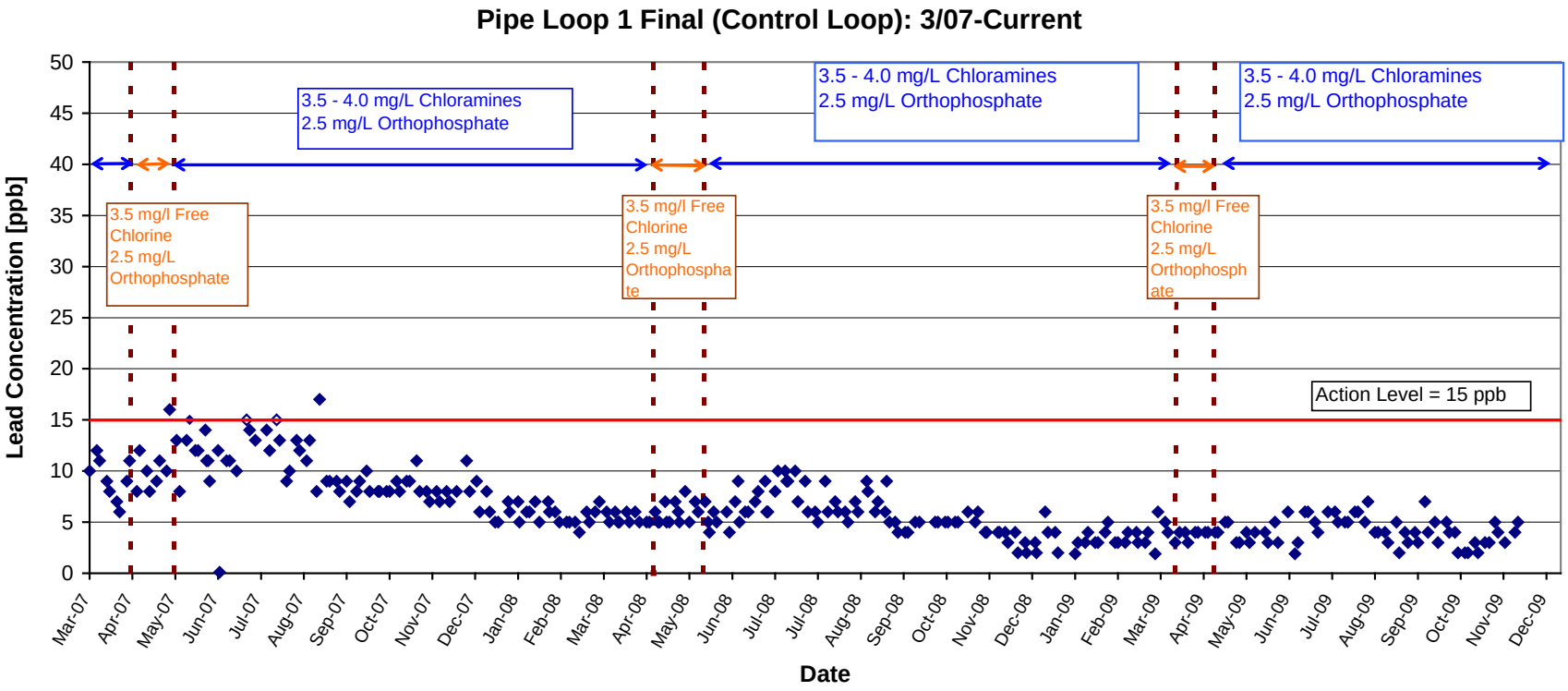
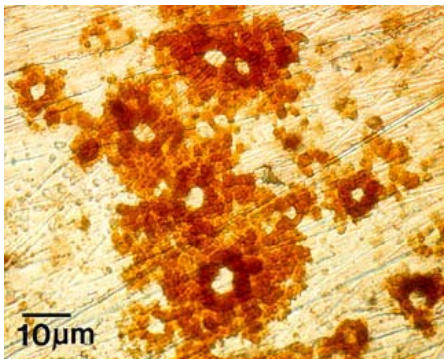
9/3/2009
10/1/2009
10/29/2009

Attachment C: DCWASA Pipe Loop Data



Attachment D: Nitrification Analysis Presentation 11-19-09

Nitrification Analysis on Cast Iron Mains in DCWASA System



Biofilm on steel pipe wall, as seen through an electron microscope

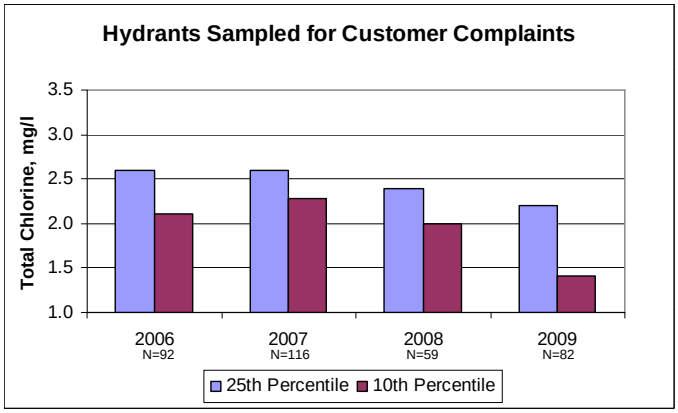
1

Nitrification Concerns

- If Nitrification cycle is in “full-swing”:
  - Chloramine levels will deplete to near zero
  - Nitrite will increase in the hundreds of ppb
  - Flushing becomes ineffective to restore chlorine residual

2

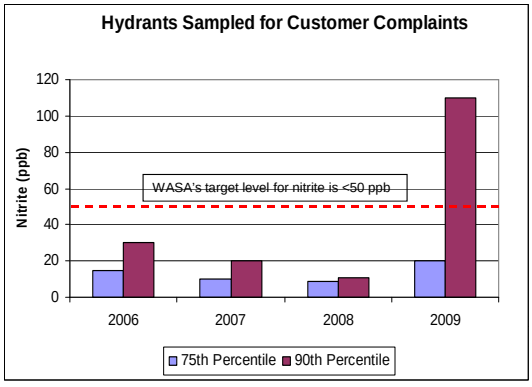
Total chlorine levels in Hydrants 2006-2009



Chlorine levels have been depleting over time during the summer months.

3

Nitrite Levels in Hydrants



- Nitrite levels have increased tremendously in 2009 indicating a significant increase in nitrification and biofilm activity.
- Frequent occurrence in the distribution system (hydrants) indicates the current water chemistry will continue to feed the nitrification cycle.

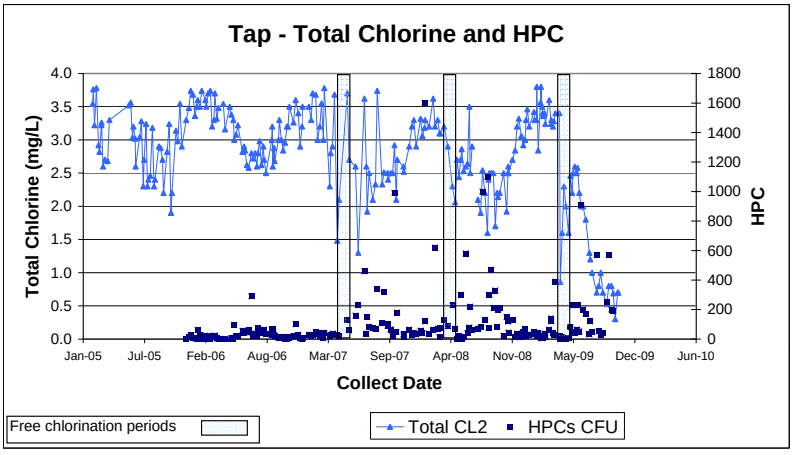
4

Secondary Impacts from Nitrification

- As biofilms grow, the potential for total coliform positive samples will also increase.
- WASA's recent total coliform positive sample was most likely due to increased nitrification.

5

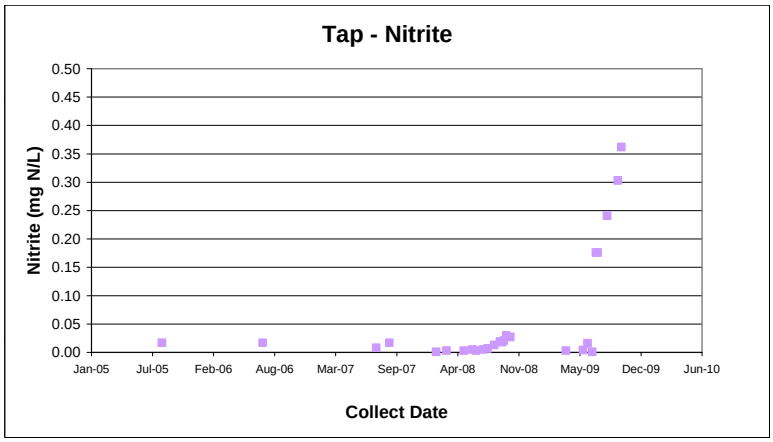
TCR Positive – Site Analysis at Tap



- Chlorine levels could not be maintained at the tap in summer 2009.

6

Same Site—TCR Positive Tap Analysis



- Note: WASA tests for nitrite when HPCs are elevated or chlorine is low. Therefore, more nitrite data was collected in 2008 and 2009 than earlier years.

7

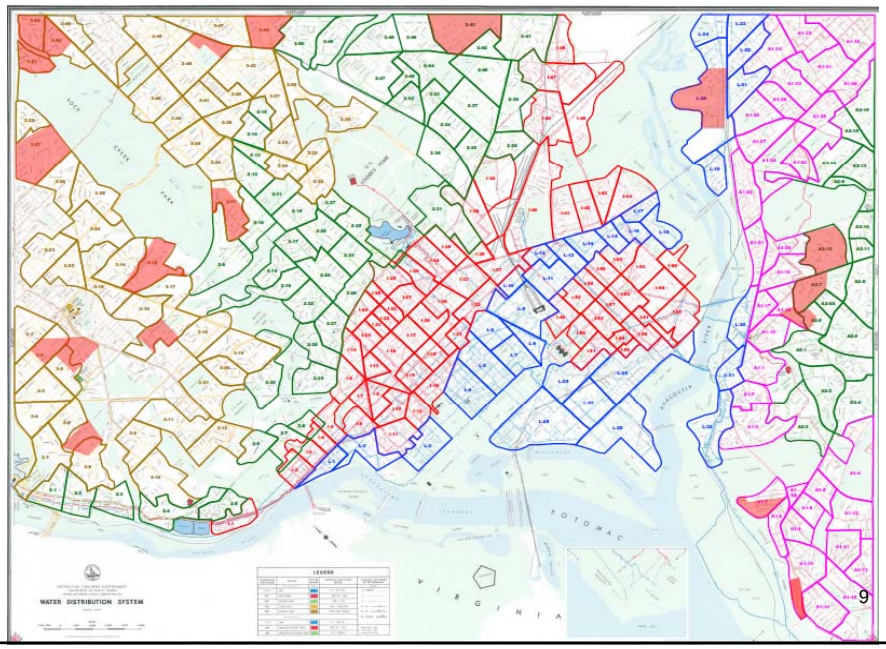
Nitrification in Cast Iron Mains

- Impacts:
  - Increased discolored water complaints
  - Very low chlorine residuals
  - Potential increase in total coliform.
  - Elevated Nitrite levels

    Possible link to increased sewer odor complaints in sinks
  - Flushing is no longer effective

8

2008-Map showing area-wide iron and low chlorine issues



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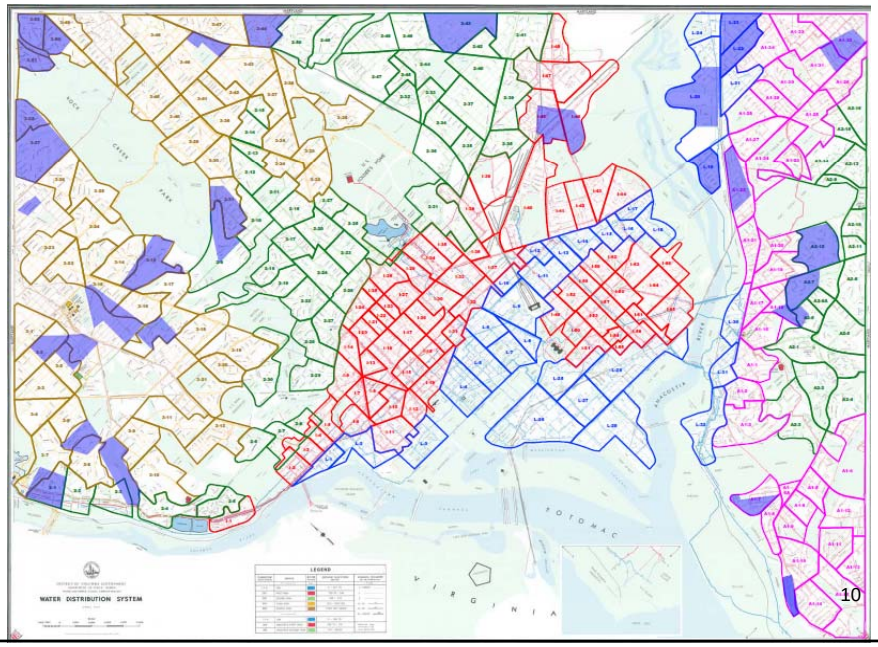
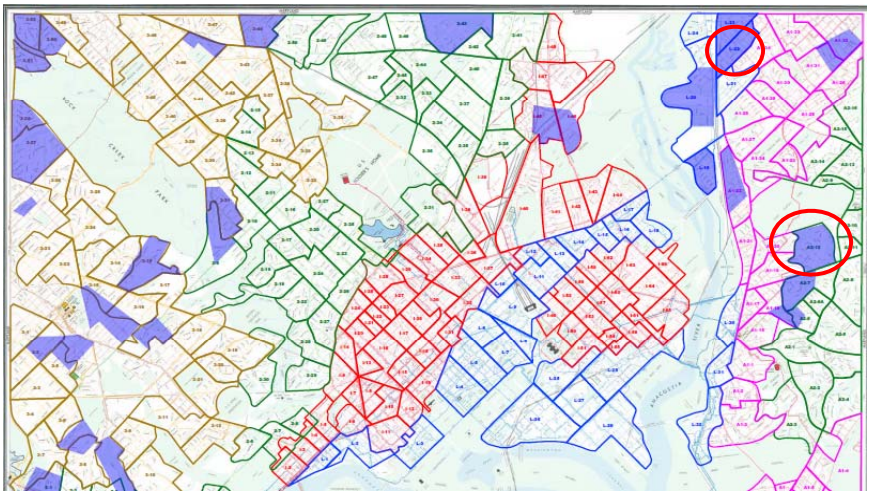
2009 -Map showing area-wide iron and low chlorine issues



10

Zone Flushing Not Effective

(Zones A2-12 and L-22 Examples)



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Before and After Zone Flush

Zone A2-12

	Iron (mg/L)		Chlorine (mg/L)		Nitrite (ppb)	
Hydrant	Jul-09	Oct-09	Jul-09	Oct-09	Jul-09	Oct-09
H06154	5.9	9.1	1.6	1.4	64	103
H02283	1.8	2.7	1.4	0.2	90	199
H05542	1.5		1.0		171	
H05255	4.0	10.0	0.8	0.6	218	142
H05252	3.2	7.5	0.2	1.2	360	86
H04415	2.8	24.6	1.6	0.8	77	8
H04313	2.2		0.3		360	
H04548		3.2		2.4		33

- Zone flushing completed Sept 15th and sampled Oct 28th.
- Elevated nitrite (> 50 ppb) indicates nitfrication activity.
- High iron levels found after flushing indicate scales are soft.
- EPA secondary MCL for iron is 0.3 mg/L

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Before and After Zone Flush

Zone L-22

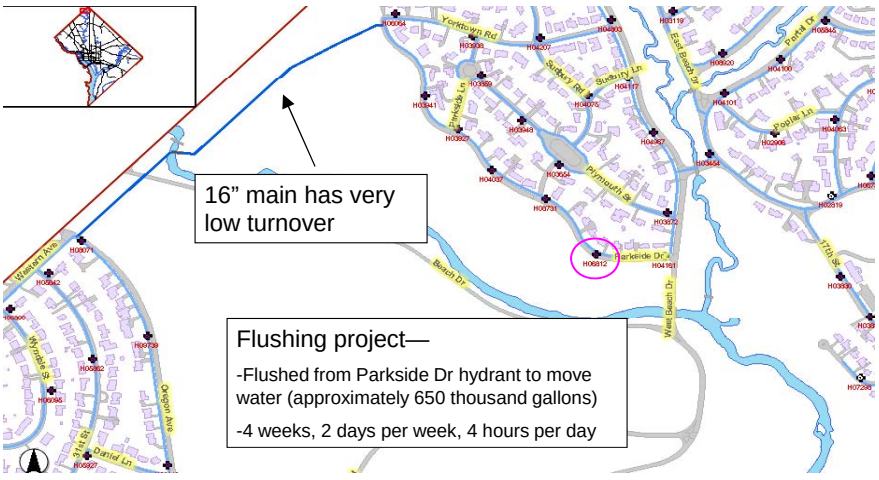
Hydrant	Iron (mg/L)		Chlorine (mg/L)		Nitrite (ppb)	
	Jun-Jul 09	Sep-09	Jun-Jul 09	Sep-09	Jun-Jul 09	Sep-09
H08025		2.7		0.2		254
H07743		24.1		0.3		90
H05685		12.0		0.8		111
H06264		10.1		0.5		129
H06265		33.0		0.2		0
H05684	2.5	17.7	0.9	0.2	165	32
H06260	1.8	12.9	0.8	0.2	107	4
H05551	0.9	33.0	1.1	0.1	75	60
H05552	7.2	33.0	0.4	0.3	278	180

- Nitrite > 50 ppb indicates nitfrication activity.
- High iron levels found after flushing indicate scales are soft.
- Near zero chlorine residual may be indicative of nitrification.

13

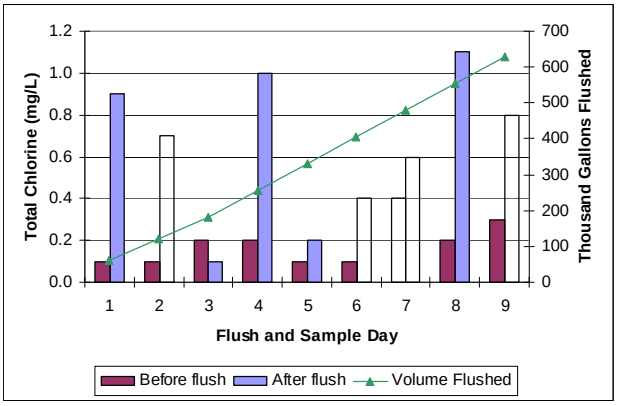
Nitrification Flushing Project

Zone 3-52



14

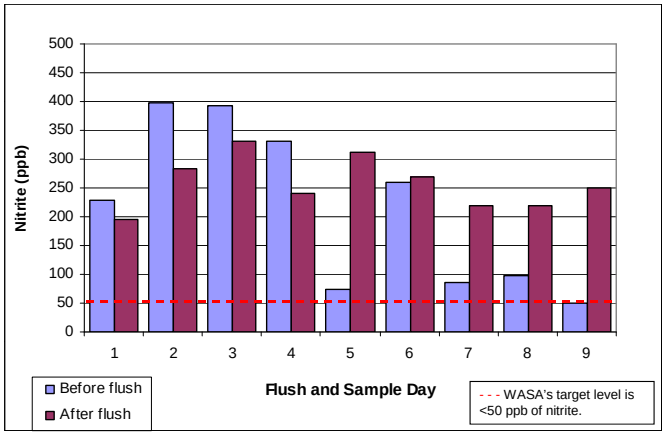
Nitrification Flushing Project



- After 9 flushing events and 650,000 gallons of water, chlorine levels could not be restored.

15

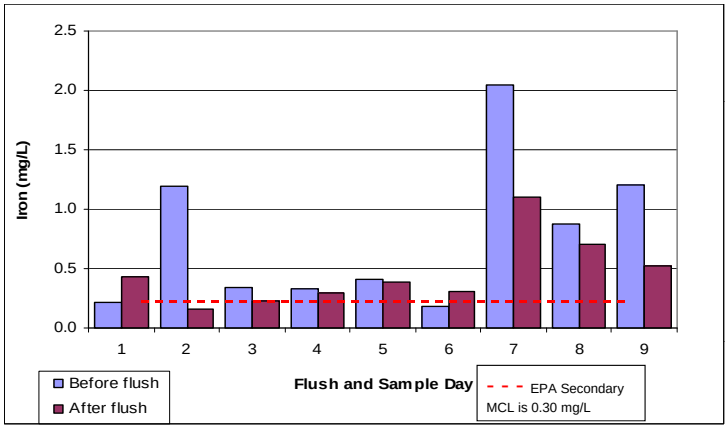
Nitrification Flushing Project (cont)



- Elevated nitrite persisted throughout the flushing

16

Nitrification Flushing Project (cont)



- Iron release increased after 3 weeks of flushing indicating scale disruption.

17

Steps Taken

- Spot flushing in affected area
- Aggressive unidirectional flushing
- Informed the Washington Aqueduct
  - Because the Washington Aqueduct wholesale customers are interdependent with respect to water treatment, a joint Nitrification Event Response Plan was established. Although this issue has not risen to a nitrification event, we are following several steps in the plan.
- Sent data to the Washington Aqueduct, Arlington, Falls Church and Technical Expert Working Group.
- A meeting of the Technical Expert Working Group is scheduled for December 4, 2009 to review this issue. **

** includes EPA, DOH, DOE, Washington Aqueduct, Arlington, Falls Church, and other subject experts

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