

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, September 24, 2015 4:58 PM
To: Devereaux, Tracy Jo (DEQ)
Subject: Fwd: Flint Baseline Info
Attachments: 02310_Flint_BaselineForm.pdf; ATT00001.htm; BaselineLetterSW - 03 14 07.pdf; ATT00002.htm; BaselineQA - 03 12 07.pdf; ATT00003.htm

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

Sent from my iPhone

Begin forwarded message:

From: "Philip, Kris (DEQ)" <PHILIPK@michigan.gov>
Date: September 23, 2015 at 10:24:15 AM EDT
To: "Busch, Stephen (DEQ)" <BUSCHS@michigan.gov>
Cc: "Rennaker, Joanne (DEQ)" <RENNAKERJ@michigan.gov>
Subject: Flint Baseline Info



COMPLETE AND RETURN THIS FORM TO THE MDEQ BY APRIL 1, 2007.

Listed below is the sum of the rated capacity of all low service or intake pumps the MDEQ has on record capable of withdrawing water from a surface water source as of May 29, 2006. If the capacity is correct, check the box provided. If the total capacity is incorrect, put the correct capacity in the blank to the right of the listed capacity. Finally, complete the signature box and return the form to the MDEQ. Thank you for your cooperation.

WSSN: 02310 FLINT

Check this box if the total capacity listed below is correct.
If the data is incorrect, leave this box blank and make the necessary correction below.



Total low service or intake pump capacity:

Capacity on
Record

Capacity
Correction

90 MGD

Signature of water supply representative:

BRENT F. WRIGHT
Printed Name

OPS & TECH SUPERVISOR
Title

[Signature]
Signature

3-22-07
Date

Please FAX or mail your
completed form to:

MDEQ, Water Bureau
Community Drinking Water Unit
PO Box 30273
Lansing, MI 48909-7773

FAX: (517) 241 - 1328



JENNIFER M. GRANHOLM
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING



STEVEN E. CHESTER
DIRECTOR

March 13, 2007

Dear Water Supply Professional:

**SUBJECT: Confirmation of "Baseline Capacity" for Surface Water Sources
RESPONSE REQUIRED BY APRIL 1, 2007**

This correspondence has been sent to confirm the "baseline capacity" of your surface water source(s). Baseline capacity is a critical component of new laws regulating water withdrawals passed by the Michigan legislature in February 2006. The enclosed "Question and Answer" (Q&A) document further explains this new legislation, its impact on you, and why responding to this letter is to your advantage.

To assign a baseline capacity for community water supplies, the MDEQ must establish the design withdrawal capacity as of May 29, 2006. For surface water sources, the design withdrawal capacity is the sum or total capacity of all pumps capable of withdrawing water from a surface water source. This capacity is the sum of the rated or design capacity of your low service or intake pumps without regard to hydraulic limitations or pump inefficiencies.

Enclosed please find a report on the sum or total rated capacity of your low service or intake pumps currently on record at the MDEQ. Please review this capacity, indicate your agreement or provide necessary corrections, and return the signed form to the MDEQ by April 1, 2007. A single response is all that is necessary, so you may wish to consult with your water system staff before returning your reply.

There is no scenario under the new legislation where confirming your baseline capacity will not be to your advantage. In fact, failure to do so may result in the MDEQ using annual pumpage data instead of available withdrawal capacity to determine your baseline. This default approach will result in a lower baseline capacity being established for your system.

In closing, the MDEQ wants to ensure the low service or intake pump capacity data it has on record is accurate and appropriate for establishing your baseline capacity from surface water source(s). If you have specific questions about the capacity listed on the enclosed report, please contact your district engineer. If you have questions regarding the new water withdrawal legislation, please read the enclosed Q&A document where you will find additional resources and contact information. Thank you for your cooperation.

Sincerely,

James K. Cleland, P.E., Chief
Lansing Operations Division
Water Bureau

Enclosures

cc: Operator in Charge

Questions and Answers Regarding New Water Withdrawal Legislation & Baseline Capacity

What is the purpose of the new water withdrawal legislation and why do we need to establish baseline capacity?

The new laws governing large quantity water withdrawals expanded upon water use and reporting requirements for large quantity water users to further assist in management of Michigan's water resources. The laws amended Parts 327 and 328 of the Natural Resources and Environmental Protection Act, and the Safe Drinking Water Act. The amendments redefined the requirements for water use registration and reporting, established environmental standards for assessment of new or increased large quantity water withdrawals, and set in place permit requirements for new large quantity water withdrawals of over 2 million gallons per day for ground water or inland surface water sources and 5 million gallons per day for surface water sources drawing from the Great Lakes or connecting waters.

What is a Large Quantity Withdrawal?

A large quantity withdrawal is defined as 1 or more cumulative total withdrawals of over 100,000 gallons per day (gpd) as an average in any 30-day period supplying a common distribution system, an amount approximately equal to new or additional capacity of 70 gallons per minute (gpm).

What is Baseline Capacity?

Baseline capacity is defined as the withdrawal capacity reported to the MDEQ by the person making a large quantity water withdrawal in the April 1, 2007 annual report of water use. For public water supplies the baseline capacity is the total designed withdrawal capacity as approved by the MDEQ under the Michigan Safe Drinking Water Act. For groundwater systems, the approved withdrawal capacity of your well(s) is the rated capacity of the well pump(s), not the capacity at which the pump(s) may be operating due to well inefficiencies. This capacity may include standby wells equipped with pumps that are maintained for emergency use. For surface water systems, the approved withdrawal capacity is the rated capacities of low service or intake pumps regardless of hydraulic limitations or pump inefficiencies. Only pumping equipment in place and operational within 90 days of the effective date of the legislation, which was February 28, 2006, can be included in the baseline capacity. If the above referenced capacity information is not reported and is otherwise unavailable, baseline capacity defaults to the maximum reported water use reported to the MDEQ for the years 2002 to 2005.

Why is establishing a baseline capacity important to you?

Under the new legislation, all new or increased "large quantity withdrawals" will be subject to evaluation under the new environmental standards. By legislative mandate, a new or increased large quantity withdrawal references a system's baseline capacity, or the existing capacity of the large quantity water user as a point of reference. All existing large quantity withdrawals that can be documented by the April 1, 2007 deadline for reporting are "grandfathered."

(continued on reverse)

How might an inaccurate or no baseline capacity affect your public water supply?

The answer to this question is best exemplified by citing a hypothetical example. Suppose a water supply system (not necessarily a public water supply) is operating with an average water use of 1.2 million gallons per day (MGD) and a peak water use reported to the department in 2004 of 1.6 MGD. However, the sum of capacities for the system's well pumps is 1800 gpm, or 2.6 MGD. Unfortunately, the system fails to notify the MDEQ of their existing well pump capacity. Under the law, 1.6 MGD becomes the grandfathered baseline capacity instead of 2.6 MGD.

Subsequently, the system increases their water use and later reports a water use to the MDEQ of 1.8 MGD, or a 200,000 gpd increase. The system is now subject to application of the new environmental standards adopted in passage of the legislation. Had they reported their baseline capacity, an increase in use of up to 1.0 MGD would have been exempt from application of the new environmental standards.

To give another example, a system using surface water has a peak daily demand reported on June 30, 2004 of 22 MGD. At the water treatment plant, there are 4 low service pumps that may be used to withdraw water from their source. Two of the pumps are rated at 10 MGD. The other 2 pumps have variable frequency motors. One of these pumps can produce up to 10 MGD; the other up to 5 MGD. If the system fails to notify the MDEQ that the total capacity of their low service pumps is 35 MGD, their grandfathered baseline capacity will become 22 MGD. As in the previous example, this system is now subject to the application of the new environmental standards should their water use increase more than 100,000 gpd beyond the 2004 peak demand.

Where can I obtain additional information on the new water use legislation?

Additional information about the new water use and water withdrawal legislation is available on the MDEQ website at <http://www.michigan.gov/deqwateruse>. Specific questions or comments regarding the new legislation should be directed to: Brant Fisher at 517-241-1415 or fisherb@michigan.gov or Ronda Page at 517-241-1380 or pagerc@michigan.gov.

Questions specific to your water supply well capacities should be directed to your MDEQ district office.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, October 02, 2015 10:04 AM
To: Wyant, Dan (DEQ); Pallone, Maggie (DEQ); Wurfel, Brad (DEQ)
Subject: Fwd: Flint WTP Lead Samples
Attachments: 7Laboratory Sample Report.htm; ATT00001.htm; 3Laboratory Sample Report.htm; ATT00002.htm; 6Laboratory Sample Report.htm; ATT00003.htm; 2Laboratory Sample Report.htm; ATT00004.htm; 1Laboratory Sample Report.htm; ATT00005.htm; 4Laboratory Sample Report.htm; ATT00006.htm; 5Laboratory Sample Report.htm; ATT00007.htm

Here's the summary of the WTP lead testing.

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

Sent from my iPhone

Begin forwarded message:

From: "Busch, Stephen (DEQ)" <BUSCHS@michigan.gov>
To: "Tommasulo, Karen (DEQ)" <TommasuloK@michigan.gov>
Cc: "Richard Benzie P.E. (BENZIER@michigan.gov)" <BENZIER@michigan.gov>
Subject: Flint WTP Lead Samples

Karen,

The Flint WTP treated water plant tap shows non-detect lead results. The sample dates were:

8/11/2015 Non-detect
 5/12/2015 Non-detect
 2/16/2015 Non-detect
 1/22/2015 Non-detect
 10/28/2014 Non-detect
 8/6/2014 Non-detect
 5/22/2014 Non-detect

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

**Michigan Department of Environmental Quality**Replicate Laboratory Report for
Lansing Drinking Water Laboratory

Owner/Location Information:

CITY OF FLINT
4500 N DORT HWY
FLINT MI 48505

Sample Number: LLF44687

Sample/Collection Information:

WSSN: 02310

County: Genesee

Township:

Section:

Well #:

Collection Date: 10/28/2014 8:04:00 AM

Arrival Date: 10/29/2014 11:15:14 AM

Site Code:

Water Source: Public Community Water Supply

Sample Reason: Routine Monitoring

Sample Point: Treated Public Distribution System

Point Description: PLANT TAP

Collector: Public Water Supply Operator

Collected By: MIKE GLASGOW

CasNo	Analyte	Result	Detect	Units	Method
16984-48-8	FLUORIDE (AUTOMATED)	0.62	0.1	mg/L	SM 4500 FC
7439-89-6	IRON	ND	0.1	mg/L	SM 3500 FeB
HARD-00-C	HARDNESS AS CaCO3	143	20	mg/L	SM 2340 C
7440-23-5	SODIUM	18	5	mg/L	SM 3500 NaB
7440-38-2	ARSENIC (TOTAL)	ND	0.002	mg/L	EPA 200.8
7440-39-3	BARIUM	0.02	0.01	mg/L	EPA 200.8
7440-41-7	BERYLLIUM	ND	0.0004	mg/L	EPA 200.8
57-12-5	CYANIDE	ND	0.02	mg/L	OIA-1677
7440-43-9	CADMIUM (TOTAL)	ND	0.0003	mg/L	EPA 200.8
7647-14-5	CHLORIDE (AUTOMATED)	60	4	mg/L	SM 4500-Cl E
7440-47-3	CHROMIUM (TOTAL)	ND	0.01	mg/L	EPA 200.8

93-76-5	2,4,5-T	ND	0.002	mg/L	EPA 515.4
93-72-1	2,4,5-TP (SILVEX)	ND	0.0003	mg/L	EPA 515.4
94-75-7	2,4-D	ND	0.002	mg/L	EPA 515.4
50594-66-6	ACIFLUORFEN	ND	0.004	mg/L	EPA 515.4
25057-89-0	BENTAZON	ND	0.002	mg/L	EPA 515.4
1918-00-9	DICAMBA	ND	0.002	mg/L	EPA 515.4
88-85-7	DINOSEB	ND	0.0003	mg/L	EPA 515.4
87-86-5	PENTACHLOROPHENOL	ND	0.00006	mg/L	EPA 515.4
1918-02-1	PICLORAM	ND	0.001	mg/L	EPA 515.4
1861-32-1	TOTAL DCPA, MONO & DI-ACID DEGRADATES	ND	0.001	mg/L	EPA 515.4
116-06-3	ALDICARB	ND	0.0005	mg/L	EPA 531.2
1646-88-4	ALDICARB SULFONE	ND	0.0005	mg/L	EPA 531.2
1646-87-3	ALDICARB SULFOXIDE	ND	0.0005	mg/L	EPA 531.2
63-25-2	CARBARYL	ND	0.001	mg/L	EPA 531.2
1563-66-2	CARBOFURAN	ND	0.0005	mg/L	EPA 531.2
16655-82-6	HYDROXYCARBOFURAN,3-	ND	0.001	mg/L	EPA 531.2
2032-65-7	METHIOCARB	ND	0.001	mg/L	EPA 531.2
16752-77-5	METHOMYL	ND	0.001	mg/L	EPA 531.2
23135-22-0	OXAMYL	ND	0.001	mg/L	EPA 531.2
114-26-1	PROPOXUR (BAYGON)	ND	0.001	mg/L	EPA 531.2
34256-82-1	ACETOCHLOR	ND	0.001	mg/L	EPA 525.2
15972-60-8	ALACHLOR	ND	0.0002	mg/L	EPA 525.2
309-00-2	ALDRIN	ND	0.0004	mg/L	EPA 525.2
1912-24-9	ATRAZINE	ND	0.0002	mg/L	EPA 525.2
5103-71-9	CHLORDANE, ALPHA-	ND	0.0002	mg/L	EPA 525.2
5103-74-2	CHLORDANE, GAMMA-	ND	0.0002	mg/L	EPA 525.2
72-54-8	DDD,4,4'-	ND	0.001	mg/L	EPA 525.2
72-55-9	DDE,4,4'-	ND	0.001	mg/L	EPA 525.2

50-29-3	DDT,4,4'-	ND	0.0005	mg/L	EPA 525.2
60-57-1	DIELDRIN	ND	0.0005	mg/L	EPA 525.2
72-20-8	ENDRIN	ND	0.0001	mg/L	EPA 525.2
7421-93-4	ENDRIN ALDEHYDE	ND	0.001	mg/L	EPA 525.2
76-44-8	HEPTACHLOR	ND	0.0002	mg/L	EPA 525.2
1024-57-3	HEPTACHLOR EPOXIDE	ND	0.0001	mg/L	EPA 525.2
118-74-1	HEXACHLOROBENZENE	ND	0.0001	mg/L	EPA 525.2
319-84-6	HEXACHLOROCYCLOHEXANE (ALPHA-BHC)	ND	0.001	mg/L	EPA 525.2
319-85-7	HEXACHLOROCYCLOHEXANE (BETA-BHC)	ND	0.001	mg/L	EPA 525.2
319-86-8	HEXACHLOROCYCLOHEXANE (DELTA-BHC)	ND	0.001	mg/L	EPA 525.2
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	0.0005	mg/L	EPA 525.2
58-89-9	LINDANE (GAMMA-BHC)	ND	0.0001	mg/L	EPA 525.2
72-43-5	METHOXYCHLOR	ND	0.0001	mg/L	EPA 525.2
51218-45-2	METOLACHLOR	ND	0.001	mg/L	EPA 525.2
21087-64-9	METRIBUZIN	ND	0.001	mg/L	EPA 525.2
2212-67-1	MOLINATE	ND	0.0005	mg/L	EPA 525.2
12674-11-2	PCB (AROCLOR 1016)	ND	0.0001	mg/L	EPA 525.2
11104-28-2	PCB (AROCLOR 1221)	ND	0.0001	mg/L	EPA 525.2
11141-16-5	PCB (AROCLOR 1232)	ND	0.0001	mg/L	EPA 525.2
53469-21-9	PCB (AROCLOR 1242)	ND	0.0001	mg/L	EPA 525.2
12672-29-6	PCB (AROCLOR 1248)	ND	0.0001	mg/L	EPA 525.2
11097-69-1	PCB (AROCLOR 1254)	ND	0.0001	mg/L	EPA 525.2
11096-82-5	PCB (AROCLOR 1260)	ND	0.0001	mg/L	EPA 525.2
59536-65-1	POLYBROMINATED BIPHENYLS	ND	0.0001	mg/L	EPA 525.2
122-34-9	SIMAZINE	ND	0.0002	mg/L	EPA 525.2
8001-35-2	TOXAPHENE	ND	0.001	mg/L	EPA 525.2
71-43-2	BENZENE	ND	0.0005	mg/L	EPA 524.2
108-86-1	BROMOBENZENE	ND	0.0005	mg/L	EPA 524.2

74-97-5	BROMOCHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
75-25-2	BROMOFORM	0.0014	0.0005	mg/L	EPA 524.2
74-83-9	BROMOMETHANE	ND	0.001	mg/L	EPA 524.2
104-51-8	BUTYLBENZENE,NORMAL-	ND	0.0005	mg/L	EPA 524.2
135-98-8	BUTYLBENZENE,SEC-	ND	0.0005	mg/L	EPA 524.2
98-06-6	BUTYLBENZENE,TERT-	ND	0.0005	mg/L	EPA 524.2
56-23-5	CARBON TETRACHLORIDE	ND	0.0005	mg/L	EPA 524.2
108-90-7	CHLOROBENZENE	ND	0.0005	mg/L	EPA 524.2
124-48-1	CHLORODIBROMOMETHANE	0.0080	0.0005	mg/L	EPA 524.2
75-00-3	CHLOROETHANE	ND	0.0005	mg/L	EPA 524.2
67-66-3	CHLOROFORM	0.012	0.0005	mg/L	EPA 524.2
74-87-3	CHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
95-49-8	CHLOROTOLUENE,2-	ND	0.0005	mg/L	EPA 524.2
106-43-4	CHLOROTOLUENE,4-	ND	0.0005	mg/L	EPA 524.2
74-95-3	DIBROMOMETHANE	ND	0.0005	mg/L	EPA 524.2
95-50-1	DICHLOROBENZENE,1,2-	ND	0.0005	mg/L	EPA 524.2
541-73-1	DICHLOROBENZENE,1,3-	ND	0.0005	mg/L	EPA 524.2
106-46-7	DICHLOROBENZENE,1,4-	ND	0.0005	mg/L	EPA 524.2
75-27-4	DICHLOROBROMOMETHANE	0.012	0.0005	mg/L	EPA 524.2
75-71-8	DICHLORODIFLUOROMETHANE	ND	0.001	mg/L	EPA 524.2
75-34-3	DICHLOROETHANE,1,1-	ND	0.0005	mg/L	EPA 524.2
107-06-2	DICHLOROETHANE,1,2-	ND	0.0005	mg/L	EPA 524.2
75-35-4	DICHLOROETHYLENE,1,1-	ND	0.0005	mg/L	EPA 524.2
156-59-2	DICHLOROETHYLENE,1,2-CIS	ND	0.0005	mg/L	EPA 524.2
156-60-5	DICHLOROETHYLENE,1,2-TRANS	ND	0.0005	mg/L	EPA 524.2
78-87-5	DICHLOROPROPANE,1,2-	ND	0.0005	mg/L	EPA 524.2
142-28-9	DICHLOROPROPANE,1,3-	ND	0.0005	mg/L	EPA 524.2
594-20-7	DICHLOROPROPANE,2,2-	ND	0.0005	mg/L	EPA 524.2
563-58-6	DICHLOROPROPENE,1,1-	ND	0.0005	mg/L	EPA 524.2
10061-01-5	DICHLOROPROPENE,1,3-CIS	ND	0.0005	mg/L	EPA 524.2
10061-02-6	DICHLOROPROPENE,1,3-TRANS	ND	0.0005	mg/L	EPA 524.2
100-41-4	ETHYLBENZENE	ND	0.0005	mg/L	EPA 524.2
75-69-4	FLUOROTRICHLOROMETHANE	ND	0.001	mg/L	EPA 524.2
87-68-3	HEXACHLOROBUTADIENE	ND	0.0005	mg/L	EPA 524.2
98-82-8	ISOPROPYL BENZENE	ND	0.0005	mg/L	EPA 524.2
99-87-6	ISOPROPYL TOLUENE, PARA-	ND	0.0005	mg/L	EPA 524.2
78-93-3	METHYL ETHYL KETONE	ND	0.005	mg/L	EPA 524.2
108-10-1	METHYL ISOBUTYL KETONE	ND	0.005	mg/L	EPA 524.2
1634-04-4	METHYL TERT-BUTYL ETHER	ND	0.001	mg/L	EPA 524.2

75-09-2	METHYLENE CHLORIDE	ND	0.0006	mg/L	EPA 524.2
91-20-3	NAPHTHALENE	ND	0.0005	mg/L	EPA 524.2
98-95-3	NITROBENZENE	ND	0.01	mg/L	EPA 524.2
103-65-1	PROPYLBENZENE, NORMAL-	ND	0.0005	mg/L	EPA 524.2
100-42-5	STYRENE	ND	0.0005	mg/L	EPA 524.2
630-20-6	TETRACHLOROETHANE,1,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-34-5	TETRACHLOROETHANE,1,1,2,2-	ND	0.0005	mg/L	EPA 524.2
127-18-4	TETRACHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
109-99-9	TETRAHYDROFURAN	ND	0.005	mg/L	EPA 524.2
108-88-3	TOLUENE	ND	0.0005	mg/L	EPA 524.2
TTHM-00-C	TOTAL TRIHALOMETHANES	0.033	NA	mg/L	EPA 524.2
87-61-6	TRICHLOROBENZENE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
120-82-1	TRICHLOROBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
71-55-6	TRICHLOROETHANE,1,1,1-	ND	0.0005	mg/L	EPA 524.2
79-00-5	TRICHLOROETHANE,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-01-6	TRICHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
96-18-4	TRICHLOROPROPANE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
95-63-6	TRIMETHYLBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
108-67-8	TRIMETHYLBENZENE,1,3,5-	ND	0.0005	mg/L	EPA 524.2
75-01-4	VINYL CHLORIDE	ND	0.0004	mg/L	EPA 524.2
XYLMP-00-C	XYLENE,META-&PARA-	0.0005	0.0005	mg/L	EPA 524.2
95-47-6	XYLENE,ORTHO-	ND	0.0005	mg/L	EPA 524.2
1330-20-7	XYLENES (TOTAL)	0.0005	NA	mg/L	EPA 524.2
7439-97-6	MERCURY	ND	0.0001	mg/L	EPA 200.8
7440-02-0	NICKEL	ND	0.01	mg/L	EPA 200.8
14797-65-0	NITRITE AS N (AUTOMATED)	ND	0.05	mg/L	10-107-04-2-B
14797-55-8	NITRATE AS N (AUTOMATED)	ND	0.4	mg/L	10-107-04-2-B
7439-92-1	LEAD (TOTAL)	ND	0.001	mg/L	EPA 200.8
7440-36-0	ANTIMONY	ND	0.0006	mg/L	EPA 200.8
7782-49-2	SELENIUM (TOTAL)	ND	0.001	mg/L	EPA 200.8
14808-79-8	SULFATE (AUTOMATED)	22	10	mg/L	SM 4500 SO4E
7440-28-0	THALLIUM	ND	0.0002	mg/L	EPA 200.8

Laboratory Comments:

A trip blank was not available for analysis with this sample.

By authority of PA 368 of 1978 as amended.

Print Date: Thu Oct 1
17:16:11 EDT 2015

**Michigan Department of Environmental Quality**Replicate Laboratory Report for
Lansing Drinking Water Laboratory

Owner/Location Information:

CITY OF FLINT
4500 N DORT HWY
FLINT MI 48505

Sample Number: LLF54660

Sample/Collection Information:

WSSN: 02310

County: Genesee

Township:

Section:

Well #:

Collection Date: 2/16/2015 9:40:00 AM

Arrival Date: 2/17/2015 10:46:51 AM

Site Code:

Water Source: Public Community Water
Supply

Sample Reason: Routine Monitoring

Sample Point: Treated Public Distribution
System

Point Description: PLANT TAP

Collector: Public Water Supply Operator

Collected By: MIKE GLASGOW

CasNo	Analyte	Result	Detect	Units	Method
16984-48-8	FLUORIDE (AUTOMATED)	0.57	0.1	mg/L	SM 4500 FC
7439-89-6	IRON	ND	0.1	mg/L	SM 3500 FeB
HARD-00-C	HARDNESS AS CaCO3	180	20	mg/L	SM 2340 C
7440-23-5	SODIUM	25	5	mg/L	SM 3500 NaB
7440-38-2	ARSENIC (TOTAL)	ND	0.002	mg/L	EPA 200.8
7440-39-3	BARIUM	ND	0.01	mg/L	EPA 200.8
7440-41-7	BERYLLIUM	ND	0.0004	mg/L	EPA 200.8
57-12-5	CYANIDE	ND	0.02	mg/L	OIA-1677
7440-43-9	CADMIUM (TOTAL)	ND	0.0003	mg/L	EPA 200.8
7647-14-5	CHLORIDE (AUTOMATED)	99	4	mg/L	SM 4500-Cl E
7440-47-3	CHROMIUM (TOTAL)	ND	0.01	mg/L	EPA 200.8

93-76-5	2,4,5-T	ND	0.002	mg/L	EPA 515.4
93-72-1	2,4,5-TP (SILVEX)	ND	0.0002	mg/L	EPA 515.4
94-75-7	2,4-D	ND	0.001	mg/L	EPA 515.4
50594-66-6	ACIFLUORFEN	ND	0.004	mg/L	EPA 515.4
25057-89-0	BENTAZON	ND	0.002	mg/L	EPA 515.4
1918-00-9	DICAMBA	ND	0.002	mg/L	EPA 515.4
88-85-7	DINOSEB	ND	0.0002	mg/L	EPA 515.4
87-86-5	PENTACHLOROPHENOL	ND	0.00004	mg/L	EPA 515.4
1918-02-1	PICLORAM	ND	0.001	mg/L	EPA 515.4
1861-32-1	TOTAL DCPA, MONO & DI-ACID DEGRADATES	ND	0.001	mg/L	EPA 515.4
116-06-3	ALDICARB	ND	0.0005	mg/L	EPA 531.2
1646-88-4	ALDICARB SULFONE	ND	0.0005	mg/L	EPA 531.2
1646-87-3	ALDICARB SULFOXIDE	ND	0.0005	mg/L	EPA 531.2
63-25-2	CARBARYL	ND	0.001	mg/L	EPA 531.2
1563-66-2	CARBOFURAN	ND	0.0005	mg/L	EPA 531.2
16655-82-6	HYDROXYCARBOFURAN,3-	ND	0.001	mg/L	EPA 531.2
2032-65-7	METHIOCARB	ND	0.001	mg/L	EPA 531.2
16752-77-5	METHOMYL	ND	0.001	mg/L	EPA 531.2
23135-22-0	OXAMYL	ND	0.001	mg/L	EPA 531.2
114-26-1	PROPOXUR (BAYGON)	ND	0.001	mg/L	EPA 531.2
34256-82-1	ACETOCHLOR	ND	0.001	mg/L	EPA 525.2
15972-60-8	ALACHLOR	ND	0.0002	mg/L	EPA 525.2
309-00-2	ALDRIN	ND	0.0004	mg/L	EPA 525.2
1912-24-9	ATRAZINE	ND	0.0002	mg/L	EPA 525.2
5103-71-9	CHLORDANE, ALPHA-	ND	0.0002	mg/L	EPA 525.2
5103-74-2	CHLORDANE, GAMMA-	ND	0.0002	mg/L	EPA 525.2
72-54-8	DDD,4,4'-	ND	0.001	mg/L	EPA 525.2
72-55-9	DDE,4,4'-	ND	0.001	mg/L	EPA 525.2

50-29-3	DDT,4,4'-	ND	0.0005	mg/L	EPA 525.2
60-57-1	DIELDRIN	ND	0.0005	mg/L	EPA 525.2
72-20-8	ENDRIN	ND	0.0001	mg/L	EPA 525.2
7421-93-4	ENDRIN ALDEHYDE	ND	0.001	mg/L	EPA 525.2
76-44-8	HEPTACHLOR	ND	0.0002	mg/L	EPA 525.2
1024-57-3	HEPTACHLOR EPOXIDE	ND	0.0001	mg/L	EPA 525.2
118-74-1	HEXACHLOROBENZENE	ND	0.0001	mg/L	EPA 525.2
319-84-6	HEXACHLOROCYCLOHEXANE (ALPHA-BHC)	ND	0.001	mg/L	EPA 525.2
319-85-7	HEXACHLOROCYCLOHEXANE (BETA-BHC)	ND	0.001	mg/L	EPA 525.2
319-86-8	HEXACHLOROCYCLOHEXANE (DELTA-BHC)	ND	0.001	mg/L	EPA 525.2
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	0.0005	mg/L	EPA 525.2
58-89-9	LINDANE (GAMMA-BHC)	ND	0.0001	mg/L	EPA 525.2
72-43-5	METHOXYCHLOR	ND	0.0001	mg/L	EPA 525.2
51218-45-2	METOLACHLOR	ND	0.001	mg/L	EPA 525.2
21087-64-9	METRIBUZIN	ND	0.001	mg/L	EPA 525.2
2212-67-1	MOLINATE	ND	0.0005	mg/L	EPA 525.2
12674-11-2	PCB (AROCLOR 1016)	ND	0.0001	mg/L	EPA 525.2
11104-28-2	PCB (AROCLOR 1221)	ND	0.0001	mg/L	EPA 525.2
11141-16-5	PCB (AROCLOR 1232)	ND	0.0001	mg/L	EPA 525.2
53469-21-9	PCB (AROCLOR 1242)	ND	0.0001	mg/L	EPA 525.2
12672-29-6	PCB (AROCLOR 1248)	ND	0.0001	mg/L	EPA 525.2
11097-69-1	PCB (AROCLOR 1254)	ND	0.0001	mg/L	EPA 525.2
11096-82-5	PCB (AROCLOR 1260)	ND	0.0001	mg/L	EPA 525.2
59536-65-1	POLYBROMINATED BIPHENYLS	ND	0.0001	mg/L	EPA 525.2
122-34-9	SIMAZINE	ND	0.0002	mg/L	EPA 525.2
8001-35-2	TOXAPHENE	ND	0.001	mg/L	EPA 525.2
71-43-2	BENZENE	ND	0.0005	mg/L	EPA 524.2
108-86-1	BROMOBENZENE	ND	0.0005	mg/L	EPA 524.2

74-97-5	BROMOCHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
75-25-2	BROMOFORM	0.0007	0.0005	mg/L	EPA 524.2
74-83-9	BROMOMETHANE	ND	0.001	mg/L	EPA 524.2
104-51-8	BUTYLBENZENE,NORMAL-	ND	0.0005	mg/L	EPA 524.2
135-98-8	BUTYLBENZENE,SEC-	ND	0.0005	mg/L	EPA 524.2
98-06-6	BUTYLBENZENE,TERT-	ND	0.0005	mg/L	EPA 524.2
56-23-5	CARBON TETRACHLORIDE	ND	0.0005	mg/L	EPA 524.2
108-90-7	CHLOROBENZENE	ND	0.0005	mg/L	EPA 524.2
124-48-1	CHLORODIBROMOMETHANE	0.0025	0.0005	mg/L	EPA 524.2
75-00-3	CHLOROETHANE	ND	0.0005	mg/L	EPA 524.2
67-66-3	CHLOROFORM	0.0018	0.0005	mg/L	EPA 524.2
74-87-3	CHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
95-49-8	CHLOROTOLUENE,2-	ND	0.0005	mg/L	EPA 524.2
106-43-4	CHLOROTOLUENE,4-	ND	0.0005	mg/L	EPA 524.2
74-95-3	DIBROMOMETHANE	ND	0.0005	mg/L	EPA 524.2
95-50-1	DICHLOROBENZENE,1,2-	ND	0.0005	mg/L	EPA 524.2
541-73-1	DICHLOROBENZENE,1,3-	ND	0.0005	mg/L	EPA 524.2
106-46-7	DICHLOROBENZENE,1,4-	ND	0.0005	mg/L	EPA 524.2
75-27-4	DICHLOROBROMOMETHANE	0.0030	0.0005	mg/L	EPA 524.2
75-71-8	DICHLORODIFLUOROMETHANE	ND	0.001	mg/L	EPA 524.2
75-34-3	DICHLOROETHANE,1,1-	ND	0.0005	mg/L	EPA 524.2
107-06-2	DICHLOROETHANE,1,2-	ND	0.0005	mg/L	EPA 524.2
75-35-4	DICHLOROETHYLENE,1,1-	ND	0.0005	mg/L	EPA 524.2
156-59-2	DICHLOROETHYLENE,1,2-CIS	ND	0.0005	mg/L	EPA 524.2
156-60-5	DICHLOROETHYLENE,1,2-TRANS	ND	0.0005	mg/L	EPA 524.2
78-87-5	DICHLOROPROPANE,1,2-	ND	0.0005	mg/L	EPA 524.2
142-28-9	DICHLOROPROPANE,1,3-	ND	0.0005	mg/L	EPA 524.2
594-20-7	DICHLOROPROPANE,2,2-	ND	0.0005	mg/L	EPA 524.2
563-58-6	DICHLOROPROPENE,1,1-	ND	0.0005	mg/L	EPA 524.2
10061-01-5	DICHLOROPROPENE,1,3-CIS	ND	0.0005	mg/L	EPA 524.2
10061-02-6	DICHLOROPROPENE,1,3-TRANS	ND	0.0005	mg/L	EPA 524.2
100-41-4	ETHYLBENZENE	ND	0.0005	mg/L	EPA 524.2
75-69-4	FLUOROTRICHLOROMETHANE	ND	0.001	mg/L	EPA 524.2
87-68-3	HEXACHLOROBUTADIENE	ND	0.0005	mg/L	EPA 524.2
98-82-8	ISOPROPYL BENZENE	ND	0.0005	mg/L	EPA 524.2
99-87-6	ISOPROPYL TOLUENE, PARA-	ND	0.0005	mg/L	EPA 524.2
78-93-3	METHYL ETHYL KETONE	ND	0.005	mg/L	EPA 524.2
108-10-1	METHYL ISOBUTYL KETONE	ND	0.005	mg/L	EPA 524.2
1634-04-4	METHYL TERT-BUTYL ETHER	ND	0.001	mg/L	EPA 524.2

75-09-2	METHYLENE CHLORIDE	ND	0.0006	mg/L	EPA 524.2
91-20-3	NAPHTHALENE	ND	0.0005	mg/L	EPA 524.2
103-65-1	PROPYLBENZENE, NORMAL-	ND	0.0005	mg/L	EPA 524.2
100-42-5	STYRENE	ND	0.0005	mg/L	EPA 524.2
630-20-6	TETRACHLOROETHANE,1,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-34-5	TETRACHLOROETHANE,1,1,2,2-	ND	0.0005	mg/L	EPA 524.2
127-18-4	TETRACHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
109-99-9	TETRAHYDROFURAN	ND	0.005	mg/L	EPA 524.2
108-88-3	TOLUENE	ND	0.0005	mg/L	EPA 524.2
TTHM-00-C	TOTAL TRIHALOMETHANES	0.008	NA	mg/L	EPA 524.2
87-61-6	TRICHLOROBENZENE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
120-82-1	TRICHLOROBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
71-55-6	TRICHLOROETHANE,1,1,1-	ND	0.0005	mg/L	EPA 524.2
79-00-5	TRICHLOROETHANE,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-01-6	TRICHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
96-18-4	TRICHLOROPROPANE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
95-63-6	TRIMETHYLBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
108-67-8	TRIMETHYLBENZENE,1,3,5-	ND	0.0005	mg/L	EPA 524.2
75-01-4	VINYL CHLORIDE	ND	0.0005	mg/L	EPA 524.2
XYLMP-00-C	XYLENE,META-&PARA-	ND	0.0005	mg/L	EPA 524.2
95-47-6	XYLENE,ORTHO-	ND	0.0005	mg/L	EPA 524.2
1330-20-7	XYLENES (TOTAL)	ND	NA	mg/L	EPA 524.2
7439-97-6	MERCURY	ND	0.0001	mg/L	EPA 200.8
7440-02-0	NICKEL	ND	0.01	mg/L	EPA 200.8
14797-65-0	NITRITE AS N (AUTOMATED)	ND	0.05	mg/L	10-107-04-2-B
14797-55-8	NITRATE AS N (AUTOMATED)	1.3	0.4	mg/L	10-107-04-2-B
7439-92-1	LEAD (TOTAL)	ND	0.001	mg/L	EPA 200.8
7440-36-0	ANTIMONY	ND	0.0006	mg/L	EPA 200.8
7782-49-2	SELENIUM (TOTAL)	0.001	0.001	mg/L	EPA 200.8
14808-79-8	SULFATE (AUTOMATED)	40	10	mg/L	SM 4500 SO4E
7440-28-0	THALLIUM	ND	0.0002	mg/L	EPA 200.8

Laboratory Comments:

Endrin Aldehyde quality control results were outside allowed limits due to matrix interferences.
Unidentified hydrocarbon peak(s) were detected.

By authority of PA 368 of 1978 as amended.

Print Date: Thu Oct 1
17:13:39 EDT 2015

**Michigan Department of Environmental Quality**Replicate Laboratory Report for
Lansing Drinking Water Laboratory

Owner/Location Information:

CITY OF FLINT -WATER
PLANT
4500 N DORT HWY
FLINT MI 48505

Sample Number: LLF19430

Sample/Collection Information:

WSSN: 02310

County: Genesee

Township:

Section:

Well #:

Collection Date: 5/22/2014 8:30:00 AM

Arrival Date: 5/22/2014 1:19:53 PM

Site Code: LAB TAP

Water Source: Public Community Water
Supply

Sample Reason: Routine Monitoring

Sample Point: Treated Public Distribution
System

Point Description: PLANT LAB

Collector: Public Water Supply Operator

Collected By: MICHAEL GLASGOW

CasNo	Analyte	Result	Detect	Units	Method
16984-48-8	FLUORIDE (AUTOMATED)	0.16	0.1	mg/L	SM 4500 FC
7439-89-6	IRON	ND	0.1	mg/L	SM 3500 FeB
HARD-00-C	HARDNESS AS CaCO3	209	20	mg/L	SM 2340 C
7440-23-5	SODIUM	15	5	mg/L	SM 3500 NaB
7440-38-2	ARSENIC (TOTAL)	ND	0.002	mg/L	EPA 200.8
7440-39-3	BARIUM	0.03	0.01	mg/L	EPA 200.8
7440-41-7	BERYLLIUM	ND	0.0004	mg/L	EPA 200.8
57-12-5	CYANIDE	ND	0.02	mg/L	OIA-1677
7440-43-9	CADMIUM (TOTAL)	ND	0.0003	mg/L	EPA 200.8
7647-14-5	CHLORIDE (AUTOMATED)	79	4	mg/L	SM 4500-Cl E
7440-47-					

3	CHROMIUM (TOTAL)	ND	0.01	mg/L	EPA 200.8
93-76-5	2,4,5-T	ND	0.002	mg/L	EPA 515.4
93-72-1	2,4,5-TP (SILVEX)	ND	0.0003	mg/L	EPA 515.4
94-75-7	2,4-D	ND	0.002	mg/L	EPA 515.4
50594-66-6	ACIFLUORFEN	ND	0.004	mg/L	EPA 515.4
25057-89-0	BENTAZON	ND	0.002	mg/L	EPA 515.4
1918-00-9	DICAMBA	ND	0.002	mg/L	EPA 515.4
88-85-7	DINOSEB	ND	0.0003	mg/L	EPA 515.4
87-86-5	PENTACHLOROPHENOL	ND	0.00006	mg/L	EPA 515.4
1918-02-1	PICLORAM	ND	0.001	mg/L	EPA 515.4
1861-32-1	TOTAL DCPA, MONO & DI-ACID DEGRADATES	ND	0.001	mg/L	EPA 515.4
116-06-3	ALDICARB	ND	0.0005	mg/L	EPA 531.2
1646-88-4	ALDICARB SULFONE	ND	0.0005	mg/L	EPA 531.2
1646-87-3	ALDICARB SULFOXIDE	ND	0.0005	mg/L	EPA 531.2
63-25-2	CARBARYL	ND	0.001	mg/L	EPA 531.2
1563-66-2	CARBOFURAN	ND	0.0005	mg/L	EPA 531.2
16655-82-6	HYDROXYCARBOFURAN,3-	ND	0.001	mg/L	EPA 531.2
2032-65-7	METHIOCARB	ND	0.001	mg/L	EPA 531.2
16752-77-5	METHOMYL	ND	0.001	mg/L	EPA 531.2
23135-22-0	OXAMYL	ND	0.001	mg/L	EPA 531.2
114-26-1	PROPOXUR (BAYGON)	ND	0.001	mg/L	EPA 531.2
34256-82-1	ACETOCHLOR	ND	0.001	mg/L	EPA 525.2
15972-60-8	ALACHLOR	ND	0.0002	mg/L	EPA 525.2
309-00-2	ALDRIN	ND	0.0004	mg/L	EPA 525.2
1912-24-9	ATRAZINE	ND	0.0002	mg/L	EPA 525.2
5103-71-9	CHLORDANE, ALPHA-	ND	0.0002	mg/L	EPA 525.2
5103-74-2	CHLORDANE, GAMMA-	ND	0.0002	mg/L	EPA 525.2
72-54-8	DDD,4,4'-	ND	0.001	mg/L	EPA 525.2

72-55-9	DDE,4,4'-	ND	0.001	mg/L	EPA 525.2
50-29-3	DDT,4,4'-	ND	0.0005	mg/L	EPA 525.2
60-57-1	DIELDRIN	ND	0.0005	mg/L	EPA 525.2
72-20-8	ENDRIN	ND	0.0001	mg/L	EPA 525.2
7421-93-4	ENDRIN ALDEHYDE	ND	0.001	mg/L	EPA 525.2
76-44-8	HEPTACHLOR	ND	0.0002	mg/L	EPA 525.2
1024-57-3	HEPTACHLOR EPOXIDE	ND	0.0001	mg/L	EPA 525.2
118-74-1	HEXACHLOROBENZENE	ND	0.0001	mg/L	EPA 525.2
319-84-6	HEXACHLOROCYCLOHEXANE (ALPHA-BHC)	ND	0.001	mg/L	EPA 525.2
319-85-7	HEXACHLOROCYCLOHEXANE (BETA-BHC)	ND	0.001	mg/L	EPA 525.2
319-86-8	HEXACHLOROCYCLOHEXANE (DELTA-BHC)	ND	0.001	mg/L	EPA 525.2
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	0.0005	mg/L	EPA 525.2
58-89-9	LINDANE (GAMMA-BHC)	ND	0.0001	mg/L	EPA 525.2
72-43-5	METHOXYCHLOR	ND	0.0001	mg/L	EPA 525.2
51218-45-2	METOLACHLOR	ND	0.001	mg/L	EPA 525.2
21087-64-9	METRIBUZIN	ND	0.001	mg/L	EPA 525.2
2212-67-1	MOLINATE	ND	0.0005	mg/L	EPA 525.2
12674-11-2	PCB (AROCLOR 1016)	ND	0.0001	mg/L	EPA 525.2
11104-28-2	PCB (AROCLOR 1221)	ND	0.0001	mg/L	EPA 525.2
11141-16-5	PCB (AROCLOR 1232)	ND	0.0001	mg/L	EPA 525.2
53469-21-9	PCB (AROCLOR 1242)	ND	0.0001	mg/L	EPA 525.2
12672-29-6	PCB (AROCLOR 1248)	ND	0.0001	mg/L	EPA 525.2
11097-69-1	PCB (AROCLOR 1254)	ND	0.0001	mg/L	EPA 525.2
11096-82-5	PCB (AROCLOR 1260)	ND	0.0001	mg/L	EPA 525.2
59536-65-1	POLYBROMINATED BIPHENYLS	ND	0.0001	mg/L	EPA 525.2
122-34-9	SIMAZINE	ND	0.0002	mg/L	EPA 525.2
8001-35-2	TOXAPHENE	ND	0.001	mg/L	EPA 525.2
71-43-2	BENZENE	ND	0.0005	mg/L	EPA 524.2

108-86-1	BROMOBENZENE	ND	0.0005	mg/L	EPA 524.2
74-97-5	BROMOCHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
75-25-2	BROMOFORM	0.0010	0.0005	mg/L	EPA 524.2
74-83-9	BROMOMETHANE	ND	0.001	mg/L	EPA 524.2
104-51-8	BUTYLBENZENE,NORMAL-	ND	0.0005	mg/L	EPA 524.2
135-98-8	BUTYLBENZENE,SEC-	ND	0.0005	mg/L	EPA 524.2
98-06-6	BUTYLBENZENE,TERT-	ND	0.0005	mg/L	EPA 524.2
56-23-5	CARBON TETRACHLORIDE	ND	0.0005	mg/L	EPA 524.2
108-90-7	CHLOROBENZENE	ND	0.0005	mg/L	EPA 524.2
124-48-1	CHLORODIBROMOMETHANE	0.013	0.0005	mg/L	EPA 524.2
75-00-3	CHLOROETHANE	ND	0.0005	mg/L	EPA 524.2
67-66-3	CHLOROFORM	0.022	0.0005	mg/L	EPA 524.2
74-87-3	CHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
95-49-8	CHLOROTOLUENE,2-	ND	0.0005	mg/L	EPA 524.2
106-43-4	CHLOROTOLUENE,4-	ND	0.0005	mg/L	EPA 524.2
74-95-3	DIBROMOMETHANE	ND	0.0005	mg/L	EPA 524.2
95-50-1	DICHLOROBENZENE,1,2-	ND	0.0005	mg/L	EPA 524.2
541-73-1	DICHLOROBENZENE,1,3-	ND	0.0005	mg/L	EPA 524.2
106-46-7	DICHLOROBENZENE,1,4-	ND	0.0005	mg/L	EPA 524.2
75-27-4	DICHLOROBROMOMETHANE	0.020	0.0005	mg/L	EPA 524.2
75-71-8	DICHLORODIFLUOROMETHANE	ND	0.001	mg/L	EPA 524.2
75-34-3	DICHLOROETHANE,1,1-	ND	0.0005	mg/L	EPA 524.2
107-06-2	DICHLOROETHANE,1,2-	ND	0.0005	mg/L	EPA 524.2
75-35-4	DICHLOROETHYLENE,1,1-	ND	0.0005	mg/L	EPA 524.2
156-59-2	DICHLOROETHYLENE,1,2-CIS	ND	0.0005	mg/L	EPA 524.2
156-60-5	DICHLOROETHYLENE,1,2-TRANS	ND	0.0005	mg/L	EPA 524.2
78-87-5	DICHLOROPROPANE,1,2-	ND	0.0005	mg/L	EPA 524.2
142-28-9	DICHLOROPROPANE,1,3-	ND	0.0005	mg/L	EPA 524.2
594-20-7	DICHLOROPROPANE,2,2-	ND	0.0005	mg/L	EPA 524.2
563-58-6	DICHLOROPROPENE,1,1-	ND	0.0005	mg/L	EPA 524.2
10061-01-5	DICHLOROPROPENE,1,3-CIS	ND	0.0005	mg/L	EPA 524.2
10061-02-6	DICHLOROPROPENE,1,3-TRANS	ND	0.0005	mg/L	EPA 524.2
100-41-4	ETHYLBENZENE	ND	0.0005	mg/L	EPA 524.2
75-69-4	FLUOROTRICHLOROMETHANE	ND	0.001	mg/L	EPA 524.2
87-68-3	HEXACHLOROBUTADIENE	ND	0.0005	mg/L	EPA 524.2
98-82-8	ISOPROPYL BENZENE	ND	0.0005	mg/L	EPA 524.2
99-87-6	ISOPROPYL TOLUENE, PARA-	ND	0.0005	mg/L	EPA 524.2
78-93-3	METHYL ETHYL KETONE	ND	0.005	mg/L	EPA 524.2
108-10-1	METHYL ISOBUTYL KETONE	ND	0.005	mg/L	EPA 524.2
1634-04-					

4	METHYL TERT-BUTYL ETHER	ND	0.001	mg/L	EPA 524.2
75-09-2	METHYLENE CHLORIDE	ND	0.0006	mg/L	EPA 524.2
91-20-3	NAPHTHALENE	ND	0.0005	mg/L	EPA 524.2
98-95-3	NITROBENZENE	ND	0.01	mg/L	EPA 524.2
103-65-1	PROPYLBENZENE, NORMAL-	ND	0.0005	mg/L	EPA 524.2
100-42-5	STYRENE	ND	0.0005	mg/L	EPA 524.2
630-20-6	TETRACHLOROETHANE,1,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-34-5	TETRACHLOROETHANE,1,1,2,2-	ND	0.0005	mg/L	EPA 524.2
127-18-4	TETRACHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
109-99-9	TETRAHYDROFURAN	ND	0.005	mg/L	EPA 524.2
108-88-3	TOLUENE	ND	0.0005	mg/L	EPA 524.2
TTHM-00-C	TOTAL TRIHALOMETHANES	0.056	NA	mg/L	EPA 524.2
87-61-6	TRICHLOROBENZENE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
120-82-1	TRICHLOROBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
71-55-6	TRICHLOROETHANE,1,1,1-	ND	0.0005	mg/L	EPA 524.2
79-00-5	TRICHLOROETHANE,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-01-6	TRICHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
96-18-4	TRICHLOROPROPANE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
95-63-6	TRIMETHYLBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
108-67-8	TRIMETHYLBENZENE,1,3,5-	ND	0.0005	mg/L	EPA 524.2
75-01-4	VINYL CHLORIDE	ND	0.0004	mg/L	EPA 524.2
XYLMP-00-C	XYLENE,META-&PARA-	ND	0.0005	mg/L	EPA 524.2
95-47-6	XYLENE,ORTHO-	ND	0.0005	mg/L	EPA 524.2
1330-20-7	XYLENES (TOTAL)	ND	NA	mg/L	EPA 524.2
7439-97-6	MERCURY	ND	0.0001	mg/L	EPA 200.8
7440-02-0	NICKEL	ND	0.01	mg/L	EPA 200.8
14797-65-0	NITRITE AS N (AUTOMATED)	ND	0.05	mg/L	10-107-04-2-B
14797-55-8	NITRATE AS N (AUTOMATED)	0.4	0.4	mg/L	10-107-04-2-B
7439-92-1	LEAD (TOTAL)	ND	0.001	mg/L	EPA 200.8
7440-36-0	ANTIMONY	ND	0.0006	mg/L	EPA 200.8
7782-49-2	SELENIUM (TOTAL)	ND	0.001	mg/L	EPA 200.8
14808-79-8	SULFATE (AUTOMATED)	25	10	mg/L	SM 4500 SO4E
7440-28-					

0	THALLIUM	ND	0.0002 mg/L	EPA 200.8

Laboratory Comments:

By authority of PA 368 of 1978 as amended.

Print Date: Thu Oct 1
17:15:56 EDT 2015

**Michigan Department of Environmental Quality**Replicate Laboratory Report for
Lansing Drinking Water Laboratory

Owner/Location Information:

CITY OF FLINT
4500 N DORT HWY
FLINT MI 48505

Sample Number: LLF63412

Sample/Collection Information:

WSSN: 02310

County: Genesee

Township:

Section:

Well #:

Collection Date: 5/12/2015 11:33:00 AM

Arrival Date: 5/13/2015 11:26:43 AM

Site Code:

Water Source: Public Community Water Supply

Sample Reason: Routine Monitoring

Sample Point: Treated Public Distribution System

Point Description: PLANT TAP

Collector: Public Water Supply Operator

Collected By: MIKE GLASGOW

CasNo	Analyte	Result	Detect	Units	Method
16984-48-8	FLUORIDE (AUTOMATED)	0.87	0.1	mg/L	SM 4500 FC
7439-89-6	IRON	ND	0.1	mg/L	SM 3500 FeB
HARD-00-C	HARDNESS AS CaCO3	163	20	mg/L	SM 2340 C
7440-23-5	SODIUM	18	5	mg/L	SM 3500 NaB
7440-38-2	ARSENIC (TOTAL)	ND	0.002	mg/L	EPA 200.8
7440-39-3	BARIUM	0.03	0.01	mg/L	EPA 200.8
7440-41-7	BERYLLIUM	ND	0.0004	mg/L	EPA 200.8
57-12-5	CYANIDE	ND	0.02	mg/L	OIA-1677
7440-43-9	CADMIUM (TOTAL)	ND	0.0003	mg/L	EPA 200.8
7647-14-5	CHLORIDE (AUTOMATED)	90	4	mg/L	SM 4500-Cl E
7440-47-3	CHROMIUM (TOTAL)	ND	0.01	mg/L	EPA 200.8

93-76-5	2,4,5-T	ND	0.002	mg/L	EPA 515.4
93-72-1	2,4,5-TP (SILVEX)	ND	0.0002	mg/L	EPA 515.4
94-75-7	2,4-D	ND	0.001	mg/L	EPA 515.4
50594-66-6	ACIFLUORFEN	ND	0.004	mg/L	EPA 515.4
25057-89-0	BENTAZON	ND	0.002	mg/L	EPA 515.4
1918-00-9	DICAMBA	ND	0.002	mg/L	EPA 515.4
88-85-7	DINOSEB	ND	0.0002	mg/L	EPA 515.4
87-86-5	PENTACHLOROPHENOL	ND	0.00004	mg/L	EPA 515.4
1918-02-1	PICLORAM	ND	0.001	mg/L	EPA 515.4
1861-32-1	TOTAL DCPA, MONO & DI-ACID DEGRADATES	ND	0.001	mg/L	EPA 515.4
116-06-3	ALDICARB	ND	0.0005	mg/L	EPA 531.2
1646-88-4	ALDICARB SULFONE	ND	0.0005	mg/L	EPA 531.2
1646-87-3	ALDICARB SULFOXIDE	ND	0.0005	mg/L	EPA 531.2
63-25-2	CARBARYL	ND	0.001	mg/L	EPA 531.2
1563-66-2	CARBOFURAN	ND	0.0005	mg/L	EPA 531.2
16655-82-6	HYDROXYCARBOFURAN,3-	ND	0.001	mg/L	EPA 531.2
2032-65-7	METHIOCARB	ND	0.001	mg/L	EPA 531.2
16752-77-5	METHOMYL	ND	0.001	mg/L	EPA 531.2
23135-22-0	OXAMYL	ND	0.001	mg/L	EPA 531.2
114-26-1	PROPOXUR (BAYGON)	ND	0.001	mg/L	EPA 531.2
34256-82-1	ACETOCHLOR	ND	0.001	mg/L	EPA 525.2
15972-60-8	ALACHLOR	ND	0.0002	mg/L	EPA 525.2
309-00-2	ALDRIN	ND	0.0004	mg/L	EPA 525.2
1912-24-9	ATRAZINE	ND	0.0002	mg/L	EPA 525.2
5103-71-9	CHLORDANE, ALPHA-	ND	0.0002	mg/L	EPA 525.2
5103-74-2	CHLORDANE, GAMMA-	ND	0.0002	mg/L	EPA 525.2
72-54-8	DDD,4,4'-	ND	0.001	mg/L	EPA 525.2
72-55-9	DDE,4,4'-	ND	0.001	mg/L	EPA 525.2

50-29-3	DDT,4,4'-	ND	0.0005	mg/L	EPA 525.2
60-57-1	DIELDRIN	ND	0.0005	mg/L	EPA 525.2
72-20-8	ENDRIN	ND	0.0001	mg/L	EPA 525.2
7421-93-4	ENDRIN ALDEHYDE	ND	0.001	mg/L	EPA 525.2
76-44-8	HEPTACHLOR	ND	0.0002	mg/L	EPA 525.2
1024-57-3	HEPTACHLOR EPOXIDE	ND	0.0001	mg/L	EPA 525.2
118-74-1	HEXACHLOROBENZENE	ND	0.0001	mg/L	EPA 525.2
319-84-6	HEXACHLOROCYCLOHEXANE (ALPHA-BHC)	ND	0.001	mg/L	EPA 525.2
319-85-7	HEXACHLOROCYCLOHEXANE (BETA-BHC)	ND	0.001	mg/L	EPA 525.2
319-86-8	HEXACHLOROCYCLOHEXANE (DELTA-BHC)	ND	0.001	mg/L	EPA 525.2
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	0.0005	mg/L	EPA 525.2
58-89-9	LINDANE (GAMMA-BHC)	ND	0.0001	mg/L	EPA 525.2
72-43-5	METHOXYCHLOR	ND	0.0001	mg/L	EPA 525.2
51218-45-2	METOLACHLOR	ND	0.001	mg/L	EPA 525.2
21087-64-9	METRIBUZIN	ND	0.001	mg/L	EPA 525.2
2212-67-1	MOLINATE	ND	0.0005	mg/L	EPA 525.2
12674-11-2	PCB (AROCLOR 1016)	ND	0.0001	mg/L	EPA 525.2
11104-28-2	PCB (AROCLOR 1221)	ND	0.0001	mg/L	EPA 525.2
11141-16-5	PCB (AROCLOR 1232)	ND	0.0001	mg/L	EPA 525.2
53469-21-9	PCB (AROCLOR 1242)	ND	0.0001	mg/L	EPA 525.2
12672-29-6	PCB (AROCLOR 1248)	ND	0.0001	mg/L	EPA 525.2
11097-69-1	PCB (AROCLOR 1254)	ND	0.0001	mg/L	EPA 525.2
11096-82-5	PCB (AROCLOR 1260)	ND	0.0001	mg/L	EPA 525.2
59536-65-1	POLYBROMINATED BIPHENYLS	ND	0.0001	mg/L	EPA 525.2
122-34-9	SIMAZINE	ND	0.0002	mg/L	EPA 525.2
8001-35-2	TOXAPHENE	ND	0.001	mg/L	EPA 525.2
71-43-2	BENZENE	ND	0.0005	mg/L	EPA 524.2
108-86-1	BROMOBENZENE	ND	0.0005	mg/L	EPA 524.2

74-97-5	BROMOCHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
75-25-2	BROMOFORM	0.0013	0.0005	mg/L	EPA 524.2
74-83-9	BROMOMETHANE	ND	0.001	mg/L	EPA 524.2
104-51-8	BUTYLBENZENE,NORMAL-	ND	0.0005	mg/L	EPA 524.2
135-98-8	BUTYLBENZENE,SEC-	ND	0.0005	mg/L	EPA 524.2
98-06-6	BUTYLBENZENE,TERT-	ND	0.0005	mg/L	EPA 524.2
56-23-5	CARBON TETRACHLORIDE	ND	0.0005	mg/L	EPA 524.2
108-90-7	CHLOROBENZENE	ND	0.0005	mg/L	EPA 524.2
124-48-1	CHLORODIBROMOMETHANE	0.0077	0.0005	mg/L	EPA 524.2
75-00-3	CHLOROETHANE	ND	0.0005	mg/L	EPA 524.2
67-66-3	CHLOROFORM	0.0072	0.0005	mg/L	EPA 524.2
74-87-3	CHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
95-49-8	CHLOROTOLUENE,2-	ND	0.0005	mg/L	EPA 524.2
106-43-4	CHLOROTOLUENE,4-	ND	0.0005	mg/L	EPA 524.2
74-95-3	DIBROMOMETHANE	ND	0.0005	mg/L	EPA 524.2
95-50-1	DICHLOROBENZENE,1,2-	ND	0.0005	mg/L	EPA 524.2
541-73-1	DICHLOROBENZENE,1,3-	ND	0.0005	mg/L	EPA 524.2
106-46-7	DICHLOROBENZENE,1,4-	ND	0.0005	mg/L	EPA 524.2
75-27-4	DICHLOROBROMOMETHANE	0.0099	0.0005	mg/L	EPA 524.2
75-71-8	DICHLORODIFLUOROMETHANE	ND	0.001	mg/L	EPA 524.2
75-34-3	DICHLOROETHANE,1,1-	ND	0.0005	mg/L	EPA 524.2
107-06-2	DICHLOROETHANE,1,2-	ND	0.0005	mg/L	EPA 524.2
75-35-4	DICHLOROETHYLENE,1,1-	ND	0.0005	mg/L	EPA 524.2
156-59-2	DICHLOROETHYLENE,1,2-CIS	ND	0.0005	mg/L	EPA 524.2
156-60-5	DICHLOROETHYLENE,1,2-TRANS	ND	0.0005	mg/L	EPA 524.2
78-87-5	DICHLOROPROPANE,1,2-	ND	0.0005	mg/L	EPA 524.2
142-28-9	DICHLOROPROPANE,1,3-	ND	0.0005	mg/L	EPA 524.2
594-20-7	DICHLOROPROPANE,2,2-	ND	0.0005	mg/L	EPA 524.2
563-58-6	DICHLOROPROPENE,1,1-	ND	0.0005	mg/L	EPA 524.2
10061-01-5	DICHLOROPROPENE,1,3-CIS	ND	0.0005	mg/L	EPA 524.2
10061-02-6	DICHLOROPROPENE,1,3-TRANS	ND	0.0005	mg/L	EPA 524.2
100-41-4	ETHYLBENZENE	ND	0.0005	mg/L	EPA 524.2
75-69-4	FLUOROTRICHLOROMETHANE	ND	0.001	mg/L	EPA 524.2
87-68-3	HEXACHLOROBUTADIENE	ND	0.0005	mg/L	EPA 524.2
98-82-8	ISOPROPYL BENZENE	ND	0.0005	mg/L	EPA 524.2
99-87-6	ISOPROPYL TOLUENE, PARA-	ND	0.0005	mg/L	EPA 524.2
78-93-3	METHYL ETHYL KETONE	ND	0.005	mg/L	EPA 524.2
108-10-1	METHYL ISOBUTYL KETONE	ND	0.005	mg/L	EPA 524.2
1634-04-4	METHYL TERT-BUTYL ETHER	ND	0.001	mg/L	EPA 524.2

75-09-2	METHYLENE CHLORIDE	ND	0.0006	mg/L	EPA 524.2
91-20-3	NAPHTHALENE	ND	0.0005	mg/L	EPA 524.2
103-65-1	PROPYLBENZENE, NORMAL-	ND	0.0005	mg/L	EPA 524.2
100-42-5	STYRENE	ND	0.0005	mg/L	EPA 524.2
630-20-6	TETRACHLOROETHANE,1,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-34-5	TETRACHLOROETHANE,1,1,2,2-	ND	0.0005	mg/L	EPA 524.2
127-18-4	TETRACHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
109-99-9	TETRAHYDROFURAN	ND	0.005	mg/L	EPA 524.2
108-88-3	TOLUENE	ND	0.0005	mg/L	EPA 524.2
TTHM-00-C	TOTAL TRIHALOMETHANES	0.026	NA	mg/L	EPA 524.2
87-61-6	TRICHLOROBENZENE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
120-82-1	TRICHLOROBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
71-55-6	TRICHLOROETHANE,1,1,1-	ND	0.0005	mg/L	EPA 524.2
79-00-5	TRICHLOROETHANE,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-01-6	TRICHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
96-18-4	TRICHLOROPROPANE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
95-63-6	TRIMETHYLBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
108-67-8	TRIMETHYLBENZENE,1,3,5-	ND	0.0005	mg/L	EPA 524.2
75-01-4	VINYL CHLORIDE	ND	0.0005	mg/L	EPA 524.2
XYLMP-00-C	XYLENE,META-&PARA-	ND	0.0005	mg/L	EPA 524.2
95-47-6	XYLENE,ORTHO-	ND	0.0005	mg/L	EPA 524.2
1330-20-7	XYLENES (TOTAL)	ND	NA	mg/L	EPA 524.2
7439-97-6	MERCURY	ND	0.0001	mg/L	EPA 200.8
7440-02-0	NICKEL	ND	0.01	mg/L	EPA 200.8
14797-65-0	NITRITE AS N (AUTOMATED)	ND	0.05	mg/L	10-107-04-2-B
14797-55-8	NITRATE AS N (AUTOMATED)	ND	0.4	mg/L	10-107-04-2-B
7439-92-1	LEAD (TOTAL)	ND	0.001	mg/L	EPA 200.8
7440-36-0	ANTIMONY	ND	0.0006	mg/L	EPA 200.8
7782-49-2	SELENIUM (TOTAL)	ND	0.001	mg/L	EPA 200.8
14808-79-8	SULFATE (AUTOMATED)	31	10	mg/L	SM 4500 SO4E
7440-28-0	THALLIUM	ND	0.0002	mg/L	EPA 200.8

Laboratory Comments:

By authority of PA 368 of 1978 as amended.

Print Date: Thu Oct 1
17:13:08 EDT 2015

**Michigan Department of Environmental Quality**Replicate Laboratory Report for
Lansing Drinking Water Laboratory

Owner/Location Information:

CITY OF FLINT
4500 N DORT HWY
FLINT MI 48505

Sample Number: LLF77582

Sample/Collection Information:

WSSN: 02310

County: Genesee

Township:

Section:

Well #:

Collection Date: 8/11/2015 10:00:00 AM

Arrival Date: 8/12/2015 1:21:17 PM

Site Code:

Water Source: Public Community Water Supply

Sample Reason: Routine Monitoring

Sample Point: Treated Public Distribution System

Point Description: PLANT TAP

Collector: Public Water Supply Operator

Collected By: C BEATENHEAD

CasNo	Analyte	Result	Detect	Units	Method
16984-48-8	FLUORIDE (AUTOMATED)	0.83	0.1	mg/L	SM 4500 FC
7439-89-6	IRON	ND	0.1	mg/L	SM 3500 FeB
HARD-00-C	HARDNESS AS CaCO3	110	20	mg/L	SM 2340 C
7440-23-5	SODIUM	18	5	mg/L	SM 3500 NaB
7440-38-2	ARSENIC (TOTAL)	ND	0.002	mg/L	EPA 200.8
7440-39-3	BARIUM	0.02	0.01	mg/L	EPA 200.8
7440-41-7	BERYLLIUM	ND	0.0004	mg/L	EPA 200.8
57-12-5	CYANIDE	ND	0.02	mg/L	OIA-1677
7440-43-9	CADMIUM (TOTAL)	ND	0.0003	mg/L	EPA 200.8
7647-14-5	CHLORIDE (AUTOMATED)	79	4	mg/L	SM 4500-Cl E
7440-47-3	CHROMIUM (TOTAL)	ND	0.01	mg/L	EPA 200.8

93-76-5	2,4,5-T	ND	0.002	mg/L	EPA 515.4
93-72-1	2,4,5-TP (SILVEX)	ND	0.0002	mg/L	EPA 515.4
94-75-7	2,4-D	ND	0.001	mg/L	EPA 515.4
50594-66-6	ACIFLUORFEN	ND	0.004	mg/L	EPA 515.4
25057-89-0	BENTAZON	ND	0.002	mg/L	EPA 515.4
1918-00-9	DICAMBA	ND	0.002	mg/L	EPA 515.4
88-85-7	DINOSEB	ND	0.0002	mg/L	EPA 515.4
87-86-5	PENTACHLOROPHENOL	ND	0.00004	mg/L	EPA 515.4
1918-02-1	PICLORAM	ND	0.001	mg/L	EPA 515.4
1861-32-1	TOTAL DCPA, MONO & DI-ACID DEGRADATES	ND	0.001	mg/L	EPA 515.4
116-06-3	ALDICARB	ND	0.0005	mg/L	EPA 531.2
1646-88-4	ALDICARB SULFONE	ND	0.0005	mg/L	EPA 531.2
1646-87-3	ALDICARB SULFOXIDE	ND	0.0005	mg/L	EPA 531.2
63-25-2	CARBARYL	ND	0.001	mg/L	EPA 531.2
1563-66-2	CARBOFURAN	ND	0.0005	mg/L	EPA 531.2
16655-82-6	HYDROXYCARBOFURAN,3-	ND	0.001	mg/L	EPA 531.2
2032-65-7	METHIOCARB	ND	0.001	mg/L	EPA 531.2
16752-77-5	METHOMYL	ND	0.001	mg/L	EPA 531.2
23135-22-0	OXAMYL	ND	0.001	mg/L	EPA 531.2
114-26-1	PROPOXUR (BAYGON)	ND	0.001	mg/L	EPA 531.2
34256-82-1	ACETOCHLOR	ND	0.001	mg/L	EPA 525.2
15972-60-8	ALACHLOR	ND	0.0002	mg/L	EPA 525.2
309-00-2	ALDRIN	ND	0.0004	mg/L	EPA 525.2
1912-24-9	ATRAZINE	ND	0.0002	mg/L	EPA 525.2
5103-71-9	CHLORDANE, ALPHA-	ND	0.0002	mg/L	EPA 525.2
5103-74-2	CHLORDANE, GAMMA-	ND	0.0002	mg/L	EPA 525.2
72-54-8	DDD,4,4'-	ND	0.001	mg/L	EPA 525.2
72-55-9	DDE,4,4'-	ND	0.001	mg/L	EPA 525.2

50-29-3	DDT,4,4'-	ND	0.0005	mg/L	EPA 525.2
60-57-1	DIELDRIN	ND	0.0005	mg/L	EPA 525.2
72-20-8	ENDRIN	ND	0.0001	mg/L	EPA 525.2
7421-93-4	ENDRIN ALDEHYDE	ND	0.001	mg/L	EPA 525.2
76-44-8	HEPTACHLOR	ND	0.0002	mg/L	EPA 525.2
1024-57-3	HEPTACHLOR EPOXIDE	ND	0.0001	mg/L	EPA 525.2
118-74-1	HEXACHLOROBENZENE	ND	0.0001	mg/L	EPA 525.2
319-84-6	HEXACHLOROCYCLOHEXANE (ALPHA-BHC)	ND	0.001	mg/L	EPA 525.2
319-85-7	HEXACHLOROCYCLOHEXANE (BETA-BHC)	ND	0.001	mg/L	EPA 525.2
319-86-8	HEXACHLOROCYCLOHEXANE (DELTA-BHC)	ND	0.001	mg/L	EPA 525.2
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	0.0005	mg/L	EPA 525.2
58-89-9	LINDANE (GAMMA-BHC)	ND	0.0001	mg/L	EPA 525.2
72-43-5	METHOXYCHLOR	ND	0.0001	mg/L	EPA 525.2
51218-45-2	METOLACHLOR	ND	0.001	mg/L	EPA 525.2
21087-64-9	METRIBUZIN	ND	0.001	mg/L	EPA 525.2
2212-67-1	MOLINATE	ND	0.0005	mg/L	EPA 525.2
12674-11-2	PCB (AROCLOR 1016)	ND	0.0001	mg/L	EPA 525.2
11104-28-2	PCB (AROCLOR 1221)	ND	0.0001	mg/L	EPA 525.2
11141-16-5	PCB (AROCLOR 1232)	ND	0.0001	mg/L	EPA 525.2
53469-21-9	PCB (AROCLOR 1242)	ND	0.0001	mg/L	EPA 525.2
12672-29-6	PCB (AROCLOR 1248)	ND	0.0001	mg/L	EPA 525.2
11097-69-1	PCB (AROCLOR 1254)	ND	0.0001	mg/L	EPA 525.2
11096-82-5	PCB (AROCLOR 1260)	ND	0.0001	mg/L	EPA 525.2
59536-65-1	POLYBROMINATED BIPHENYLS	ND	0.0001	mg/L	EPA 525.2
122-34-9	SIMAZINE	ND	0.0002	mg/L	EPA 525.2
8001-35-2	TOXAPHENE	ND	0.001	mg/L	EPA 525.2
71-43-2	BENZENE	ND	0.0005	mg/L	EPA 524.2
108-86-1	BROMOBENZENE	ND	0.0005	mg/L	EPA 524.2

74-97-5	BROMOCHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
75-25-2	BROMOFORM	0.0013	0.0005	mg/L	EPA 524.2
74-83-9	BROMOMETHANE	ND	0.001	mg/L	EPA 524.2
104-51-8	BUTYLBENZENE,NORMAL-	ND	0.0005	mg/L	EPA 524.2
135-98-8	BUTYLBENZENE,SEC-	ND	0.0005	mg/L	EPA 524.2
98-06-6	BUTYLBENZENE,TERT-	ND	0.0005	mg/L	EPA 524.2
56-23-5	CARBON TETRACHLORIDE	ND	0.0005	mg/L	EPA 524.2
108-90-7	CHLOROBENZENE	ND	0.0005	mg/L	EPA 524.2
124-48-1	CHLORODIBROMOMETHANE	0.0052	0.0005	mg/L	EPA 524.2
75-00-3	CHLOROETHANE	ND	0.0005	mg/L	EPA 524.2
67-66-3	CHLOROFORM	0.0015	0.0005	mg/L	EPA 524.2
74-87-3	CHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
95-49-8	CHLOROTOLUENE,2-	ND	0.0005	mg/L	EPA 524.2
106-43-4	CHLOROTOLUENE,4-	ND	0.0005	mg/L	EPA 524.2
74-95-3	DIBROMOMETHANE	ND	0.0005	mg/L	EPA 524.2
95-50-1	DICHLOROBENZENE,1,2-	ND	0.0005	mg/L	EPA 524.2
541-73-1	DICHLOROBENZENE,1,3-	ND	0.0005	mg/L	EPA 524.2
106-46-7	DICHLOROBENZENE,1,4-	ND	0.0005	mg/L	EPA 524.2
75-27-4	DICHLOROBROMOMETHANE	0.0036	0.0005	mg/L	EPA 524.2
75-71-8	DICHLORODIFLUOROMETHANE	ND	0.001	mg/L	EPA 524.2
75-34-3	DICHLOROETHANE,1,1-	ND	0.0005	mg/L	EPA 524.2
107-06-2	DICHLOROETHANE,1,2-	ND	0.0005	mg/L	EPA 524.2
75-35-4	DICHLOROETHYLENE,1,1-	ND	0.0005	mg/L	EPA 524.2
156-59-2	DICHLOROETHYLENE,1,2-CIS	ND	0.0005	mg/L	EPA 524.2
156-60-5	DICHLOROETHYLENE,1,2-TRANS	ND	0.0005	mg/L	EPA 524.2
78-87-5	DICHLOROPROPANE,1,2-	ND	0.0005	mg/L	EPA 524.2
142-28-9	DICHLOROPROPANE,1,3-	ND	0.0005	mg/L	EPA 524.2
594-20-7	DICHLOROPROPANE,2,2-	ND	0.0005	mg/L	EPA 524.2
563-58-6	DICHLOROPROPENE,1,1-	ND	0.0005	mg/L	EPA 524.2
10061-01-5	DICHLOROPROPENE,1,3-CIS	ND	0.0005	mg/L	EPA 524.2
10061-02-6	DICHLOROPROPENE,1,3-TRANS	ND	0.0005	mg/L	EPA 524.2
100-41-4	ETHYLBENZENE	ND	0.0005	mg/L	EPA 524.2
75-69-4	FLUOROTRICHLOROMETHANE	ND	0.001	mg/L	EPA 524.2
87-68-3	HEXACHLOROBUTADIENE	ND	0.0005	mg/L	EPA 524.2
98-82-8	ISOPROPYL BENZENE	ND	0.0005	mg/L	EPA 524.2
99-87-6	ISOPROPYL TOLUENE, PARA-	ND	0.0005	mg/L	EPA 524.2
78-93-3	METHYL ETHYL KETONE	ND	0.005	mg/L	EPA 524.2
108-10-1	METHYL ISOBUTYL KETONE	ND	0.005	mg/L	EPA 524.2
1634-04-4	METHYL TERT-BUTYL ETHER	ND	0.001	mg/L	EPA 524.2

75-09-2	METHYLENE CHLORIDE	ND	0.0006	mg/L	EPA 524.2
91-20-3	NAPHTHALENE	ND	0.0005	mg/L	EPA 524.2
103-65-1	PROPYLBENZENE, NORMAL-	ND	0.0005	mg/L	EPA 524.2
100-42-5	STYRENE	ND	0.0005	mg/L	EPA 524.2
630-20-6	TETRACHLOROETHANE,1,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-34-5	TETRACHLOROETHANE,1,1,2,2-	ND	0.0005	mg/L	EPA 524.2
127-18-4	TETRACHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
109-99-9	TETRAHYDROFURAN	ND	0.005	mg/L	EPA 524.2
108-88-3	TOLUENE	ND	0.0005	mg/L	EPA 524.2
TTHM-00-C	TOTAL TRIHALOMETHANES	0.012	NA	mg/L	EPA 524.2
87-61-6	TRICHLOROBENZENE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
120-82-1	TRICHLOROBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
71-55-6	TRICHLOROETHANE,1,1,1-	ND	0.0005	mg/L	EPA 524.2
79-00-5	TRICHLOROETHANE,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-01-6	TRICHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
96-18-4	TRICHLOROPROPANE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
95-63-6	TRIMETHYLBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
108-67-8	TRIMETHYLBENZENE,1,3,5-	ND	0.0005	mg/L	EPA 524.2
75-01-4	VINYL CHLORIDE	ND	0.0005	mg/L	EPA 524.2
XYLMP-00-C	XYLENE,META-&PARA-	ND	0.0005	mg/L	EPA 524.2
95-47-6	XYLENE,ORTHO-	ND	0.0005	mg/L	EPA 524.2
1330-20-7	XYLENES (TOTAL)	ND	NA	mg/L	EPA 524.2
7439-97-6	MERCURY	ND	0.0001	mg/L	EPA 200.8
7440-02-0	NICKEL	ND	0.01	mg/L	EPA 200.8
14797-65-0	NITRITE AS N (AUTOMATED)	ND	0.05	mg/L	10-107-04-2-B
14797-55-8	NITRATE AS N (AUTOMATED)	ND	0.4	mg/L	10-107-04-2-B
7439-92-1	LEAD (TOTAL)	ND	0.001	mg/L	EPA 200.8
7440-36-0	ANTIMONY	ND	0.0006	mg/L	EPA 200.8
7782-49-2	SELENIUM (TOTAL)	ND	0.001	mg/L	EPA 200.8
14808-79-8	SULFATE (AUTOMATED)	21	10	mg/L	SM 4500 SO4E
7440-28-0	THALLIUM	ND	0.0002	mg/L	EPA 200.8

Laboratory Comments:

Matrix spike recovery was below the acceptance criteria due to the presence of residual chlorine in the sample. This does not affect the validity of the sample result.

By authority of PA 368 of 1978 as amended.

Print Date: Thu Oct 1
17:12:44 EDT 2015

**Michigan Department of Environmental Quality**Replicate Laboratory Report for
Lansing Drinking Water Laboratory

Owner/Location Information:

CITY OF FLINT
4500 N DORT HWY
FLINT MI 48505

Sample Number: LLF52712

Sample/Collection Information:

WSSN: 02310

County: Genesee

Township:

Section:

Well #:

Collection Date: 1/22/2015 10:00:00 AM

Arrival Date: 1/23/2015 8:37:00 AM

Site Code:

Water Source: Public Community Water Supply

Sample Reason: Other

Sample Point: Treated Public Distribution System

Point Description: PLANT TAP

Collector: Public Water Supply Operator

Collected By: MIKE GLASGOW

CasNo	Analyte	Result	Detect	Units	Method
7440-38-2	ARSENIC (TOTAL)	ND	0.002	mg/L	EPA 200.8
7440-39-3	BARIUM	0.01	0.01	mg/L	EPA 200.8
7440-41-7	BERYLLIUM	ND	0.0004	mg/L	EPA 200.8
7440-43-9	CADMIUM (TOTAL)	ND	0.0003	mg/L	EPA 200.8
7440-47-3	CHROMIUM (TOTAL)	ND	0.01	mg/L	EPA 200.8
7439-97-6	MERCURY	ND	0.0001	mg/L	EPA 200.8
7440-02-0	NICKEL	ND	0.01	mg/L	EPA 200.8
7439-92-1	LEAD (TOTAL)	ND	0.001	mg/L	EPA 200.8
7440-36-0	ANTIMONY	ND	0.0006	mg/L	EPA 200.8
7782-49-2	SELENIUM (TOTAL)	0.001	0.001	mg/L	EPA 200.8
7440-28-					

0	THALLIUM	ND	0.0002	mg/L	EPA 200.8

Laboratory Comments:

By authority of PA 368 of 1978 as amended.

Print Date: Thu Oct 1
17:14:07 EDT 2015

**Michigan Department of Environmental Quality**Replicate Laboratory Report for
Lansing Drinking Water Laboratory

Owner/Location Information:

CITY OF FLINT
CITY OF FLINT WATER
PLANT
FLINT MI 48505

Sample Number: LLF31222

Sample/Collection Information:

WSSN: 02310
County: Genesee

Township:

Section:

Well #:

Collection Date: 8/6/2014 2:30:00 PM

Arrival Date: 8/6/2014 4:23:13 PM

Site Code:

Water Source: Other

Sample Reason: Other

Sample Point: Other

Point Description: PLANT TAP

Collector: Public Water Supply Operator

Collected By: MIKE GLASGOW

CasNo	Analyte	Result	Detect	Units	Method
16984-48-8	FLUORIDE (AUTOMATED)	0.70	0.1	mg/L	SM 4500 FC
7439-89-6	IRON	ND	0.1	mg/L	SM 3500 FeB
HARD-00-C	HARDNESS AS CaCO3	155	20	mg/L	SM 2340 C
7440-23-5	SODIUM	16	5	mg/L	SM 3500 NaB
7440-38-2	ARSENIC (TOTAL)	ND	0.002	mg/L	EPA 200.8
7440-39-3	BARIUM	0.03	0.01	mg/L	EPA 200.8
7440-41-7	BERYLLIUM	ND	0.0004	mg/L	EPA 200.8
7440-43-9	CADMIUM (TOTAL)	ND	0.0003	mg/L	EPA 200.8
7647-14-5	CHLORIDE (AUTOMATED)	61	4	mg/L	SM 4500-Cl E
7440-47-3	CHROMIUM (TOTAL)	ND	0.01	mg/L	EPA 200.8
93-76-5	2,4,5-T	ND	0.002	mg/L	EPA 515.4

93-72-1	2,4,5-TP (SILVEX)	ND	0.0003	mg/L	EPA 515.4
94-75-7	2,4-D	ND	0.002	mg/L	EPA 515.4
50594-66-6	ACIFLUORFEN	ND	0.004	mg/L	EPA 515.4
25057-89-0	BENTAZON	ND	0.002	mg/L	EPA 515.4
1918-00-9	DICAMBA	ND	0.002	mg/L	EPA 515.4
88-85-7	DINOSEB	ND	0.0003	mg/L	EPA 515.4
87-86-5	PENTACHLOROPHENOL	ND	0.00006	mg/L	EPA 515.4
1918-02-1	PICLORAM	ND	0.001	mg/L	EPA 515.4
1861-32-1	TOTAL DCPA, MONO & DI-ACID DEGRADATES	ND	0.001	mg/L	EPA 515.4
116-06-3	ALDICARB	ND	0.0005	mg/L	EPA 531.2
1646-88-4	ALDICARB SULFONE	ND	0.0005	mg/L	EPA 531.2
1646-87-3	ALDICARB SULFOXIDE	ND	0.0005	mg/L	EPA 531.2
63-25-2	CARBARYL	ND	0.001	mg/L	EPA 531.2
1563-66-2	CARBOFURAN	ND	0.0005	mg/L	EPA 531.2
16655-82-6	HYDROXYCARBOFURAN,3-	ND	0.001	mg/L	EPA 531.2
2032-65-7	METHIOCARB	ND	0.001	mg/L	EPA 531.2
16752-77-5	METHOMYL	ND	0.001	mg/L	EPA 531.2
23135-22-0	OXAMYL	ND	0.001	mg/L	EPA 531.2
114-26-1	PROPOXUR (BAYGON)	ND	0.001	mg/L	EPA 531.2
34256-82-1	ACETOCHLOR	ND	0.001	mg/L	EPA 525.2
15972-60-8	ALACHLOR	ND	0.0002	mg/L	EPA 525.2
309-00-2	ALDRIN	ND	0.0004	mg/L	EPA 525.2
1912-24-9	ATRAZINE	0.0003	0.0002	mg/L	EPA 525.2
5103-71-9	CHLORDANE, ALPHA-	ND	0.0002	mg/L	EPA 525.2
5103-74-2	CHLORDANE, GAMMA-	ND	0.0002	mg/L	EPA 525.2
72-54-8	DDD,4,4'-	ND	0.001	mg/L	EPA 525.2
72-55-9	DDE,4,4'-	ND	0.001	mg/L	EPA 525.2
50-29-3	DDT,4,4'-	ND	0.0005	mg/L	EPA 525.2

60-57-1	DIELDRIN	ND	0.0005	mg/L	EPA 525.2
72-20-8	ENDRIN	ND	0.0001	mg/L	EPA 525.2
7421-93-4	ENDRIN ALDEHYDE	ND	0.001	mg/L	EPA 525.2
76-44-8	HEPTACHLOR	ND	0.0002	mg/L	EPA 525.2
1024-57-3	HEPTACHLOR EPOXIDE	ND	0.0001	mg/L	EPA 525.2
118-74-1	HEXACHLOROBENZENE	ND	0.0001	mg/L	EPA 525.2
319-84-6	HEXACHLOROCYCLOHEXANE (ALPHA-BHC)	ND	0.001	mg/L	EPA 525.2
319-85-7	HEXACHLOROCYCLOHEXANE (BETA-BHC)	ND	0.001	mg/L	EPA 525.2
319-86-8	HEXACHLOROCYCLOHEXANE (DELTA-BHC)	ND	0.001	mg/L	EPA 525.2
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	0.0005	mg/L	EPA 525.2
58-89-9	LINDANE (GAMMA-BHC)	ND	0.0001	mg/L	EPA 525.2
72-43-5	METHOXYCHLOR	ND	0.0001	mg/L	EPA 525.2
51218-45-2	METOLACHLOR	ND	0.001	mg/L	EPA 525.2
21087-64-9	METRIBUZIN	ND	0.001	mg/L	EPA 525.2
2212-67-1	MOLINATE	ND	0.0005	mg/L	EPA 525.2
12674-11-2	PCB (AROCLOR 1016)	ND	0.0001	mg/L	EPA 525.2
11104-28-2	PCB (AROCLOR 1221)	ND	0.0001	mg/L	EPA 525.2
11141-16-5	PCB (AROCLOR 1232)	ND	0.0001	mg/L	EPA 525.2
53469-21-9	PCB (AROCLOR 1242)	ND	0.0001	mg/L	EPA 525.2
12672-29-6	PCB (AROCLOR 1248)	ND	0.0001	mg/L	EPA 525.2
11097-69-1	PCB (AROCLOR 1254)	ND	0.0001	mg/L	EPA 525.2
11096-82-5	PCB (AROCLOR 1260)	ND	0.0001	mg/L	EPA 525.2
59536-65-1	POLYBROMINATED BIPHENYLS	ND	0.0001	mg/L	EPA 525.2
122-34-9	SIMAZINE	ND	0.0002	mg/L	EPA 525.2
8001-35-2	TOXAPHENE	ND	0.001	mg/L	EPA 525.2
71-43-2	BENZENE	ND	0.0005	mg/L	EPA 524.2
108-86-1	BROMOBENZENE	ND	0.0005	mg/L	EPA 524.2
74-97-5	BROMOCHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2

75-25-2	BROMOFORM	0.0018	0.0005	mg/L	EPA 524.2
74-83-9	BROMOMETHANE	ND	0.001	mg/L	EPA 524.2
104-51-8	BUTYLBENZENE,NORMAL-	ND	0.0005	mg/L	EPA 524.2
135-98-8	BUTYLBENZENE,SEC-	ND	0.0005	mg/L	EPA 524.2
98-06-6	BUTYLBENZENE,TERT-	ND	0.0005	mg/L	EPA 524.2
56-23-5	CARBON TETRACHLORIDE	ND	0.0005	mg/L	EPA 524.2
108-90-7	CHLOROBENZENE	ND	0.0005	mg/L	EPA 524.2
124-48-1	CHLORODIBROMOMETHANE	0.015	0.0005	mg/L	EPA 524.2
75-00-3	CHLOROETHANE	ND	0.0005	mg/L	EPA 524.2
67-66-3	CHLOROFORM	0.045	0.0005	mg/L	EPA 524.2
74-87-3	CHLOROMETHANE	ND	0.0005	mg/L	EPA 524.2
95-49-8	CHLOROTOLUENE,2-	ND	0.0005	mg/L	EPA 524.2
106-43-4	CHLOROTOLUENE,4-	ND	0.0005	mg/L	EPA 524.2
74-95-3	DIBROMOMETHANE	ND	0.0005	mg/L	EPA 524.2
95-50-1	DICHLOROBENZENE,1,2-	ND	0.0005	mg/L	EPA 524.2
541-73-1	DICHLOROBENZENE,1,3-	ND	0.0005	mg/L	EPA 524.2
106-46-7	DICHLOROBENZENE,1,4-	ND	0.0005	mg/L	EPA 524.2
75-27-4	DICHLOROBROMOMETHANE	0.024	0.0005	mg/L	EPA 524.2
75-71-8	DICHLORODIFLUOROMETHANE	ND	0.001	mg/L	EPA 524.2
75-34-3	DICHLOROETHANE,1,1-	ND	0.0005	mg/L	EPA 524.2
107-06-2	DICHLOROETHANE,1,2-	ND	0.0005	mg/L	EPA 524.2
75-35-4	DICHLOROETHYLENE,1,1-	ND	0.0005	mg/L	EPA 524.2
156-59-2	DICHLOROETHYLENE,1,2-CIS	ND	0.0005	mg/L	EPA 524.2
156-60-5	DICHLOROETHYLENE,1,2-TRANS	ND	0.0005	mg/L	EPA 524.2
78-87-5	DICHLOROPROPANE,1,2-	ND	0.0005	mg/L	EPA 524.2
142-28-9	DICHLOROPROPANE,1,3-	ND	0.0005	mg/L	EPA 524.2
594-20-7	DICHLOROPROPANE,2,2-	ND	0.0005	mg/L	EPA 524.2
563-58-6	DICHLOROPROPENE,1,1-	ND	0.0005	mg/L	EPA 524.2
10061-01-5	DICHLOROPROPENE,1,3-CIS	ND	0.0005	mg/L	EPA 524.2
10061-02-6	DICHLOROPROPENE,1,3-TRANS	ND	0.0005	mg/L	EPA 524.2
100-41-4	ETHYLBENZENE	ND	0.0005	mg/L	EPA 524.2
75-69-4	FLUOROTRICHLOROMETHANE	ND	0.001	mg/L	EPA 524.2
87-68-3	HEXACHLOROBUTADIENE	ND	0.0005	mg/L	EPA 524.2
98-82-8	ISOPROPYL BENZENE	ND	0.0005	mg/L	EPA 524.2
99-87-6	ISOPROPYL TOLUENE, PARA-	ND	0.0005	mg/L	EPA 524.2
78-93-3	METHYL ETHYL KETONE	ND	0.005	mg/L	EPA 524.2
108-10-1	METHYL ISOBUTYL KETONE	ND	0.005	mg/L	EPA 524.2
1634-04-4	METHYL TERT-BUTYL ETHER	ND	0.001	mg/L	EPA 524.2
75-09-2	METHYLENE CHLORIDE	ND	0.0006	mg/L	EPA 524.2

91-20-3	NAPHTHALENE	ND	0.0005	mg/L	EPA 524.2
98-95-3	NITROBENZENE	ND	0.01	mg/L	EPA 524.2
103-65-1	PROPYLBENZENE, NORMAL-	ND	0.0005	mg/L	EPA 524.2
100-42-5	STYRENE	ND	0.0005	mg/L	EPA 524.2
630-20-6	TETRACHLOROETHANE,1,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-34-5	TETRACHLOROETHANE,1,1,2,2-	ND	0.0005	mg/L	EPA 524.2
127-18-4	TETRACHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
109-99-9	TETRAHYDROFURAN	ND	0.005	mg/L	EPA 524.2
108-88-3	TOLUENE	ND	0.0005	mg/L	EPA 524.2
TTHM-00-C	TOTAL TRIHALOMETHANES	0.086	NA	mg/L	EPA 524.2
87-61-6	TRICHLOROBENZENE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
120-82-1	TRICHLOROBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
71-55-6	TRICHLOROETHANE,1,1,1-	ND	0.0005	mg/L	EPA 524.2
79-00-5	TRICHLOROETHANE,1,1,2-	ND	0.0005	mg/L	EPA 524.2
79-01-6	TRICHLOROETHYLENE	ND	0.0005	mg/L	EPA 524.2
96-18-4	TRICHLOROPROPANE,1,2,3-	ND	0.0005	mg/L	EPA 524.2
95-63-6	TRIMETHYLBENZENE,1,2,4-	ND	0.0005	mg/L	EPA 524.2
108-67-8	TRIMETHYLBENZENE,1,3,5-	ND	0.0005	mg/L	EPA 524.2
75-01-4	VINYL CHLORIDE	ND	0.0004	mg/L	EPA 524.2
XYLMP-00-C	XYLENE,META-&PARA-	ND	0.0005	mg/L	EPA 524.2
95-47-6	XYLENE,ORTHO-	ND	0.0005	mg/L	EPA 524.2
1330-20-7	XYLENES (TOTAL)	ND	NA	mg/L	EPA 524.2
7439-97-6	MERCURY	ND	0.0001	mg/L	EPA 200.8
7440-02-0	NICKEL	ND	0.01	mg/L	EPA 200.8
14797-65-0	NITRITE AS N (AUTOMATED)	ND	0.05	mg/L	10-107-04-2-B
14797-55-8	NITRATE AS N (AUTOMATED)	0.5	0.4	mg/L	10-107-04-2-B
7439-92-1	LEAD (TOTAL)	ND	0.001	mg/L	EPA 200.8
7440-36-0	ANTIMONY	ND	0.0006	mg/L	EPA 200.8
7782-49-2	SELENIUM (TOTAL)	0.001	0.001	mg/L	EPA 200.8
14808-79-8	SULFATE (AUTOMATED)	23	10	mg/L	SM 4500 SO4E
7440-28-0	THALLIUM	ND	0.0002	mg/L	EPA 200.8

Laboratory Comments:

By authority of PA 368 of 1978 as amended.

Print Date: Thu Oct 1
17:15:37 EDT 2015

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, March 30, 2015 3:27 PM
To: Benzie, Richard (DEQ); Shekter Smith, Liane (DEQ)
Subject: Fwd: FYI: Kildee Letter to EPA on SRF Loan Forgiveness
Attachments: image001.gif; ATT00001.htm; image002.gif; ATT00002.htm; image003.jpg; ATT00003.htm; image004.png; ATT00004.htm; 03-27-15 - SRF Loan Forgiveness for Flint - EPA (McCarthy).pdf; ATT00005.htm

Here's the string

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

Sent from my iPhone

Begin forwarded message:

From: "Crooks, Jennifer" <crooks.jennifer@epa.gov>
Date: March 30, 2015 at 3:00:29 PM EDT
To: "Prysby, Mike (DEQ)" <PRYSBYM@michigan.gov>, "Busch, Stephen (DEQ)" <BUSCHS@michigan.gov>
Subject: **FYI: Kildee Letter to EPA on SRF Loan Forgiveness**

Here is the issue – Flint has an old SRF loan and they want principle forgiveness. We told them it was not allowed as PF is for initial financing....and for debt incurred on or after the enactment of the act pursuant to the approps text.

Please let me know if we should work with someone on this. thanks

Steve Marquardt
 USEPA Region 5
 77 West Jackson Blvd
 Chicago, Illinois 60604
 (312)353-3214

From: Deamer, Eileen
Sent: Monday, March 30, 2015 8:42 AM
To: Marquardt, Steve
Cc: Baltazar, Debbie; Fortin, Denise
Subject: FW: Kildee Letter to EPA on SRF Loan Forgiveness

I haven't completely gone through the letter, but giving you a heads up that we will be assigned this letter for response. Eileen

From: Davis, CatherineM
Sent: Monday, March 30, 2015 8:30 AM
To: Eades, Cassaundra; Mims, Kathy
Cc: Deamer, Eileen
Subject: Fw: Kildee Letter to EPA on SRF Loan Forgiveness

Hi Sandy and Kathy,

Can you put this in CMS and assign it to R5? They've been working with Cong. Kildee's office on this issue.

Thanks,
Cathy Davis
Office of Congressional and Intergovernmental Relations
Office: 202-564-2703
Mobile: 202-573-1704
Email: davis.catherinem@epa.gov

Send mail to:
US Environmental Protection Agency
1200 Pennsylvania Ave, NW
MC: 1305A
Washington, DC 20460

From: Dickinson, Jordan <Jordan.Dickinson@mail.house.gov>
Sent: Friday, March 27, 2015 4:19 PM
To: Davis, CatherineM
Subject: Kildee Letter to EPA on SRF Loan Forgiveness

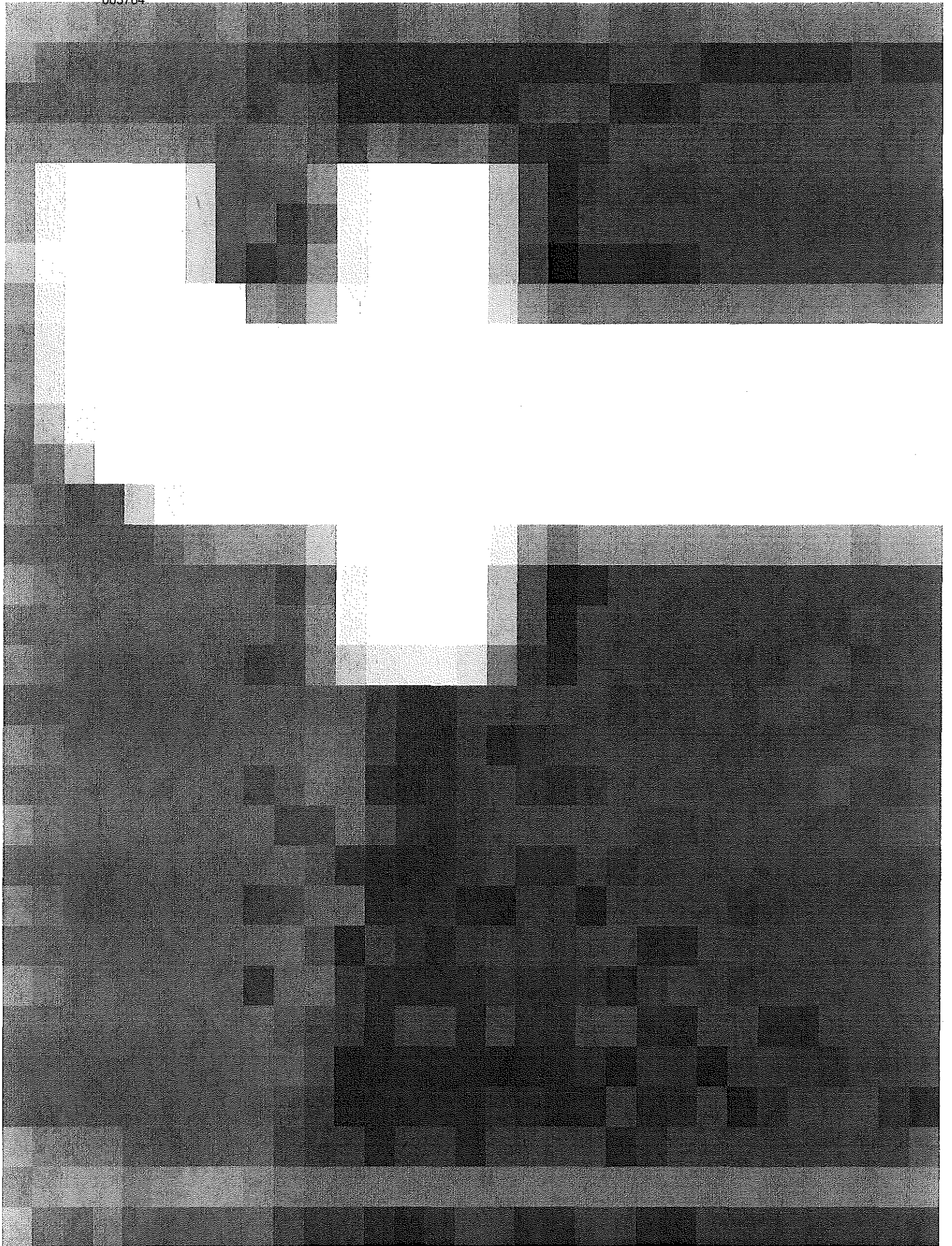
Hi Eileen,

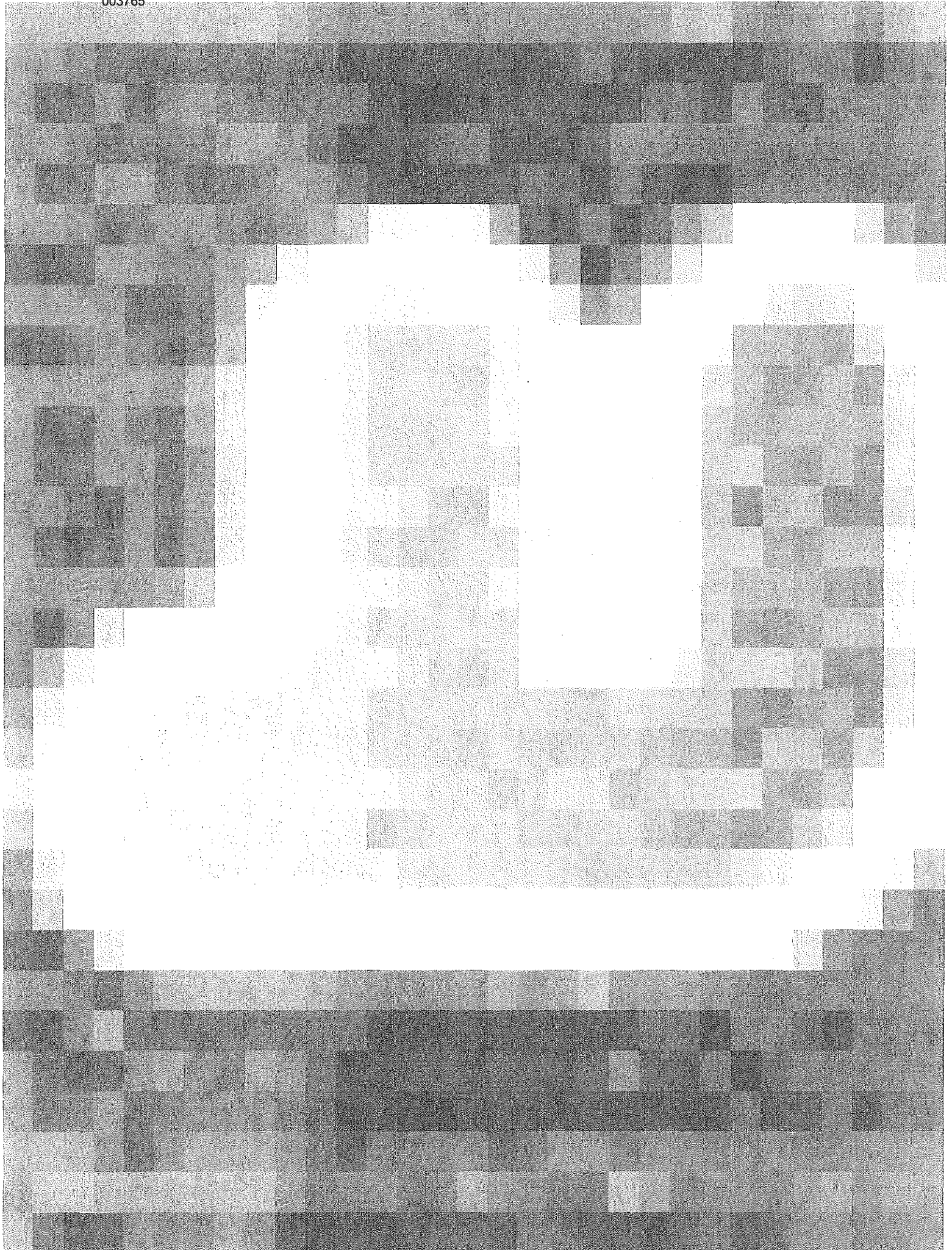
I want you to see the letter that Congressman Kildee sent to Administrator McCarthy today. We sent a hard copy in the mail and you were cc'd. Could you make sure the Administrator and the corresponding staff see the letter?

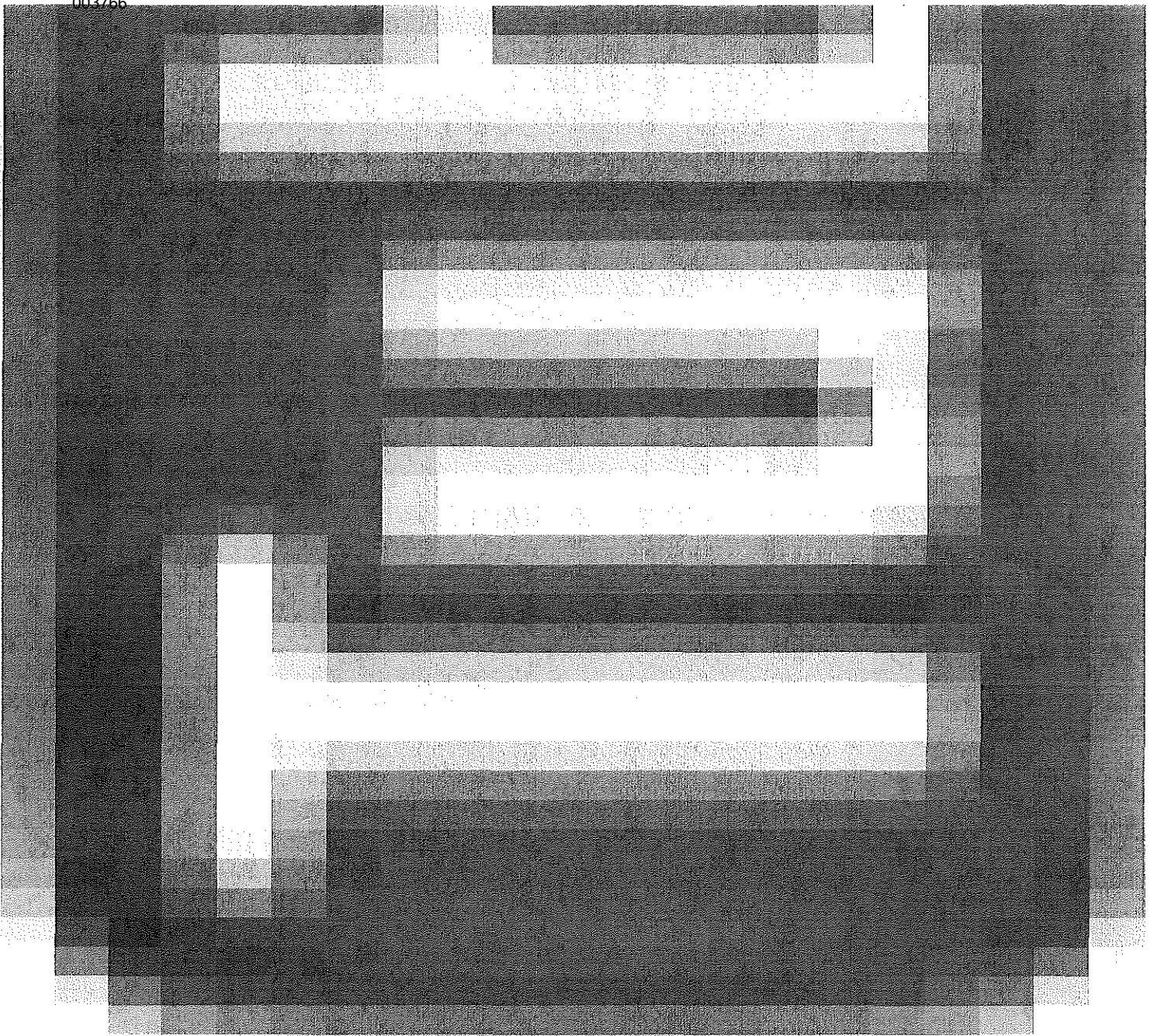
Let me know if you have any questions.

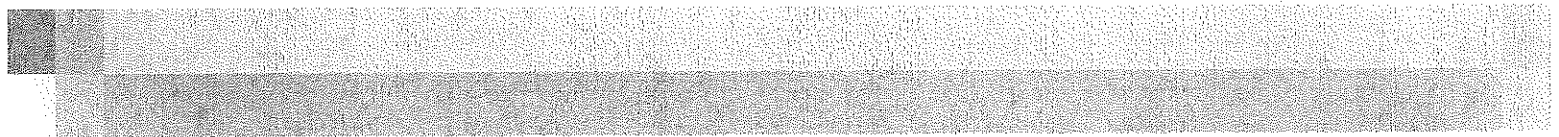
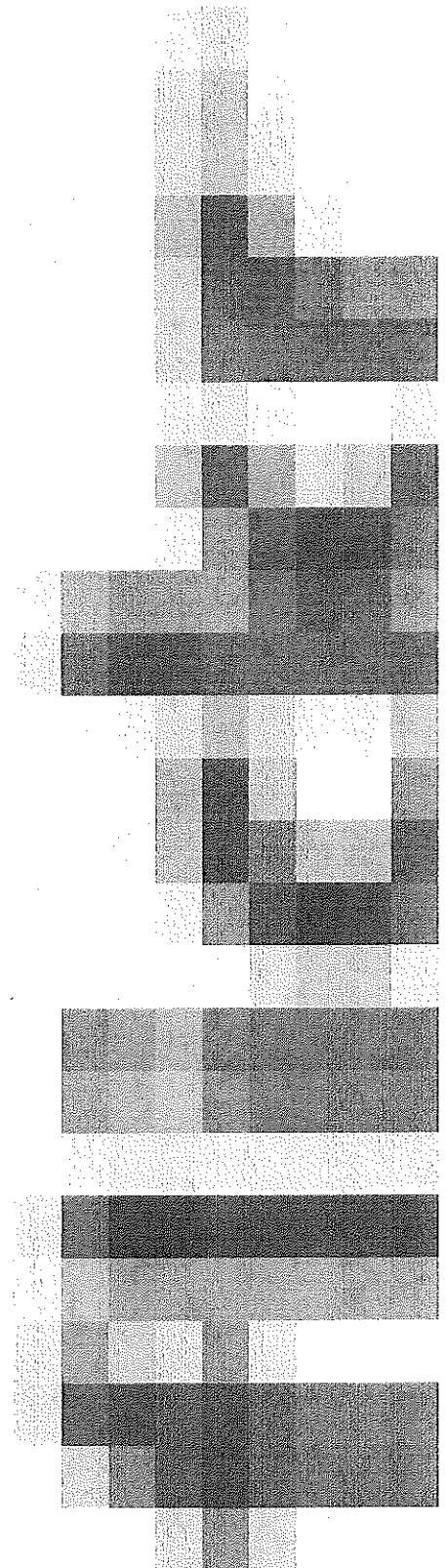
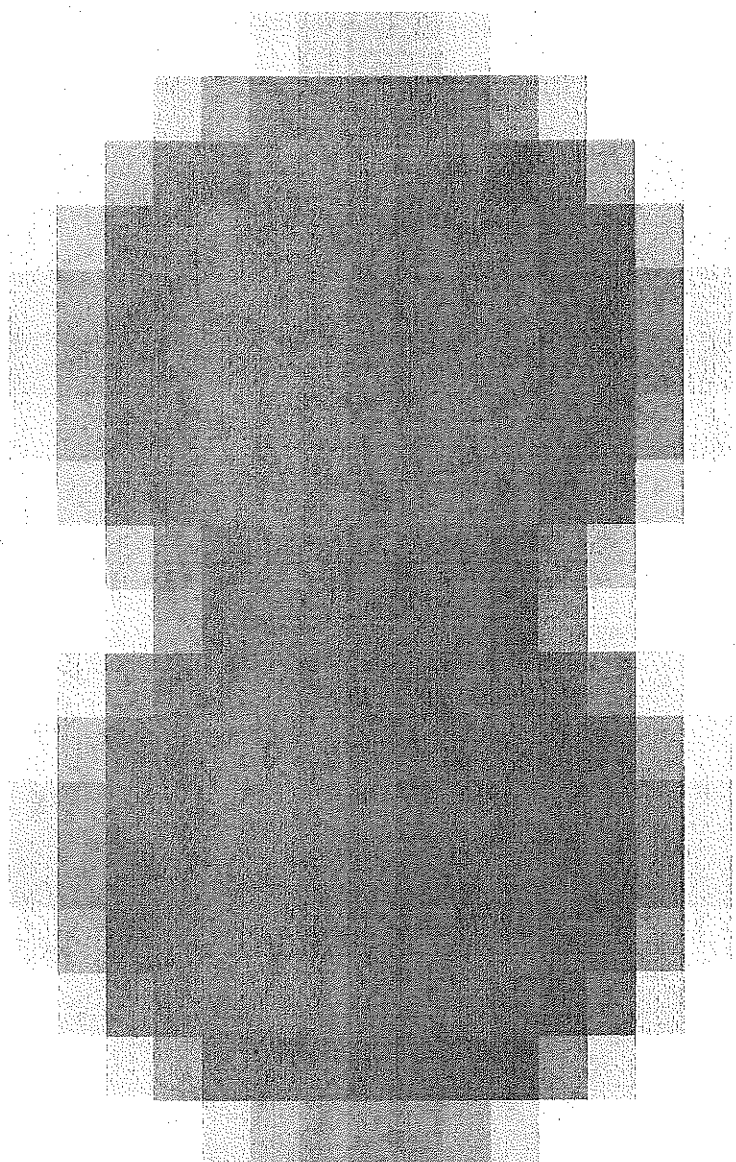
Thanks,

Jordan Dickinson
Legislative Assistant
Congressman Dan Kildee (MI-05)
227 Cannon House Office Building
Washington, D.C. 20515
Phone: (202) 225-3611
www.dankildee.house.gov









DANIEL T. KILDEE
5TH DISTRICT, MICHIGAN

**COMMITTEE ON
FINANCIAL SERVICES**

**SUBCOMMITTEE ON
HOUSING AND INSURANCE**

**SUBCOMMITTEE ON
MONETARY POLICY AND TRADE**

SENIOR WHIP

**DEMOCRATIC POLICY AND
COMMUNICATIONS COMMITTEE**



Congress of the United States
House of Representatives
Washington, DC 20515

WASHINGTON OFFICE

227 CANNON HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-3611
(202) 225-6393 (Fax)

DISTRICT OFFICE

801 SOUTH SAGINAW STREET
PLAZA LEVEL
FLINT, MI 48502
(810) 238-8527
(810) 238-8658 (Fax)

March 26, 2015

Ms. Gina McCarthy
Administrator, Environmental Protection Agency
1101 A
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Dear Administrator McCarthy:

My office has reached out to both the Office of Congressional and Intergovernmental Relations at the Environmental Protection Agency (EPA) and the Congressional Research Service (CRS) to determine if there are any statutory limitations on states to forgive the principal on loans made through the Safe Drinking Water State Revolving Fund (SDWSRF) program. After talking to both of these offices, there seems to be a difference in legal opinion between the two interpretations as to whether forgiveness of principal is statutorily allowed, and I am requesting further clarification.

The City of Flint, Mich., located in my district, continues to endure prolonged and severe financial stress due to the loss of thousands of manufacturing jobs, resulting in population loss and an erosion of its tax base. In an effort to improve the city's financial stability, Flint decided to end its 50-plus-year affiliation with the City of Detroit Water and Sewage Department in April of 2013. Instead, Flint would become a partner in the Karegnondi Water Authority (KWA) to bring raw water from Lake Huron to the city.

The water contract between the City of Detroit Water and Sewage Department and Flint was terminated in May of 2014. The KWA, however, will not be able to provide water to the city until its pipeline from Flint to Lake Huron is completed at the end of 2016. To fill the gap in service until the KWA is completed, Flint has turned to the Flint River as its current source for raw water. The Flint River has proven to have an inconsistent quality because of high levels of organic matter. Flint water officials have used high levels of trihalomethanes to treat the occasional elevated levels of organic matter in the water. On December 16, 2014, the Michigan Department of Environmental Quality cited the city for being in violation of water standards determined by the Safe Drinking Water Act (SDWA) due to high levels of trihalomethanes. In accordance with the SDWA, a cautionary notice about the citation was subsequently sent to residents.

Since its citation, Flint has engaged local and state leaders to find a solution for the poor quality of the water. On February 3, 2015, the state gave the city close to \$2 million to hire consultants to assess the condition and find leaks in the water infrastructure system. While this funding is a step in the right direction, it is not nearly enough to significantly improve the water quality.

This background on Flint's water situation is to point out that the SDWA is intended to improve drinking water in America's cities, such as Flint, by creating water quality standards and funding the SDWSRF to invest in water infrastructure. In addition to the high levels of trihalomethanes, the poor condition of water infrastructure in Flint, regardless of the water's source, contributes to discolored and poor tasting water. Furthermore, Flint currently suffers an over 35 percent loss ratio of water between the treatment plant and the end user. In the past, Flint has benefitted from the SDWSRF and currently has close to \$22 million in outstanding loans from it that the city has used to repair the water system. The financial stress of making payments on these loans, however, has prevented the city from making the necessary ongoing investments to its water infrastructure.

To decrease the burden of these loans, on January 18, 2015, Flint requested that the state of Michigan, as the responsible party in appropriating funds from the SDWSRF to local governments, forgive part of the principal. The state responded that forgiving the principal is not an option as the state does not have the authority to do so.

In response to the state's reply, on February 10, 2015, my staff reached out to the Office of Congressional and Intergovernmental Relations at the EPA to ask if they were aware of any statutory language that prevents principal forgiveness of loans made under the SDWSRF. On February 25, 2015, the EPA responded that they "could find ... no provision that would allow a state to [forgive an existing loan made from a Safe Drinking Water Act state revolving fund]."

On February 23, 2015, my staff also reached out to the CRS for their legal opinion on this matter. Although they could not find any precedent for doing so, the CRS did find two instances in statute that, in their opinion, allows states to forgive the principal on loans made through the SDWSRF.

First, SDWA sec. 1452(d)(1), 42 USC 300j-12(d)(1), states -- "Notwithstanding any other provision of this section, in any case in which the State makes a loan pursuant to subsection (a)(2) of this section to a disadvantaged community ... , the State may provide additional subsidization (including forgiveness of principal)."

Second, the Consolidated and Further Continuing Appropriations Act, 2015, Pub. Law 113-235, states on page 296 -- "Provided further, [t]hat not less than 20 percent but not more than 30 percent of the funds made available under this title to each State for Drinking Water State Revolving Fund capitalization grants shall be used by the State to provide additional subsidy to eligible recipients in the form of forgiveness of principal, negative interest loans, or grants (or any combination of these), and shall be so used by the State only where such funds are provided as initial financing for an eligible recipient or to buy, refinance, or restructure the debt obligations of eligible recipients only where such debt was incurred on or after the date of enactment of this Act;"

The difference in opinion between EPA and CRS has created ambiguity for the affected parties. The ability of states to forgive portions of the principal on loans made through the SDWSRF could have a significant impact on the financial state of Flint and many other distressed municipalities across the county. I would appreciate clarification from you on what, according to EPA's interpretation of the law, statutorily prevents states from forgiving the principal on loans made under the SDWSRF.

Due to critical nature of the water quality in Flint and the impact that loan forgiveness could have on improving the quality of the water, I ask for your prompt attention to this matter.

Sincerely,

A handwritten signature in black ink, appearing to read "Daniel T. Kildee", with a long horizontal flourish extending to the right.

Dan Kildee
MEMBER OF CONGRESS

cc:

Cathy Davis, EPA
Eileen Deamer, EPA
Robert Meltz, CRS

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, February 26, 2015 11:43 AM
To: Shekter Smith, Liane (DEQ); Benzie, Richard (DEQ)
Subject: Fwd: HIGH LEAD: FLINT Water testing Results

FYI. As indicated by Mike and Adam the city is meeting 90th percentile. Not sure why region 5 sees this one sample as such a big deal.

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

Sent from my iPhone

Begin forwarded message:

From: "Prysby, Mike (DEQ)" <PRYSBYM@michigan.gov>
Date: February 26, 2015 at 11:24:32 AM EST
To: "Crooks, Jennifer" <crooks.jennifer@epa.gov>
Cc: "Busch, Stephen (DEQ)" <BUSCHS@michigan.gov>, "Rosenthal, Adam (DEQ)" <ROSENTHALA@michigan.gov>
Subject: RE: HIGH LEAD: FLINT Water testing Results

Jennifer,

I recall Adam showing me a high lead/copper sample result (perhaps it was this one)....as part of the city's routine lead-copper monitoring. If so, it was a stagnated sample as part of the sampling protocol. Adam mentioned that all other samples were below the AL...and the city will not exceed the lead AL. I will confirm this. The city; however, needs to take further action to help address Ms. Walter's concern. The type of plumbing needs to be identified and sample tap location within the premise plumbing. They should offer to re-sample for PB after flushing the tap to demonstrate that flushing the tap will reduce the lead concentration. The city also needs to provide other lead-reduction strategies to Mrs. Walters.

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

From: Crooks, Jennifer [<mailto:crooks.jennifer@epa.gov>]
Sent: Thursday, February 26, 2015 10:53 AM
To: Busch, Stephen (DEQ); Prysby, Mike (DEQ)
Cc: Poy, Thomas; Deltoral, Miguel
Subject: HIGH LEAD: FLINT Water testing Results

Hi, Steve and Mike. Thanks for talking with me yesterday, Steve, about the most recent TTHM results. We'll look forward to receiving them whenever you get them back from the lab.

However, the main purpose of my email is to alert you to the high lead levels reported to a citizen yesterday by Flint Water Dept. I have been discussing the water situation with LeeAnn Walters since January, and she has been talking with Mike Glasgow at the plant about the black sediment in her water. (HUGE KUDOs to MIKE!!) He did test it to find that the iron levels were greater than his test would go; GT 3.3. But, because the iron levels were so high, he suggested testing for lead and copper. WOW!!!! Did he find the LEAD! **104 ppb**. She has 2 children under the age of 3... Big worries here.

So, Steve, this goes back to what you and I were talking about yesterday. That the different chemistry water is leaching out contaminants from the insides of the biofilms inside the pipes. I think Lead is a good indication that other contaminants are also present in the tap water, that obviously were not present in the compliance samples taken at the plant. VOC/SOC and inorganics/metals would be good samples to start with to take at the tap. And since Ms. Walters' drinking water is showing the high lead levels, her tap water would be a good place to start, I think.

We also talked about Dr. Joan Rose from Michigan State being on the Flint Tech Advisory Committee—you also mentioned that someone from the Dept of Community Health was on the Committee. I'm thinking that Dr. Rose would want to dive further into this, since there's actual evidence that the water is leaching contaminants from the biofilms; or Dept of Community Health would want to get involved and look at this from an epidemiological perspective. (She and her family are also exhibiting the rashes when exposed to the water, and her daughter's hair is falling out in clumps.)

Maybe MSU could authorize the payment of the analyses for these samples? Or Dept of Community Health?

The citizen's name is:
 LeeAnn Walters
 212 Browning Ave
 Flint, MI 48507
 616-212-6233
Lwalters313@gmail.com

Jennifer

From: Lea Moste [<mailto:lwalters313@gmail.com>]
Sent: Thursday, February 26, 2015 9:08 AM
To: Crooks, Jennifer
Subject: Fwd: Re: Water testing Results

----- Forwarded message -----

From: "Michael Glasgow" <mglasgow@cityofflint.com>
Date: Feb 26, 2015 7:55 AM
Subject: Re: Water testing Results

To: "Lea Moste" <lwalters313@gmail.com>

Cc:

Lee,

Here are your Lead & Copper Results. This number is very high, 104 ppb of lead. In the last few months over 100 samples have been tested and only 2 were over the 15 ppb regulatory limit, and the highest level I have seen is 37 ppb. I will pass this info to Mr. Croft so he is aware. I will send the sample I collected from your kitchen faucet today for a complete metals test (12 different metals), to see what the level is without letting the water stagnate over night. I'm hoping that value will be much, but we will have to see. Sorry for this news, but I wanted to let you know right away.

Mike

On Tue, Feb 24, 2015 at 1:50 PM, Michael Glasgow <mglasgow@cityofflint.com> wrote:

Lee,

I will bring a copy of last years annual report when I stop by tomorrow. The annual report from 2014 must be delivered to residents by July 1st of this year. I imagine we may have it complete by June.

Mike

On Fri, Feb 20, 2015 at 1:00 AM, Lea Moste <lwalters313@gmail.com> wrote:

Mike,

Thank you for the water reports and we already planned to see you on the 25th at 10:00am. I was wondering if you know who I need to talk to in the water plant to obtain the Annual Drinking Water Report from last year. According to the EPA website there is link to access but when you click on it, it cannot be accessed. Was also curious if there is an expected time frame for this years report due to the switch. If you can be of any assistance I would appreciate it.

Thank You

LeeAnne Walters

On Thu, Feb 19, 2015 at 12:47 PM, Michael Glasgow <mglasgow@cityofflint.com> wrote:

Lee & Dennis,

Here is a list of test results from water sampled at your home over the last 2 weeks. I have sent in your lead and copper sample, and also a sample from the toilet tank for manganese. I should hopefully have results from this testing early next week. I'll plan on stopping over on Wednesday (the 25th) around 10 am again to give you these results & sample again.

Mike

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, April 18, 2013 11:48 AM
To: Ms. Kristina Donaldson P.E.
Cc: Shekter Smith, Liane (DEQ)
Subject: Fwd: KWA and City of Flint

Kris,

As I mentioned on the phone the director would like you to be available via conference call as necessary to answer any DWSD related questions.

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

Sent from my iPhone

Begin forwarded message:

From: "Thelen, Mary Beth (DEQ)" <THELENM2@michigan.gov>
Date: April 18, 2013, 8:21:02 AM EDT
To: "Busch, Stephen (DEQ)" <BUSCHS@michigan.gov>
Cc: "Shekter Smith, Liane (DEQ)" <SHEKTERL@michigan.gov>, "Willard, Veronica (DEQ)" <WILLARDV@michigan.gov>, "Thelen, Mary Beth (DEQ)" <THELENM2@michigan.gov>
Subject: RE: KWA and City of Flint

Hi Stephen,

I received word last night the Governor has called a meeting on Friday, April 19, 3:00-4:30 at the Detroit Cadillac Place Office. Director has asked that you attend with him. He will also have Bill Creal attend regarding the stormwater/wastewater issues. You may ride with the Director and Bill Creal. At this time, they plan to leave Lansing at 1:00.

Please give me a call after 10:30 today to discuss if this is a problem. I am going downstairs with the Director shortly for his Earth Day kickoff.

Hopefully, you can make this work for your schedule.

Thank you.

Mary Beth

Mary Beth Thelen
 Executive Management Assistant to the Director
 Department of Environmental Quality
Thelenm2@michigan.gov

517-373-7917 or 517-241-7390

From: Busch, Stephen (DEQ)
Sent: Wednesday, April 17, 2013 9:51 AM
To: Sygo, Jim (DEQ); Shekter Smith, Liane (DEQ); Thelen, Mary Beth (DEQ)
Cc: Shaler, Karen (DEQ); Benzie, Richard (DEQ); Prysby, Mike (DEQ)
Subject: RE: KWA and City of Flint

Director Wyant, Deputy Director Sygo, and Liane,

A response at this point may be moot as Flint and Genesee Co. already held a press conference yesterday rejecting the DWSD offer.

It is also unclear whether DWSD provided its offer directly to Flint and Genesee Co. by the deadline in Treasurer Dillon's letter. However, Flint and Genesee Co. still took the offer under consideration.

Our office concurs with both Flint and Genesee Co. that the offers provided by DWSD were incomplete.

Of the two scenarios provided by DWSD it appeared that only Scenario 2 was listed as potentially being more cost effective. However, this scenario did not address the following:

1. The DWSD scenarios are based on 40 MGD of service capacity. However, the KWA project is providing 60 MGD of initial capacity with potential expansion to 75 MGD in the future. Therefore, in order for a more direct comparison the DWSD scenario would need to increase capacity to 60 MGD, which would increase fixed rate commodity costs as well as the capital costs for the Huron Plant that DWSD was planning to allocate to Flint and Genesee Co., presumably by as much as 50%.
2. DWSD proposals cover a 30 year period to 2042, but fail to recognize that after this period bond payments for the KWA project will be complete and result in a significant reduction in costs for the KWA option.
3. While DWSD indicates that Flint and Genesee Co. would be given "broadened representation", it remains unclear exactly what this means in terms of actual control in the decision making process.
4. This scenario continues to rely on a single transmission system and would require the City of Flint to maintain its WTP for emergency purposes and these costs do not appear to be included. In addition, use of the Flint WTP as an emergency backup would leave Genesee Co. without an adequate backup supply to meet their 30 year needs.

Again, without DWSD providing the specific details of these proposals, it is difficult to provide a true comparative analysis, and as such Flint and Genesee Co. appear to be justified in their rejection of these proposals.

Please let me know if you require any further response.

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

From: Sygo, Jim (DEQ)
Sent: Tuesday, April 16, 2013 9:59 AM
To: Busch, Stephen (DEQ); Prysby, Mike (DEQ); Benzie, Richard (DEQ)
Cc: Shekter Smith, Liane (DEQ); Shaler, Karen (DEQ); Thelen, Mary Beth (DEQ)
Subject: FW: KWA and City of Flint

Steve, Mike and Richard,

Please take a look at DWSD's last best offer to the City of Flint and provide your collective perspective to the Director through Liane by the end of the week. Copy me in as well. I'll be out of the office but would like to know if you think this is worth considering.

Thank you for your expedited review.

From: Wyant, Dan (DEQ)
Sent: Tuesday, April 16, 2013 6:52 AM
To: Sygo, Jim (DEQ)
Subject: FW: KWA and City of Flint

Jim,

Liane is out of the office today, Can you forward this directly to her staff that worked on this with us.

Dan Wyant, Director
 Department of Environmental Quality
 517-373-7917

From: Wyant, Dan (DEQ)
Sent: Tuesday, April 16, 2013 6:51 AM
To: Sygo, Jim (DEQ); Creal, William (DEQ); Shekter Smith, Liane (DEQ)
Cc: Anderson, Madhu (DEQ)
Subject: FW: KWA and City of Flint

Bill and Liane,

Can you have your staff's take a quick look at this and let me know today if they think this changes their thoughts and comments to me last week.

Dan Wyant, Director
 Department of Environmental Quality
 517-373-7917

From: Dillon, Andy (Treasury)
Sent: Monday, April 15, 2013 7:55 PM
To: Wyant, Dan (DEQ); Dennis Muchmore; Roberts, John (GOV)
Cc: Stibitz, Brom (Treasury); Saxton, Thomas (Treasury)
Subject: Fwd: KWA and City of Flint

FYI

Dan, any thoughts re the attached?

We gave dwsd until today to put best offer on table. Flint is to get back to us tmrw. I want to make sure their expected rejection is made in good faith.

Sent from my iPad

Begin forwarded message

From: "Debra Ragland" <dragland@dwsd.org>
To: "ekurtz@cityofflint.com" <ekurtz@cityofflint.com>
Cc: "jwright@co.genesees.mi.us" <jwright@co.genesees.mi.us>, "Dillon, Andy (Treasury)" <DillonA2@michigan.gov>, "James Fausone" <fausone@dwsd.org>, "orrk@detroitmi.gov" <orrk@detroitmi.gov>, "Sue McCormick" <mccormick@dwsd.org>
Subject: KWA and City of Flint

Please see attached on behalf of Sue F. McCormick.

Faxed copy forwarded to Mayor Dayne Walling and Jeff Wright.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, September 28, 2015 5:41 PM
To: Wyant, Dan (DEQ); Pallone, Maggie (DEQ)
Subject: Fwd: Letter to Governor Regarding Flint Water
Attachments: 09.28.2015-letter-ananich-snyder-water-requests.pdf; ATT00001.htm

I didn't see you on the distribution list.

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

Sent from my iPhone

Begin forwarded message:

From: The Office of Senator Ananich <SenJAnanich@senate.michigan.gov>
Date: September 28, 2015 at 4:07:45 PM EDT
To: "Jordan.Dickinson@mail.house.gov" <Jordan.Dickinson@mail.house.gov>, "mayor@cityofflint.com" <mayor@cityofflint.com>, "HCroft@cityofflint.com" <HCroft@cityofflint.com>, "hedman.susan@epa.gov" <hedman.susan@epa.gov>, "poy.thomas@epa.gov" <poy.thomas@epa.gov>, "Schock.michael@epa.gov" <Schock.michael@epa.gov>, "Lytle.darren@epa.gov" <Lytle.darren@epa.gov>, "fortin.denise@epa.gov" <fortin.denise@epa.gov>, "ShekterL@michigan.gov" <ShekterL@michigan.gov>, "Cookp@michigan.gov" <Cookp@michigan.gov>, "BuschS@michigan.gov" <BuschS@michigan.gov>, "Wurfelb@michigan.gov" <Wurfelb@michigan.gov>, "Edwardsm@vt.edu" <Edwardsm@vt.edu>
Subject: Letter to Governor Regarding Flint Water

Good Afternoon,

Please see the attached letter that my office sent to Governor Rick Snyder earlier today. The letter contains a series of short, medium, and long-term requests to ensure access to safe drinking water in the City of Flint.

As I said in a statement to the press, my constituents and I believe the state must act urgently to provide concrete solutions to the public health crisis in the City of Flint. In speaking with Governor Snyder and his key aides today, I stressed the need to work together on a number of initiatives that will ensure safe water for Flint residents. My formal request included immediate and long-term solutions, and strong consideration for switching back to the Detroit water source until the Karegnondi Pipeline Authority project is complete. Anything less than an aggressive, comprehensive approach is simply unacceptable.

Please do not hesitate to contact my office if you have any questions. Thank you for your time and attention.

Sincerely,

The Office of State Senator Jim Ananich
Senate Minority Leader
District 27

SENATE MINORITY LEADER
JIM ANANICH

☎ 517.373.0142
✉ senjananich@senate.michigan.gov
🌐 senatedems.com/ananich

September 28, 2015

State of Michigan
Executive Office of the Governor
P.O. Box 30013
Lansing, MI 48909

Governor Snyder,

Access to safe, affordable drinking water is a basic necessity for every community. It is completely unacceptable that respected scientific experts and our trusted local physicians have verified that the City of Flint's drinking water is dangerous for our citizens, especially our most vulnerable young people.

As a result, I am formally requesting assistance as suggested by the experts on the frontline of this public health crisis. Here are the top priorities we should work together to address:

1. **Swift transfer to a safe source of water until the Karegnondi Water Authority (KWA) project is complete next year.** Your administration has the ability to ensure a financially acceptable and responsible contract between Flint and the Detroit Water and Sewerage Department, particularly in light of the public health implications with the Flint River supply.
2. **Equally urgent is the need for corrosion control as recommended by independent scientific experts.** There are chemical treatment additives that could help reduce this corrosion. I urge you to help the city implement anti-corrosion methods immediately. The current emergency makes the January timeline unacceptable.
3. **Filters and bottled water assistance.** Flint water touches the entire city. Whether it's a person's home, work, school, restaurant or place of worship, access to safe, clean drinking water should not be hindered. Water filters, used in conjunction with corrosion control methods, are necessary to help guard against toxic exposure.

I have been working with the philanthropic community and private sector to secure donations to acquire filters and water; however, more funds will be necessary to effectively cover the thousands of residents impacted. I would like to formally request emergency funding to help supplement the acquisition of water filters and bottled water. Any and all appropriate state or federal money to help accomplish this feat should be considered.

SENATE MINORITY LEADER
JIM ANANICH

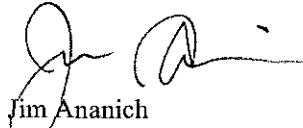
☎ 517.373.0142
✉ senjananich@senate.michigan.gov
🌐 senatedems.com/ananich

4. **Support for completion of the KWA pipeline.** It is presumed that the upcoming KWA pipeline will solve a number of problems associated with the current sourcing of Flint's water from the Flint River. I am requesting a meeting between representatives from your office, KWA board members and project engineers to discuss any options to expedite the pipeline's construction.
5. **A long-term commitment to addressing outdated infrastructure.** A recent EPA report just outlined the billions of dollars necessary over the next several decades to adequately secure safe water for our entire state. You have the position and opportunity to be a national leader on moving the debate forward on this topic so that we can avoid the type of catastrophe my community is grappling with today.

I look forward to working with you to deliver on these concrete and urgent action items to alleviate the public health crisis facing our residents.

We jeopardize any progress and comeback for our cities and state if we cannot ensure safe, basic necessities for our families or if we cannot come together swiftly to fix an identified, severe threat to the safety of our people.

Sincerely,



Jim Ananich
Senate Democratic Leader
District 27

cc:

U.S. Representative Dan Kildee
Mayor Dayne Walling, City of Flint
Howard Croft, City of Flint
Susan Hedman, EPA
Thomas Poy, EPA
Michael Schock, EPA-ORD
Darren Lytle, EPA-ORD
Denise Fortin, EPA
Liane Shekter-Smith, MDEQ
Pat Cook, MDEQ
Stephen Busch, MDEQ
Brad Wurfel, MDEQ
Marc Edwards, Virginia Tech

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, September 23, 2015 4:20 PM
To: Wurfel, Brad (DEQ); Benzie, Richard (DEQ); Shekter Smith, Liane (DEQ); Wyant, Dan (DEQ); Thelen, Mary Beth (DEQ); Pallone, Maggie (DEQ)
Subject: Fwd: Technical Advisory Meeting

FYI. Note the invitees

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

Sent from my iPhone

Begin forwarded message:

From: "Prysby, Mike (DEQ)" <PRYSBYM@michigan.gov>
Date: September 23, 2015 at 4:09:15 PM EDT
To: "Busch, Stephen (DEQ)" <BUSCHS@michigan.gov>
Subject: FW: Technical Advisory Meeting

Steve,

It appears that I may have the opportunity to meet Mr. Edwards.

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

From: Howard Croft [<mailto:hcroft@cityofflint.com>]
Sent: Wednesday, September 23, 2015 3:52 PM
To: Brent Wright; Dayne Walling; donna. cole; edwardsm; Gerald (Jed) Natzke; Howard Croft; James Henry; Jason Lorenz; jmikewright; JoAnne Herman; John O'Brien; Kirk Smith; larry.koehler@mcc.edu; Laura Sullivan; lytle.darrin@epa.gov; Michael Glasgow; Michael Wright; Mike Lane; Prysby, Mike (DEQ); Natasha Henderson; Norb Birchmeier; Pete Levine; Robert Bincsik; rosejo@msu.edu; Russell Hudson; Samir Matta; schock.michael@epa.gov; Sean Kammer; Warren Green; Busch, Stephen (DEQ)
Subject: Technical Advisory Meeting

Technical Advisory Team,

I am writing to inform everyone that we have scheduled the next Technical Advisory Committee meeting to be Wednesday October 7th, 2015 from 2:00 – 4:30 pm. We are extending invitations to Marc Edwards of Virginia Tech along with two lead experts from the EPA (Darren Lytle & Michael Schock) to become a part of the technical team and we are hopeful that they will all be present at the upcoming meeting.

At the meeting we will discuss an overview of the City water system, compliance with the Safe Drinking Water Act, lead concerns, corrosion control, water testing, public education, capital improvement plans, the KWA pipeline, and next steps.

I will forward a specific location and agenda in the near future but we are firmly committing to the time and date. As with previous meetings we look forward to this group having positive dialogue that will benefit the community.

Thank you,

--

Howard Croft

Public Works Director

City of Flint

1101 S. Saginaw Street

Flint, MI 48502

PH# 810.766.7135 Ext.2043

hcroft@cityofflint.com

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, October 07, 2015 11:48 AM
To: Sygo, Jim (DEQ)
Subject: Fwd: Technical Committee Agenda and Number
Attachments: TAC Meeting_10_7_15_Agenda.pdf; ATT00001.htm

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

Sent from my iPhone

Begin forwarded message:

From: Howard Croft <hcroft@cityofflint.com>
Date: October 6, 2015 at 4:54:01 PM EDT
To: Amy Hovey <Amy.Hovey@mail.house.gov>, Andy Leavitt <aleavitt@senatedems.org>, Brent Wright <bwright@cityofflint.com>, "Darren Lytle" <lytle.darren@epa.gov>, Dayne Walling <dwalling@cityofflint.com>, "donna. cole" <donna.cole@genesys.org>, edwardsm <edwardsm@vt.edu>, "Gerald (Jed) Natzke" <gdn2@aol.com>, Howard Croft <hcroft@cityofflint.com>, "James Henry" <jhenry@gchd.us>, Jamie Gaskin <jgaskin@unitedwaygenesee.org>, "Jason Lorenz" <jlorenz@cityofflint.com>, jmikewright <jmikewright@yahoo.com>, JoAnne Herman <jherman@genesys.org>, John O'Brien <jfobrien@gcdcwws.com>, Kirk Smith <ksmith@flint.org>, <larry.koehler@mcc.edu>, Laura Sullivan <dr.laura2@gmail.com>, Michael Glasgow <mglasgow@cityofflint.com>, "Michael Wright" <Wright.Michael@epa.gov>, Mike Lane <mjlane@umflint.edu>, "Mike Prysby (DEQ)" <prysbym@michigan.gov>, Natasha Henderson <nhenderson@cityofflint.com>, Norb Birchmeier <nbirchml@hurleymc.com>, "Pete Levine" <plevine@gcms.org>, Robert Bincsik <rbincsik@cityofflint.com>, <rosejo@msu.edu>, Russell Hudson <Russell.Hudson@mclaren.org>, Samir Matta <SFMatta@lan-inc.com>, <schock.michael@epa.gov>, Sean Kammer <skammer@cityofflint.com>, "Stephen Busch (DEQ)" <BUSCHS@michigan.gov>, Warren Green <jwgreen@lan-inc.com>, <wellse3@michigan.gov>

Subject: Technical Committee Agenda and Number

Team,

We are looking forward to a very productive meeting on Wednesday with those in attendance and those calling in.

I am sending a brief document that includes an agenda and an anticipated attendance list as we expect most of the meeting to be good discussion.

Below is the call in information for those that cannot make it:

Number: (641) 715-3580

Access Code: 373-510

Thank you,

--

Howard Croft

Public Works Director

City of Flint

1101 S. Saginaw Street

Flint, MI 48502

PH# 810.766.7135 Ext.2043

hcroft@cityofflint.com



City of Flint

TECHNICAL ADVISORY COMMITTEE

Meeting
October 7th 2:00 pm

Agenda

Introductions

Comments - Natasha Henderson (City Administrator)

System Overview/Update - Howard Croft (DPW Director)

Purpose of Committee

TTHM Review

Lead Concerns

Virginia Tech Findings - Marc Edwards (VA Tech Lead Expert)

EPA Comments - Darren Lytle (EPA Lead Expert)

Open Discussion - Q & A

Solutions (short term & long term)

- DWSD Option - Natasha Henderson (City Administrator)
- Corrosion Control - Samir Matta (LAN Engineer)
- Update on Filter Efforts - Jamie Gaskin (United Way CEO)
- Service Line Replacement - Howard Croft (DPW Director)
- Update on KWA - John O'Brien (KWA Engineer PE)

Open Discussion - Q & A

Committee Recommendations

Next Meeting Dates

November Date

December Date

Close

TAC - Participants

Member	Organization	
Donna Cole	Greater Flint Health Coalition	
** Eden Wells	State of Michigan – Chief Medical Executive	
Gerald Natzke	Genesys	
** Jamie Gaskin	United Way	
Jim Henry	Genesee County Health Department	
JoAnne Herman	Genesys	
John O'Brien	Genesee County Drain Commission	
** Kevin Kilby	KWA Associate	
Kirk Smith	Greater Flint Health Coalition	
Larry Kohler	Mott Community College	
Laura Sullivan	Kettering University	
Mike Lane	University of Michigan Flint	
Mike Sargent	Flint Strong	
Norb Birchmeier	Hurley Medical Center	
Joan Rose	Michigan State University	
Pete Levine	Genesee County Medical Society	
Russell Hudson	McLaren Hospital	
Warren Green	Lockwood Andrews Newnam - Engineering	
Samir Matta	Lockwood Andrews Newnam - Engineering	
** Amy Hovey	U.S. Congressional Representative	
** Andy Leavitt	State Senate Representative	
Mike Prysby	DEQ	
** Jim Sygo	DEQ	
** George Krisztian	DEQ	
Michael Wright	EPA	By Ph.
** Darren Lytle	EPA	
** Michel Schock	EPA	Out
** Marc Edwards	Virginia Tech	By Ph.

**** New Member or Special Guest**

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, November 24, 2014 11:54 AM
To: Thelen, Mary Beth (DEQ) (THELENM2@michigan.gov)
Cc: Shekter Smith, Liane (DEQ) (SHEKTERL@michigan.gov)
Subject: Hold Date for Flint Mtg. with Locals/Legislators?

Mary Beth,

Director Wyant had suggested a meeting with Flint area members of the state legislature and others to provide them information about a water standard violations which may occur.

My office anticipates receiving the applicable monitoring results for determining such a violation during the week of December 1-5.

If the Director would still like to hold such a meeting, it would be best to do so during the following week December 8-12. Can you let me know whether this will work so we can start the planning process?

Thanks.

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, September 11, 2015 4:47 PM
To: Richard Benzie P.E. (BENZIER@michigan.gov)
Subject: Kildee draft
Attachments: Congressman Kildee Response.docx

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

Dear Congressman Kildee,

Your concerns regarding drinking water in the City of Flint are appreciated. The Michigan Department of Environmental Quality (MDEQ) takes its authority to protect the public health and provide supervision and control over all public water supplies throughout the State of Michigan to ensure safe drinking water very seriously.

The MDEQ has a strong public water supply oversight program which has developed continuous partnerships with regulated systems and EPA Region 5 to achieve compliance with all related public water supply standards.

Regulations associated with lead treatment technique requirements include monitoring of customer tap water samples. The entire pool of properly sited and collected samples during a monitoring period is used to determine compliance with the federally established Action Level (AL) of 15 parts per billion. An AL exceedance is not a violation but can trigger other requirements of the public water supply. However, the City of Flint compliance monitoring for lead has never exceeded this AL.

Based on the size of the population served by the City of Flint public water supply system, as part of the Michigan Safe Drinking Water Act lead treatment technique, the City's water system is also required to provide optimized corrosion control. One option for demonstrating optimized corrosion control is through lead monitoring. This was done by the City of Flint public water system following its change in source to the Flint River. Two monitoring periods for lead were conducted in accordance with these requirements, the first July through December 2014 and the second January through June 2015. As indicated above neither round of lead compliance monitoring exceeded the AL. However, results were unable to demonstrate optimized corrosion control and the MDEQ notified the City of Flint on August 17, 2015, that it must provide additional treatment to meet this optimized corrosion control requirement. The City of Flint has committed to having this treatment in place by January 2016.

The City of Flint currently has no outstanding violations of any primary drinking water standard.

Information regarding individual lead sample results are provided to those customers by the City of Flint in accordance with state requirements. Individuals with sample results that exceed 15 parts per billion are also provided information on actions they can take to limit lead exposure in drinking water. Results from the City's most current lead compliance monitoring determination is included each year in the City's annual consumer confidence report, also known as their annual water quality report. This report also includes general consumer awareness information regarding lead.

Lead blood level monitoring is overseen by the Michigan Department of Health and Human Services. Their review of lead blood testing results for May 2014 – April 2015, the 12 month time frame just after the City of Flint changed its water source to the Flint River, in comparison with lead blood testing results for the previous three years, showed no change in lead poisoning rates attributable to changes in the City's drinking water source.

Additionally, compliance sampling of treated water from the City of Flint drinking water treatment plant show no detection of lead. The source of lead being detected in water samples collected at peoples' homes is from individual service connection piping and household plumbing.

The MDEQ continues to assist the City of Flint in providing a safe, reliable, and adequate supply of affordable water for protecting public health, enhancing public safety, and as a pillar for economic development to advance the quality of life in this community.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, July 15, 2014 10:49 AM
To: McClellan, Michael (DEQ); Shekter Smith, Liane (DEQ)
Cc: prysbym@michigan.gov; Arduin, Jim (DEQ)
Subject: Lansing District Dashboard Draft Article - Flint WTP
Attachments: Lansing DEQ Dashboard - Draft - Flint WTP Startup.doc

Michael,

Attached is a final draft article for the Lansing District, DEQ Legislative Dashboard Newsletter. This article from ODWMA covers the startup of the City of Flint WTP and the involvement and efforts of DEQ staff.

Liane, please let us know if you have any comments or concerns before this is moved forward for publication.

Also, it was initially suggested to have a separate article from OWMRP regarding work with the City of Flint to enter into an ACO that addresses reconstruction of the storage lagoons for the WTP's refuse lime, elimination of a wastewater discharge, and correction of unauthorized solid waste disposal at the site. I'm not sure what the status is regarding such an article but Mike Prysby and I can assist Jim as needed.

Let us know if you have any questions or need anything else.

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

City of Flint Water Treatment Plant Startup

(Contact Mike Prysby 517-290-8817)



On April 25, 2014, the City of Flint water system discontinued water service from the Detroit Water and Sewerage Department, and began full time use of its own water treatment plant (WTP). The switch from water customer to water supplier and use of the Flint River as a water source elicits many additional requirements to ensure public health protection. The DEQ proactively provided information and educated City staff regarding associated costs and risks, supporting the local decision making process, and allowing them to make a well informed decision. DEQ staff then worked diligently with the City of Flint and their consultants to expediently complete major improvements needed to convert of the WTP from temporary emergency to full time treatment. DEQ staff continues to work in partnership with the City, overseeing water system operations, assisting the City with all aspects of compliance and future use of Lake Huron as its source water.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, September 16, 2015 10:07 AM
To: Shekter Smith, Liane (DEQ) (SHEKTERL@michigan.gov); Richard Benzie P.E. (BENZIER@michigan.gov)
Subject: List of potential FAQ Questions

Here is a list of potential FAQs. Let me know what you think.

What is the frequency of lead and copper sampling?
 Why are customers asked to collect lead and copper samples?
 How is compliance determined?
 Why are some samples not included in the compliance determination?
 When is customer and public notification required?
 What will happen when Flint obtains water from the Karegnondi Water Authority?
 What is the source of lead?
 Who is responsible for replacement of leaded materials?
 Why doesn't the City just replace their portion of lead service lines?
 What is the timeline for corrosion control treatment?
 What will it cost to have lead service lines replaced?
 How long will it take to replace lead service lines across Flint?
 How does blood level monitoring tie into customer tap water monitoring?
 How long has the City of Flint conducted lead monitoring?
 Has the City's compliance monitoring ever exceeded the lead action level?
 What is the goal of the Lead and Copper Rule?

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, June 25, 2015 9:46 AM
To: 'mglasgow@cityofflint.com'
Cc: Adam Rosenthal (rosenthala@michigan.gov); prysbym@michigan.gov
Subject: LT2 monitoring plan due 7/1
Attachments: Cover letter 2nd round Sch 2 plants.docx; Schedule 2 LT2 Sampling Plan Template.docx; Round 2 Sched 2 Calendar.xlsx; Crypto Certified labs April 2015.pdf

Importance: High

Mike,

With Mike Prysby currently out of the office I'm not sure if you have already submitted this information, but Adam and I are not aware of our office receiving it.

The City of Flint water system falls into Schedule 2 of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2 ESWTR) and the sampling plan for conducting crypto monitoring must be submitted to our office for approval by July 1. The Sampling Plan Template is attached for your use along with the calendar spreadsheet and a list of certified crypto labs.

The attached cover letter also provides some additional info. Give Adam or I a call if you have any questions. Thanks.

This information was originally mailed to Brent and copied to Howard back on April 3.

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

Date:

To: Schedule 2 Plants

Address:

Dear :

SUBJECT: Long Term 2 Enhanced Surface Water Treatment Rule
2nd Round of Source Water Monitoring Requirements

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2 Rule) was promulgated by the U.S. Environmental Protection Agency on January 5, 2006. The Michigan Department of Environmental Quality adopted this rule into the Michigan Administrative Rules in December, 2009. All public water systems that are supplied by a surface water source and systems supplied by a ground water source under the direct influence of surface water (GWUDI) are subject to this rule.

According to the LT2 Rule, systems are required to conduct an initial and a second round of source water monitoring for each plant that treats a surface water or GWUDI source. Please keep in mind that Grandfathering data will not be accepted for the second round of monitoring. This monitoring includes at least one source water *Cryptosporidium*, *E. coli*, and turbidity sample per month for a period of 24 months for systems serving populations greater than 10,000 people. Systems will be assigned to a "treatment bin" based on the results of source water monitoring. The treatment bin specifies the level of *Cryptosporidium* removal and/or inactivation that the system must achieve.

Our records indicate that your system is required to comply with the source water monitoring requirements on **Schedule 2** as stated below in Table 1. Therefore, your system is required to submit to the DEQ a source water monitoring plan for each plant by July 1, 2015, and start the 2nd round of monitoring in October, 2015.

Table 1 – LT2 Milestone Dates for 2nd Round of Source Water Sampling

System Population	Schedule	Must submit Source Water Sampling Plan by...	Must begin second round of source water monitoring...
At least 100,000	1	January 1, 2015	April 1, 2015
50,000 – 99,999	2	July 1, 2015	October 1, 2015
10,000 – 49,999	3	July 1, 2016	October 1, 2016
<10,000	4	July 1, 2017	October 1, 2017

Enclosed with this letter is a Source Water Sampling Plan template that you can complete and submit to this office to comply with the July 1, 2015 deadline. The template includes instructions and a worksheet that will assist the DEQ in determining if your plan meets the requirements of the LT2 Rule.

If you have any questions about this subject, please contact this office.



**MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF DRINKING WATER AND MUNICIPAL ASSISTANCE**

**LONG TERM 2 (LT2) SOURCE WATER SAMPLING PLAN TEMPLATE
Round 2 Sampling – Schedule 2 Systems**

A responsible official for the water system should submit the following information for DEQ review and approval.

A sampling plan packet consisting of:

1. The name of the Michigan Accredited Lab that will be performing the *Cryptosporidium* analysis. A list of approved labs can be obtained at <http://www.michigan.gov/deqlaboratoryservices>, click on Certifications, click on Drinking Water Analysis Laboratory, click on Cryptosporidium Laboratories.
2. The name of the Michigan Accredited Lab that will be performing the *E.coli* analysis. The laboratory that you select must be certified for *E.coli* enumeration (counting) using an U.S. EPA Approved Analytical Method.
3. Use the enclosed calendars for 2015 - 2017 to select or highlight the days between October 1, 2015, and September 30, 2017, on which you will be collecting your samples. You may also submit a one-page summary of the dates when samples will be collected in mm/dd/yy format. Samples must be collected within a five day window (the date you select, plus or minus 2 days).
4. A schematic indicating all raw water sources, chemical feed points and recycle locations along with an arrow indicating the exact sample location.
5. Completed Source Water Sampling Location Worksheet (provided on the following pages with instructions). Completed worksheets must be submitted to your DEQ Drinking Water District Engineer at least 3 months prior to the start of your system's required sampling period (7-1-15).
6. Signature of the responsible official for the water system acknowledging that water system staff will notify the DEQ immediately upon discovery of any issues related to timely source water sample collection or accurate lab analysis of samples.

LT2 SOURCE WATER SAMPLING LOCATION WORKSHEET INSTRUCTIONS:

If your treatment plant uses surface or GWUDI (groundwater under direct influence of surface water) sources, the LT2 rule requires that you monitor each source for *Cryptosporidium*, *E.coli* and turbidity once a month over a 2 year period. Please complete one column of this worksheet for each source.

<u>Source Name</u> - List all sources that will be monitored for <i>Cryptosporidium</i>, <i>E.coli</i> and turbidity. Blending of two or more sources is permitted as long as it is prior to any chemical addition and the blended portions are representative of normal operations. Next to each source, indicate if it is "Blended" or "Not Blended". <i>Please list information for each source in a separate column.</i>
<u>Source Type</u> – For each source, state if it's a Flowing Stream, Lake/Reservoir or GWUDI.
<u>Source Identification Number</u> - Be sure to list a source identification number for each source. Contact your local DEQ District office if you are uncertain of the source identification number for your source(s).
<u>Source Water Sampling Location</u> - Please describe, in detail, the specific location where you will be collecting your samples. If your system has more than one source, you should collect your samples after the raw water from all sources is combined. Your sampling point(s) should be representative of water entering the treatment plant. If you have a raw water off-stream reservoir or storage, samples should be collected after the raw water storage/reservoir. If the raw water is not combined prior to treatment, you may need to composite samples from each source (recommended), or analyze separate samples from each source and calculate a weighted average. <u>Include a plant schematic with an arrow indicating your proposed LT2 sampling location.</u> Example plant schematics are available upon request.
<u>Usage</u> - Please describe, in detail, the specific usage practices for each source – "All year" or "Part-Year/Seasonal"- for your source in recent years and describe the anticipated use in future years. For Part-Year/Seasonal sources, include the months of operation.
<u>Proportion of Flow</u> - Provide the most accurate information available regarding the % of average yearly flow that each source contributes. After providing information for all sources, please clearly indicate which source is your primary. Your primary source is the source that clearly provides the majority of water on a yearly basis to the treatment plant.
<u>Presedimentation, Bank Filtration, or Off-Stream Storage (if applicable)</u> - If you utilize any of these practices, please include them in your plant schematic and indicate if your samples will be collected before or after these practices.
<u>Recycling Practices (if applicable)</u> - If your plant recycles filter backwash water or other waste streams, you must indicate the point where the recycled backwash re-enters the treatment process. Your sampling point should be prior to the location where recycled streams come back into the treatment process. If you do not recycle, please state "Do not recycle" on your plant schematic. Samples collected after recycling will be invalidated; re-sampling will be required.
<u>Chemical Pretreatment</u> - On the plant schematic, indicate chemical feed locations from the intake to the plant. Your sampling point must be prior to any chemical treatment. If you feed any chemical(s) prior to your sampling point, you need to include this information in your sampling worksheet. Samples containing treatment chemicals will be invalidated; re-sampling will be required.
<u>Sample Compositing Procedure</u> - If a blended sample location prior to chemical addition is available, you should collect one blended sample from this location. If such a sample location is not available, plants may choose to sample each blended source separately. In this case, a composite sample representing % contribution of each source is needed. Describe Compositing in detail. A system may request to evaluate blended sources separately in order to provide additional information on <i>Cryptosporidium</i> loading for each source.

Note: Collection of at least one matrix spike sample for every 20 *Cryptosporidium* samples is required and should be documented in the sampling plan schedule (i.e. at least two matrix spike samples are needed for 24 *Cryptosporidium* samples).

Long Term 2 Enhanced Surface Water Treatment Rule Source Water Sampling Location Worksheet

Public Water System (PWS) Name: _____ WSSN: _____

Water Treatment Plant Name: _____

Water Treatment Plant ID: _____

Name and Phone Number of Person completing this Form: _____

Source Name		
Source Type Flowing Stream Lake/Reservoir GWUDI - Ground Water Under the Influence of Surface Water		
Source Identification Number		
Source Water Sampling Location (Raw water tap or sampled at source, indicate location on schematic)		
Usage Operational – almost all the time Demand – a few times a year Emergency – fewer than once per year		
Proportion of Typical Average Daily Flow (if only 1 source, 100%)	_____ %	_____ %
Pretreatment Practices (if applicable) None Presedimentation Bank filtration Other – write in		
Recycling Practices (yes or no) (If yes, describe and indicate location on schematic)		
Chemical Pretreatment (yes or no) (If yes, describe and indicate location on schematic)		
Compositing Procedure (yes or no) (If yes, state if using blended sample tap, composite sample, or weighted)		

Use additional sheets to provide more information.

I acknowledge that water system staff will notify the DEQ immediately upon discovery of any issues related to timely source water sample collection or accurate lab analysis of samples.

Signature

Date

Michigan Certified Laboratories for Cryptosporidium Analysis
Michigan Department of Environmental Quality
Remediation and Redevelopment Division
Laboratory Services Section
Laboratory Certification Officer: Gregg A Lundy
Chief of Laboratory Services: George L. Krisztian
Date of Report: July 15, 2014

Phone: (517) 335-9800 Fax: (517) 335-9600
Phone: (517) 335-9219
Phone: (517) 335-8812

Michigan DEQ Certified In State Laboratories

Laboratory Name / Address /Contact Information

Michigan Laboratory ID #

Michigan State University
 Environmental and Molecular Microbiology Laboratory
 480 Wilson Road, 3 Natural Resources Building
 East Lansing, MI 48824

9982

Contact: Rebecca Ives
 Phone: (517) 432-8185
 Fax: (517) 432-1699
 Email: ivesrebe@msu.edu

Michigan DEQ Certified Out of State Laboratories

Laboratory Name / Address /Contact Information

Michigan Laboratory ID #

EMSL Analytical, Inc.
 Cinnaminson, New Jersey Laboratory
 200 Route 130 North
 Cinnaminson, NJ 08077

9970

Contact: Helen MacMinn
 Phone: (856) 303-2584
 Fax: (856) 786-5971
 Email: hmacminn@emsl.com

Eurofins Eaton Analytical, Inc.
 South Bend, Indiana Laboratory
 110 South Hill Street
 South Bend, IN 46617

9926

Contact: Dale Piechocki
 Phone: (574) 472 5523
 Fax: (574) 233-8207
 Email: dalepiechocki@eurofinsus.com

Laboratory Name / Address /Contact Information**Michigan Laboratory ID #**

Scientific Methods Inc.
12441 Beckley Street
Granger, IN 46530

9984

Contact: Matt Hayes
Phone: (574) 277-4078
Fax: (574) 968-0269
Email: matt@scientificmethods.com

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, December 12, 2014 9:00 AM
To: 'Rennaker, Joanne (DEQ) (RENNAKERJ@michigan.gov)'
Subject: ltr to final
Attachments: Flint DBP MCL 4Q14 d3.doc

Jo Anne please, final this letter and hold it.

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



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



DAN WYANT
DIRECTOR

December 12, 2014

Mr. Brent Wright, Operation Supervisor
City Of Flint - DPW
Flint Water Plant
4500 North Dort Highway
Flint, MI 48505

WSSN: 02310

Dear Mr. Wright:

SUBJECT: Violation Notice – Maximum Contaminant Level for Total Trihalomethanes
Operational Evaluation – Total Trihalomethanes
4th 3rd-Quarter 2014 Monitoring Period

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The Department of Environmental Quality (DEQ), Office of Drinking Water and Municipal Assistance (ODWMA), records show that the City of Flint is in violation of the Safe Drinking Water Act, 1976 PA 399, as amended (Act 399); R 325.10610, *Maximum contaminant levels (MCL) for disinfection byproducts*, of the 1979 Administrative Code.

In accordance with R.325.10610, *MCLs for disinfection byproducts*, of the 1979 Administrative Code, the MCL for disinfection byproduct total trihalomethanes (TTHM) is 0.080 milligrams per liter (mg/L) as a Locational Running Annual Average (LRAA) at each monitoring location. As listed in the table below, our records show that the City of Flint's highest TTHM locational running annual average (LRAA), based on the last three quarters ending November 30, 2014, is 0.099 mg/l which exceeds the standard, and that two of the eight sample site locations exceed the standard of 0.080 mg/L.

Further, in accordance with R325.10719I, *Disinfection byproducts: operational evaluation levels*, of the 1979 Administrative Code, when an operational evaluation level (OEL) at a monitoring location for TTHM exceeds 0.080 mg/L, a supply shall conduct an operational evaluation and submit a written report of the evaluation to the department not later than 90 days after being notified of the analytical result that causes the supply to exceed the operational evaluation level. As listed in the table below, our records show that TTHM operational evaluation levels for the City of Flint exceed 0.080 mg/L, at four of the City's eight sample site locations.

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TTHM Results (mg/L)	5/21/14	8/21/14	11/20/14	LRAA	OEL
DBP1 McDonalds 3719 Davison	0.162	0.145	0.059	0.092	0.106
DBP2 Liquor Palace 3302 S. Dort Highway	0.112	0.127	0.033	0.068	0.076
DBP3 North Flint Auto 6204 N. Saginaw St.	0.097	0.118	0.041	0.064	0.074

DBP4 University Market 2501 Flushing Road	0.106	0.196	0.094	0.099	0.122
DBP5 Taco Bell 3606 Corunna Road	0.079	0.181	0.034	0.074	0.082
DBP6 Rite-Aid Pharmacy 5018 Clio Road	0.088	0.144	0.054	0.072	0.085
DBP7 Salem Housing 3216 MLK Boulevard	0.082	0.112	0.050	0.061	0.074
DBP8 BP Gas Station 822 S. Dort Highway	0.075	0.112	0.036	0.056	0.065

Our investigation consisted of a review of ODWMA files for laboratory reports received for compliance monitoring. Our investigation is considered complete. This violation began on December 1, 2014, and will continue until TTHM LRAA is below the MCL at all sample sites.

We acknowledge and appreciate the city's cooperation with our recommendation to preemptively conduct an Operational Evaluation following the City's second quarterly round of monitoring in August. That Operational Evaluation report has identified possible causes and corrective measures for the elevated TTHM levels which we encourage the City continue implementing. These modifications have likely contributed in part to the reduction in TTHM levels reported in the most recent quarter, and suggest the City may be able to achieve compliance with the TTHM standard.

Our office is continuing to review the Operational Evaluation report that was submitted on December 1, 2014 and will provide the City and their consultant comments as needed to help address this MCL violation.

Water systems ~~who~~^{that} exceed the OEL must complete and submit an Operational Evaluation in accordance with Administrative Rule 747191 94(R325.104719194) within 90 days ~~of being notified since the start of the violation.~~ **An updated Operational Evaluation report, which incorporates the most recent sample results, must now be completed and received by our office by no later than March 1, 2015.**

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~~We acknowledge and appreciate the city's collaborative cooperation effort with our department recommendation to conduct towards preparing an Operational Evaluation before being required to do so several months prior to OEL exceedance and submitting a draft report when the exceedance was foreseeable. The draft report identifies possible causes and corrective measures for the elevated TTHM levels. We also acknowledge that the city has implemented some of these measures identified in the Operational Evaluation, including improved distribution system operation and initiating softening of the entire treatment plant flow, both of which have and has likely contributed to the reduction in TTHM levels reported in the most recent quarter.~~

~~The city is encouraged to continue working with their consultant towards implementing additional TTHM reduction measures identified in the draft report. At the same time, we will review the draft report and provide comments as needed towards assisting the city in this endeavor. The (final?) Operational Evaluation report needs to be completed and received by our office by no later than March 1, 2015~~

If you have any other factual information you would like us to consider regarding the violation identified in this Notice, please provide them in a written response by January 12, 2015.

Administrative rule R 325.10403 of Act 399 requires that suppliers provide public notice as soon as practical but no later than thirty (30) days after the supplier learns of this type of violation, by mail or direct delivery **and** by any other means reasonably calculated to reach customers not normally reached by mail. Enclosed is a sample public notice (PN) which contains the minimum required language. The City is encouraged to include provide additional information regarding its response to this violation. **Please notify your consumers by January 10, 2015, and send us a signed and dated copy of the notice that you issued within ten (10) days of distributing the public notice.** This violation must ~~(also?)~~ be included in your 2014 Consumer Confidence Report (CCR,) due by July 1, 2015. The public notification must be repeated every quarter until you no longer exceed the TTHM standard. Failure to issue a PN for this violation will result in a fine of at least \$1,000 per event, with a maximum of \$5,000 per violation. Contact our office for a more complete summary of our fines policies. (is the prior really sentence necessary?)

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We anticipate and appreciate your continued cooperation in resolving this matter. If you have any questions regarding this Violation Notice, please contact us at the numbers below.

Sincerely,

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

Adam Rosenthal, EQA
Lansing District Office
Office of Drinking Water & Municipal
Assistance
517-284-6644

MFP:AR:JR

Enclosure

cc:

Genesee County Health Dept.
Jennifer Crooks, EPA Region 5
Mr. Darnell Early, Emergency Manager, City of Flint
Daughtry Johnson
Howard Croft
Robert Bincsik
Liane Shekter Smith, P.E.
Richard Benzie, P.E.
Stephen Busch, P.E.

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

City of Flint Did Not Meet Treatment Requirements

Our water system recently violated a drinking water standard. Although this incident was not an emergency, as our customers, you have a right to know what happened and what we are doing to correct this situation.

We routinely monitor for the presence of drinking water contaminants. Samples were collected for total trihalomethanes (TTHM) analysis from eight locations on a quarterly basis (May 21, August 21, and November 20 of 2014). The average of the results at **ANY** of the eight locations must not exceed the maximum contaminant level (MCL) for TTHMs, otherwise our water system exceeds the MCL. The standard for TTHMs is 80 µg/L. The location reporting the highest TTHM level was 99 ug/L; thus, our water system exceeds the TTHM MCL.

What should I do?

- There is nothing you need to do unless you have a severely compromised immune system, have an infant, or are elderly. These people may be at increased risk and should seek advice about drinking water from their health care providers.
- You do not need to boil your water or take other corrective actions. If a situation arises where the water is no longer safe to drink, you will be notified within 24 hours.

What does this mean?

This is not an emergency. If it had been an emergency, you would have been notified within 24 hours.

People who drink water containing trihalomethanes in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous system, and may have an increased risk of getting cancer.

What is being done?

We are currently working on solutions to correct the problem. We anticipate resolving the problem by 2015.

For more information, please contact Mr. Brent Wright at 517-787-6537 or the Flint Water Plant at 4500 North Dort Highway, Flint, MI 48505.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by the City of Flint.

CERTIFICATION:

WSSN: 02310

I certify that this water supply has fully complied with the public notification requirements in the Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the administrative rules.

Signature

Title

Date Distributed

Reminder to water supplier: This notice / certification must be sent to the DEQ.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, March 28, 2014 2:11 PM
To: Wurfel, Brad (DEQ); Feuerstein, Heather (DEQ); Shekter Smith, Liane (DEQ); Richard Benzie P.E. (BENZIER@michigan.gov); Willard, Veronica (DEQ)
Cc: prysbym@michigan.gov
Subject: Media Contact : Flint WTP River Use Channel 25 News

I was contacted by Mr. Walter Smith-Randolph with Channel 25 News in Flint earlier today.

He simply had me confirm that:

We have not received a permit application form for the construction permits from Flint regarding the WTP. We have received preliminary engineering design plans and specifications which we have commented on and work with the City to address.

And that: We have a meeting with the City on Monday to in part discuss the design issues.

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, April 28, 2014 8:56 AM
To: Wurfel, Brad (DEQ); Feuerstein, Heather (DEQ); Shekter Smith, Liane (DEQ); Benzie, Richard (DEQ); Willard, Veronica (DEQ)
Cc: Prysby, Mike (DEQ); McClellan, Michael (DEQ)
Subject: Media Contact: City of Flint WTP

On Friday April 25, Mike Prysby and I attended the startup ceremony for the City of Flint Water Treatment Plant.

Following the ceremony, I was interviewed by NBC 25 in Flint, CBS 5 Saginaw, and Mlive/Flint Journal. Mike Prysby was interviewed by ABC 12 Flint.

Related articles follow:

Flint Journal/Mlive

http://www.mlive.com/news/flint/index.ssf/2014/04/closing_the_valve_on_history_f.html

http://www.mlive.com/news/flint/index.ssf/2014/04/watch_mayor_dayne_walling_em_d.html

ABC 12

<http://www.abc12.com/video?clipId=10093328&autostart=true>

<http://www.abc12.com/video?clipId=10093129&autostart=true>

<http://www.abc12.com/video?clipId=10093661&autostart=true>

CBS 5

<http://www.wnem.com/video?clipId=10093499&autostart=true>

<http://www.wnem.com/story/25341227/flint-begins-using-own-water-supply>

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, October 16, 2014 3:25 PM
To: 'Wurfel, Brad (DEQ) (WurfelB@michigan.gov)'; Shekter Smith, Liane (DEQ) (SHEKTERL@michigan.gov); Richard Benzie P.E. (BENZIER@michigan.gov); Howes, Sarah (DEQ); Feuerstein, Heather (DEQ); Sygo, Jim (DEQ); Willard, Veronica (DEQ)
Cc: prysbym@michigan.gov
Subject: Media Contact - Flint DW Chloride - Michigan Radio NPR

I was just contacted by Kate Wells, Michigan Radio NPR regarding the recent news about General Motors concerns regarding chloride levels in Flint's Drinking Water.

I explained that chloride does have a secondary level set by EPA which is not for health related issues but rather for taste and aesthetic concerns. Chloride which can generally come from salt, NaCl, sodium chloride, is a normal part of people's diets, and the amounts in Flint's drinking water would likely be minor compared to normal dietary intakes.

She asked about how chloride could be causing corrosion issues at GM. I indicated that I wasn't sure how they were utilizing the water or what their process consisted of. I did indicate that we normally look at other parameters in drinking water such as pH and alkalinity when considering its corrosivity.

She asked about where water is analyzed. I indicated that most chemical analysis is performed at a certified laboratory, and that Flint has generally used the State Drinking Water Lab. She asked about how results are reported and I said that results go back to the system which then provides results to the DEQ, and that the State DW lab will report directly to the DEQ in addition to the City.

She asked about consumer confidence reports (CCRs). I explained that these are federal requirements for all Community Water Systems. I informed her that detections for regulated contaminants would be reported but that with the exception of sodium, unregulated contaminants such as chloride are not required to be reported. That sodium is included so people with low sodium diets can determine their intake from water. I also clarified that the City's current CCR which had to be issued by July 1 would reflect results from 2013 (when Flint was on DWSD) and that 2014 results would be in the CCR issued in 2015.

She asked whether there would be similar health related issues from chloride as there are with sodium since they are both in salt, but I indicated that I'm not aware of any such issue and that if there were EPA would have asked it to be reported on the CCR and/or established a primary standard for it.

She asked about salt entering water, it's visibility, and I explained that when salt is present in water it will dissolve into sodium and chloride, that it would not be visible in the water, especially at the levels indicated.

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, June 12, 2014 1:16 PM
To: Wurfel, Brad (DEQ) (WurfelB@michigan.gov); Feuerstein, Heather (DEQ); Shekter Smith, Liane (DEQ); Richard Benzie P.E. (BENZIER@michigan.gov); Willard, Veronica (DEQ)
Cc: prysbym@michigan.gov; McClellan, Michael (DEQ)
Subject: Media Contact - Flint WTP

I just spoke with Ron Fongers of the Flint Journal.

He said he was at a press conference this morning held by the Flint Emergency Manager in which the EM brought in Flint Water System staff to report on the first full month of operation at the City's Water Treatment Plant. Ron indicated the City stated they were in 100% compliance with the treatment standards.

Ron asked me to confirm that this statement was accurate. I stated that the City has been meeting all applicable standards for water quality and treatment operations.

Ron asked about the City using lime treatment to soften the water. I explained that when the City was a customer of DWSD, the source of their water was from the Great Lakes which have natural levels of hardness that normally don't require softening to meet customer expectations. However, the City's current source of the Flint River has higher levels of hardness and the City is using lime softening to lower the hardness level. I also indicated that this treatment is for aesthetic purposes and goes beyond minimum treatment requirements for public health protection.

Ron indicated the City was receiving an increase in complaints from customers and asked whether we had seen a significant increase in complaint calls. I indicated we have received a couple of complaints specific to Flint, but that this is not a significant increase as we receive complaints from customers sporadically for all the water systems we regulate.

Ron asked if we were in contact with the City regarding their operations. I stated that we have been in consultation with the City regarding the operation of all of their water facilities, treatment (including softening) and distribution.

Ron asked about what monitoring we have reviewed mentioning bacteria and turbidity. I indicated in addition the City has monitored for metals, organics including disinfection byproducts, and other inorganics such as nitrate along with microbial contaminants and applicable operational requirements like turbidity and disinfection.

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, June 24, 2014 11:50 AM
To: Wurfel, Brad (DEQ) (WurfelB@michigan.gov); Feuerstein, Heather (DEQ); Shekter Smith, Liane (DEQ); Richard Benzie P.E. (BENZIER@michigan.gov); Willard, Veronica (DEQ) prysbym@michigan.gov; McClellan, Michael (DEQ); Bean, Lawrence (DEQ); Shirey, Kathleen (DEQ)
Cc:
Subject: Media Contact City of Flint

I just spoke with Dominic Adams, Flint Journal/MLive.

According to the City of Flint Police Dept., prior to full time operation of the Flint WTP (April 2014), the City had a Bomb exercise/disposal range at the back of the property for the City's Water Treatment Plant. Dominic wanted to know if DEQ drinking water staff had discussions about this with the City prior to the WTP startup. I stated that I did not have discussions with the City on this, I would need to verify my staff hadn't discussed it, but I am sure they did not. I did ask whether he meant a firing/target range and he indicated that the site was used by the Flint bomb squad.

I indicated that I don't have expertise in explosives or the related waste issues, and that our focus has been on the water quality (we have no evidence of impact to the Flint River from this site). Those types of questions about impact to the land or waste issues would be best responded by staff in RRD and OWMRP, so I provided Dominic with the Lansing DS contacts for both (Kathy and Larry).

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, March 25, 2014 2:16 PM
To: Wurfel, Brad (DEQ); Feuerstein, Heather (DEQ); Shekter Smith, Liane (DEQ); Benzie, Richard (DEQ); Willard, Veronica (DEQ)
Cc: prysbym@michigan.gov
Subject: Media Contact FW: questions about Flint River

I received the email below from Mr. Dominic Adams with Mlive and the Flint Journal.

I called Mr. Adams back and we discussed the following:

Process for switching from DWSD to Flint River

Water provided by DWSD is treated. The City's of Flint's existing WTP was designed for emergency use of the Flint River in the event of a failure in the DWSD system. So the WTP is already capable of the switchover, they would just close the line from DWSD and start pumps from the intake. The DEQ would need to be notified prior to the switchover in source water as there are regulatory requirements under the Safe Drinking Water Act. Failure to meet regulatory requirements would result in violations, and both the City and DEQ, would prefer to prevent that from occurring if possible.

(He asked about fines and I provided a link to the administrative fines information on our website)

Is time needed for the Detroit line

Other water systems utilize the pipeline from Detroit and will continue to do so without interruption.

Why is the City upgrading the WTP and what is being done

The City WTP is designed for short term emergency operation, these improvements would give them the ability to better operate the plant on a continuous basis. You should be able to obtain the full project scope from the City, but it includes additional chemical storage, modification to the disinfection system, electrical modifications, and pump modifications.

How is the DEQ involved in the project

The City is required to obtain construction permits from the DEQ Office of Drinking Water and Municipal Assistance prior to making modifications to its water system. The City has provided preliminary design information regarding the WTP improvements which we have commented on, but we have not received a formal permit application at this time.

(FYI they already held a groundbreaking which was reported)

http://www.mlive.com/news/flint/index.ssf/2014/03/flint_residents_should_be_drin.html

How long will a permit take?

For a permit of this complexity, we are normally able to respond to an applicant 30-45 days after receiving a permit application.

Does the DEQ have to inspect the system.

The DEQ conducts routine inspection visits of public water systems, we conduct at least 4 inspection visits with the City of Flint (its treatment and distribution systems) each year and a full inspection of the system is required once every 3 years. The last full inspection report was completed in 2013.

When the City operates its water treatment plant, they need to conduct daily monitoring and report those results to the DEQ. So we are constantly reviewing their treatment operations.

The City has set a date of April 17 to switchover, is that achievable?

I believe this is a tentative date based on a one year deadline set when the contract between Flint and DWSD was terminated. You would need to contact the City regarding their timeline for completing construction work upon obtaining a permit.

I indicated it would be good to contact the City about what residents should expect regarding water service when the change is made.

I tried to get a better idea from Mr. Adams about his article. He indicated he didn't feel the City was fully disclosing everything that is involved in completing this changeover.

PS, Mr. Adams claimed to have my info wrong or dialed a wrong number, my voicemail is not full and has been working fine. I provided him with my current info.

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

From: Adams, Dominic [mailto:DADAMS5@mlive.com]
Sent: Tuesday, March 25, 2014 12:20 PM
To: Busch, Stephen (DEQ)
Subject: questions about Flint River

Steve:

My name is Dominic Adams and I am a reporter with The Flint Journal. We spoke in July about the city using the Flint River as a primary drinking water source until the Karegnondi Water Authority is complete. Here is a link to that story:
http://www.mlive.com/news/flint/index.ssf/2013/07/flint_to_spend_171000_for_engi.html

The city says it is going to start using the Flint River and cut off from Detroit by April 17. I'd like to speak to you about the technical aspect about what that means. I tried leaving you a voicemail, but it says your voicemail is full.

Please give me a call at 810-241-8803 as soon as possible so we can discuss this.

If you are not the person I need to speak to about this, please give the name and contact information for the person I should talk to.

Thanks a lot and have a great day.

Dominic Adams | metro reporter | [The Flint Journal](#) | 810-241-8803 | dadams5@mlive.com |
[On Twitter](#) | [On Facebook](#) |

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, April 18, 2014 5:32 PM
To: Wurfel, Brad (DEQ); Feuerstein, Heather (DEQ); Shekter Smith, Liane (DEQ); Richard Benzie P.E. (BENZIER@michigan.gov); Willard, Veronica (DEQ)
Cc: prysbym@michigan.gov
Subject: Media Contacts: City of Flint WTP

I was contacted today by the following reporters:

- Stephanie Parkinson, NBC news 25 Flint
- Kevin Wilson, ABC news 12 Flint
- Dominic Adams, Flint Journal/MLive

I provided a statement to each late this afternoon that:

DEQ staff were in the City of Flint today (4/18) to check on construction progress of work being completed at the Flint water treatment plant. The construction work nearing completion but is not yet complete. The WTP has initialized some of its treatment systems, and this process will take several days to complete. As such the WTP is not yet serving water to residents.

Stephanie Parkinson had a few followup questions.

- Will the work be completed by Monday? I indicated the City would be best able to answer questions regarding the construction schedule, Monday does not appear likely but they did think construction would be completed by next week.
- Has the DEQ completed testing of the City water? The City maintains a lab that conducts most operational testing, and then the City is required to submit their results to the DEQ.
- What equipment is still under construction? Disinfection equipment is the main focus of the remaining work.

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, July 08, 2013 11:20 AM
To: Wurfel, Brad (DEQ); Copen, Leigh (DEQ); Shekter Smith, Liane (DEQ); Bloemker, Jon (DEQ); Willard, Veronica (DEQ)
Cc: Prysby, Mike (DEQ); Benzie, Richard (DEQ)
Subject: Media Inquiry - Flint WTP Engineering

I received a call this morning (July 8) from Dominic Adams, Flint Journal/Mlive. I called him back with Mike Prysby, District Engineer sitting in on the call.

Mr. Adams had obtained information that the City of Flint was contracting some engineering work for the Flint WTP, and the work was in part to potentially use the Flint River as a primary drinking water source.

I informed Mr. Adams that the City of Flint receives treated water from DWSD and has been since the 1960's, but has had the WTP available for reliability should the single transmission line system from DWSD fail. In an emergency the Flint WTP is already approved to use the Flint River for source water and is designed to meet all drinking water standards and public health requirements.

I also informed Mr. Adams that the engineering work in question would be to primarily enhance treatment capabilities beyond minimum requirements for the purpose of softening to provide customers with water quality consistent with what they already receive from DWSD. Some equipment for softening is already in place, but under emergency operation would not normally be used due to the time required for startup and fine tuning.

Mr. Adams asked whether the DEQ has approved or signed off on the proposed engineering work and on allowing the City of Flint to use the River as its source water. I explained that the ODWMA has not received a construction permit application for such work at this time, and that one would be required. I also indicated to Mr. Adams, that regardless of the source water, the City of Flint would be required to meet all applicable Drinking Water Standards and public health requirements and again that the WTP is already approved as a redundant supply to use the Flint River as a source water meeting all drinking water standards and that the WTP undergoes test runs on a quarterly basis to maintain the WTP.

Mr. Adams asked for more specifics regarding the treatment process and I explained that the removal of hardness for aesthetic water quality at this WTP is called lime softening.

Mr. Adams also inquired about the City being able to use the Flint River after the contract with DWSD terminates, and I indicated that may be one option, but they could also continue to purchase treated water from DWSD.

In Mr. Adams voicemail he mentioned a variance to use the Flint River, and I reiterated that there is no "Variance", but that the WTP has been constructed and approved to treat water from the Flint River to appropriate standards as needed.

Let me know if you have any questions.

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, April 25, 2014 10:45 AM
To: prysbym@michigan.gov
Subject: Message during Flint event

Mike,

I spoke with Brad this morning. We focused on soundbites for television. Here is our message for the media at today's event. I'll plan to give these remarks if called upon.

- Our Office oversees public water systems, such as the City of Flint, to ensure public health standards for drinking water are continually being met.
- Department staff have been working in partnership with the City on this project over the past year to ensure the City can provide a safe, adequate, and reliable supply of drinking water. We are here today to recognize the City for the culmination of their hard work and effort associated with this undertaking.
- Work on this project also serves the City's long term needs as it will continue to rely upon this water treatment plant once connected to the Karegnondi Water Authority. The Department will continue to oversee the City's water operations, just as it does for the over 1400 community water systems throughout the state and we look forward to continued successful partnership with the City.

If there are any technical questions from the media I will pass them on to you. Just remember to keep things simple.

Let me know if you have any questions. Otherwise I'll see you this afternoon. Thanks.

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, October 20, 2015 2:45 PM
To: Gardner, Michael (OAG) (MGardner@audgen.michigan.gov)
Cc: Shekter Smith, Liane (DEQ) (SHEKTERL@michigan.gov); Richard Benzie P.E. (BENZIER@michigan.gov); Kris Philip (philipk@michigan.gov); Shekter, Jean (DEQ); prysbym@michigan.gov; Adam Rosenthal (rosenthala@michigan.gov); Sygo, Jim (DEQ) (SygoJ@michigan.gov)
Subject: OAG Requested Items
Attachments: CWS Monitoring Charts - January 2014.pdf; Flint.pdf; Flint-GMsites.jpg

Mike,

Here are the following items you requested during our meeting on 10/15.

Reference to the Recommended standards for water works (Ten State Standards) is as follows under Rule 113 and Rule 1302:

R 325.10113 Compliance with rules; guidance information.

Rule 113. Public water supplies may use the information in the following publications as guidance to comply with these rules:

(a) Recommended standards for water works, prepared by the Great Lakes--upper Mississippi river board of state sanitary engineers, is available for inspection at the department offices in Lansing, and may be purchased at a cost of \$12.00 from the Health Education Services, P.O. Box 7126, Albany, New York 12224 telephone 518-439-7286, Internet <http://www.hes.org/>.

(b) The American water works association manual M 19, emergency planning for water utilities, 2001, as referred to in part 23, is available for inspection at the department offices in Lansing, and may be purchased at a cost of \$95.00 from the American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235, telephone 1-800-926-7337, Internet www.awwa.org.

(c) Suggested practices for waterworks design, construction, and operation for type I public water supplies, February 2008, prepared by the Michigan department of environmental quality, water bureau, is available for inspection at the department offices in Lansing and on the Internet at <http://www.michigan.gov/deq>.

(d) Cross connection rules manual, fourth edition, October 2008, prepared by the Michigan department of environmental quality, water bureau, is available for inspection at the department offices in Lansing and on the Internet at <http://www.michigan.gov/deq>.

History: 1979 AC; 2000 AACS; 2009 MR 23, Eff. Dec. 4, 2009.

R 325.11302 Submission of plans and specifications for construction or alteration of waterworks system; guidance material.

Rule 1302. (1) For type I public water supplies, before the construction or alteration of a waterworks system, or a portion of a waterworks system, plans and specifications shall be submitted to the department by a public water supply or its designated agent for review, approval, and issuance of a permit, unless otherwise accepted under R 325.11304.

(2) A permit application shall be submitted with the plans and specifications, shall identify and summarize plans or projects, and, if applicable, shall indicate the authorization of the designated agent for the public water supply.

(3) Both of the following shall be used, whenever applicable, when preparing plans and specifications:

(a) Recommended standards for water works, prepared by the Great Lakes Upper Mississippi board of state sanitary engineers under R 325.10113.

(b) Suggested practices for waterworks design, construction, and operation for type I public water supplies, prepared by the Michigan department of environmental quality, water bureau under R 325.10113.

History: 1979 AC; 2009 MR 23, Eff. Dec. 4, 2009.

Here's a link to the current version of the Recommended Standards for water works.

<http://www.10statesstandards.com/waterrev2012.pdf>

Summary of monitoring requirements chart

The attached, CWS Monitoring Charts – January 2014.pdf, should give you a more readable listing of the monitoring requirements instead of having to look at each rule. Jean Shekter and Kris Philip can help decipher this chart if you have questions or need the rule references.

Map of Flint Water System

A copy of the water system map is attached (Flint.pdf). Please note that this map is a controlled document that should not be shared with others for security purposes related to critical infrastructure.

Flint WTP in relation to GM Sites

A google earth map image attached, Flint-GMsites.jpg, shows the location of the Flint WTP in relation to the GM assembly plant and the Buick City site. Not sure if these were the GM site(s) you were wondering about.

Flint Population and Service Connection History

Before 2006, population = 140,761

2006, population = 124,943 (2000 census); 41,537 residential & small commercial accounts

2009, population = 118,645 (DWRP project plan); 38,000 residential accounts

1/2013, population = 102,434 (2010 census); 31,228 residential accounts

3/2015, population = 99,763 (2013 census estimate); 24,600 residential accounts

(FYI the 2014 census estimate is listed as 99,002)

Let me know when you want to meet again and if there is any other info you need.

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

Entry Point Monitoring			
		GW Sources	SW Sources (including GWUDI)
Partial Chemistry ¹	Initial	1 / year	Quarterly for 1 year
	Routine		1 / year
Metals ²	Initial	1 / 3 years (3 sets)	1 / year (3 sets)
	Routine	1 / 9 years	1 / 9 years
Volatile Organic Compounds ⁵	Initial	Quarterly for 1 year ⁶	Quarterly for 1 year ⁶
	Routine	1 / 3 years	1 / year
Synthetic Organic Compounds (CXPT, CXHB, CXLP)	Initial	Quarterly for 1 year ⁶	Quarterly for 1 year ⁶
	Routine	With WHPP ⁷ / Tritium ⁸ : Waived Without WHPP / Tritium: 1 / 3 years	Least Vulnerable ⁹ : 1 / 3 years Moderately Vulnerable ⁹ : 2 / 3 years ¹⁰ Highly Vulnerable ⁹ : Quarterly ¹¹
Expanded SOC (EDB, DBCP, Endothal, Diquat, Glyphosate if unchlorinated, Dalapon)		Vulnerable aquifers (karst, gravel/cobble): 1 / 3 years All others: Waived	Least Vulnerable and a majority of Moderately Vulnerable ⁹ : Waived Select Moderately Vulnerable ¹² : 1 / 3 years ¹³ Highly Vulnerable ⁹ : 1 / year ¹³
Cyanide	Initial	1 / 3 years (3 sets)	1 / year (3 sets)
	Routine	1 / 9 years	1 / 9 years
Radionuclides ¹⁴	Initial	Quarterly for 1 year ¹⁵	Quarterly for 1 year ¹⁵
	Routine	< Detection Limit: 1 / 9 years ≥ Detection Limit but ≤ 1/2 MCL: 1 / 6 years > 1/2 MCL but ≤ MCL: 1 / 3 years > MCL: Quarterly	< Detection Limit: 1 / 9 years ≥ Detection Limit but ≤ 1/2 MCL: 1 / 6 years > 1/2 MCL but ≤ MCL: 1 / 3 years > MCL: Quarterly
Water Quality Parameters ¹⁶	Initial	WQPs of Rule 710b(4)(b): 2 / 6 months	WQPs of Rule 710b(4)(b): 2 / 6 months
	OCCT	WQPs of Rule 710b(5)(b): 1 / 2 weeks	WQPs of Rule 710b(5)(b): 1 / 2 weeks
Bromate	Initial	1 / month / plant that uses ozone	1 / month / plant that uses ozone
	Reduced	1 / quarter / plant if RAA ≤ 0.0025 mg/L	1 / quarter / plant if RAA ≤ 0.0025 mg/L
Chlorite		1 / day / plant if disinfecting with ClO ₂	1 / day / plant if disinfecting with ClO ₂
Chlorine Dioxide		1 / day / plant if disinfecting with ClO ₂	1 / day / plant if disinfecting with ClO ₂
TOC & Alkalinity	Initial	NA	1 set source alkalinity, source TOC, & treated TOC / month / conventional filtration plant
	Reduced	NA	1 set / quarter if average treated TOC < 2.0 mg/L for 2 cons years, or <1.0 mg/L for 1 year

Footnotes:

¹ Partial Chemistry scan (at MDEQ laboratory only) includes contaminants with varying monitoring frequencies as follows:

		GW Sources	SW Sources (including GWUDI)
Nitrate	Initial	1 / year	Quarterly for 1 year
	Routine	1 / year if <50% MCL Quarterly if any sample ≥50% MCL ³	1 / year if all quarters <50% MCL Quarterly if any sample ≥50% MCL ⁴
Nitrite	Initial	1 / 3 years	1 / 3 years
	Routine	1 / 3 years if <50% MCL Qtrly for 1 yr if any 1 sample ≥50% MCL ³	1 / 3 years if <50% MCL Qtrly for 1 yr if any 1 sample ≥50% MCL ³
Fluoride		1 / 3 years	1 / year
Sodium		1 / 3 years	1 / year

² For detailed arsenic monitoring information, see Water Division policy WD-03-020 dated October 20, 2003.

³ If all samples from 4 consecutive quarters <MCL, return to 1/year and monitor during quarter that had highest result.

⁴ If all samples from 4 consecutive quarters <50% of the MCL, return to 1/year and monitor during quarter that had highest result.

⁵ If VOCs are confirmed detected, monitor quarterly for VOCs and monitor once for EDB and DBCP.

⁶ If no detects in first quarter, waive remaining quarterly monitoring and go directly to routine monitoring.

⁷ A Contaminant Source Inventory must be completed, with no indication of vulnerability, to be eligible for this waiver.

⁸ Tritium in lieu of WHPP: Waiver requires initial/confirmation tritium samples <1.0 and sampling 1 / 3 years thereafter.

⁹ Least Vulnerable: SW systems and GWUDI systems that are not moderately or highly vulnerable.

Moderately Vulnerable: Bay City, Lake St Clair, St Clair & Detroit Rivers, Monroe, Frenchtown, St Joseph, Benton Harbor, Alpena.

Highly Vulnerable: All inland river supplies.

¹⁰ Collect one sample in the 2nd quarter AND one sample in the 3rd quarter of every 3rd calendar year.

¹¹ With sufficient historical data, may reduce frequency of non-detect contaminants to 1 / year, to be taken during 2nd OR 3rd quarter.

¹² Select moderately vulnerable systems include: Alpena, Bay City, Monroe, Mt Clemens, St Joseph, Wyandotte

¹³ Collect sample during the 2nd OR 3rd quarter of year due.

¹⁴ Gross Alpha may be substituted for radium 226 and/or uranium if results ≤ 5 pCi/L or ≤ 15 pCi/L, respectively.

¹⁵ If first 2 quarters are below the detection limit, waive remaining quarterly monitoring and go directly to routine monitoring.

¹⁶ Required for systems > 50,000. Required for systems ≤ 50,000 during any monitoring period the Pb and/or Cu AL is exceeded.

Distribution Monitoring			
		GW Sources	SW Sources (including GWUDI)
Bacteriological		Required # / month	Required # / month
Lead / Copper	Initial	Required # of sites / 6 months for 1 year	Required # of sites / 6 months for 1 year
	Routine	Required reduced # of sites / 1, 3, or 9 years ¹	Required reduced # of sites / 1, 3, or 9 years ¹
Water Quality Parameters ²	Initial	WQP of Rule 710b(4)(a): 2 / # of sites / 6 mnths	WQP of Rule 710b(4)(a): 2 / # of sites / 6 mnths
	Reduced	WQPs of Rule 710b(5)(a): 2 / reduced # of sites / 6 months, 1 year, or 3 years	WQPs of Rule 710b(5)(a): 2 / reduced # of sites / 6 months, 1 year, or 3 years
Chlorine or Chloramines Residual		Same time & place as bacteriological sampling	Same time & place as bacteriological sampling ³
TTHM & HAA5 (if adding chemical disinfectant)	Routine	Required # of sites / quarter or 1 year	Required # of sites / quarter or 1 year
	Reduced ⁷	Required reduced # of sites / quarter, 1 year, or 3 years	Required reduced # of sites / quarter or 1 year
Chlorite (if adding ClO ₂)	Routine	1 set of 3 samples ⁸ / month / plant and 1 set of 3 samples ⁸ on day following a daily sample > MCL at EPTDS	1 set of 3 samples ⁸ / month / plant and 1 set of 3 samples ⁸ on day following a daily sample > MCL at EPTDS
	Reduced ⁹	1 set of 3 samples ⁸ / quarter / plant	1 set of 3 samples ⁸ / quarter / plant
Chlorine Dioxide (if adding ClO ₂)		If chlorine dioxide at the entry point >MRDL, then monitor according to footnote 10.	If chlorine dioxide at the entry point >MRDL, then monitor according to footnote 10.

Footnotes:

¹ Samples must be collected during June, July, August or September.

² Required for all systems > 50,000. Required for all systems ≤ 50,000 during any monitoring period the lead and/or copper action level is exceeded.

³ System with a heterotrophic plate count ≤ 500 /mL is considered to have a detectable disinfectant residual.

⁴ Collect annual samples during month of warmest water temperature.

⁵ Collect samples at a locations representing maximum residence time.

⁶ Collect 25% of samples at locations representing maximum residence time and 75% at locations representing at least average residence time.

⁷ May not reduce TTHM & HAA5 if source water TOC > 4.0 mg/l.

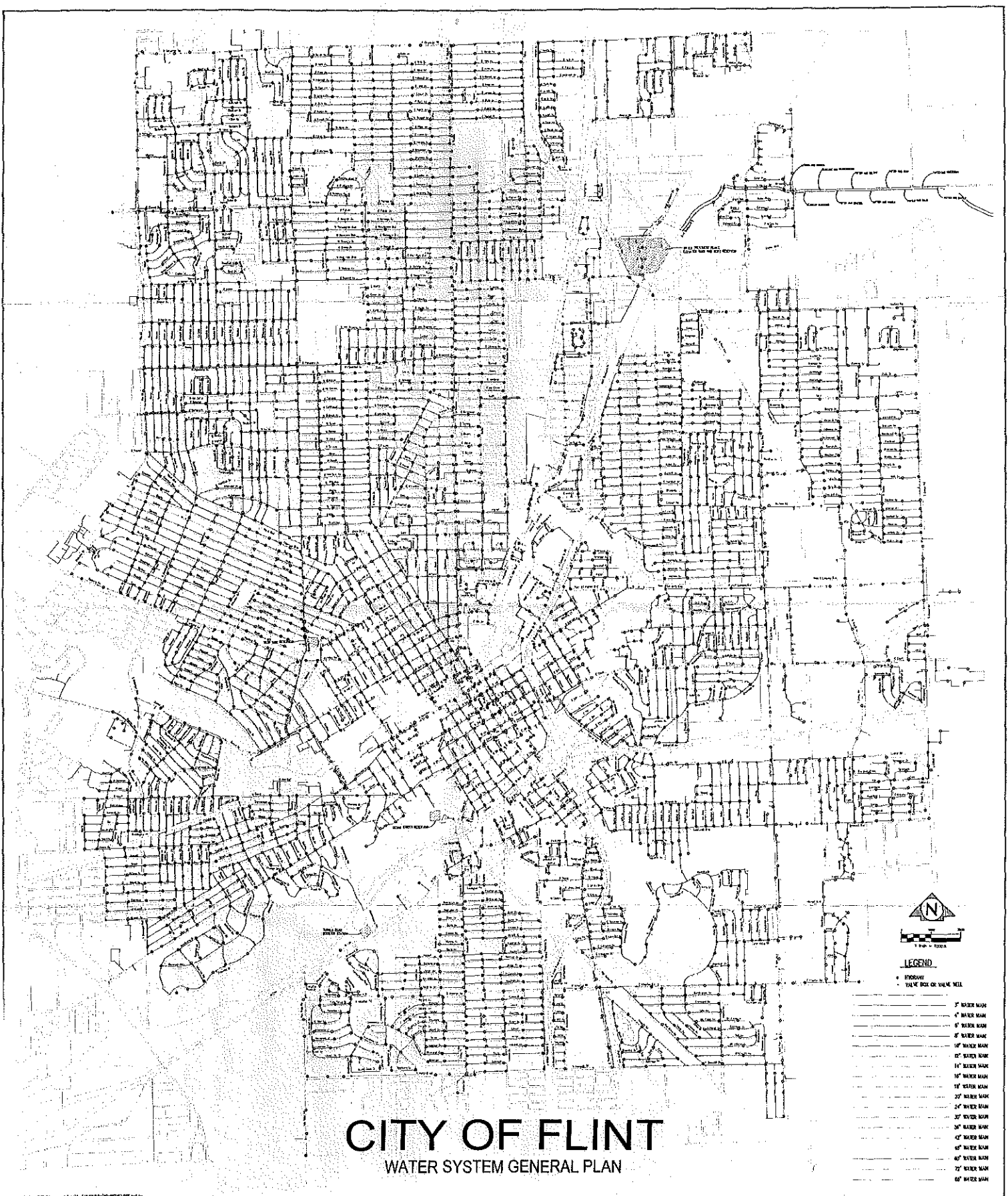
⁸ Collect 1 sample near first customer, 1 at location representing average residence time, and 1 at location representing maximum residence time.

⁹ Applies if all samples of the 3-sample set <1.0 mg/l (MCL) for 1 year and supply is not required to monitor due to an exceedance at the EPTDS. Resume routine if 1 or more chlorite samples from 3-sample set >MCL or EPTDS sample >MCL.

¹⁰ If chlorine dioxide at the entry point >MRDL, then monitor according to the following table:

If maintaining a residual in the distribution system using ...	Then sample for chlorine dioxide at the following distribution locations:
chlorine dioxide or chloramines ...	
chlorine, and one or more disinfection addition points after the EPTDS are not present ...	3 as close to the first customer as possible at intervals of at least 6 hours.
chlorine, and one or more disinfection addition points after the EPTDS are present...	1 sample near the first customer, 1 each at locations representing average and maximum resident time.

Note: Some contaminants (asbestos, dioxin, etc.) are waived in part or in full per 1992/93 monitoring waiver program.





Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, March 27, 2013 1:39 PM
To: Thelen, Mary Beth (DEQ); Wyant, Dan (DEQ); Sygo, Jim (DEQ); Shekter Smith, Liane (DEQ)
Cc: Willard, Veronica (DEQ); Richard Benzie P.E. (BENZIER@michigan.gov); prysbym@michigan.gov; Jon Bloemker P.E. (BLOEMKERJ@michigan.gov); Donaldson, Kristina (DEQ); Creal, William (DEQ)
Subject: ODWMA Response - Flint KWA-DWSD Report
Attachments: deq-wb-dwehs-wwciu-gcdclqwwpermitresponsepubliccomment_290345_7.pdf; Rowe Review of Tucker Young Report.pdf
Importance: High

Director Wyant, and Deputy Director Sygo,

Addendums to ODWMA comments provided yesterday regarding the City of Flint water system and comments on the reports from Tucker, Young, Jackson, Tull, Inc. (TYJT) can be found below in red. Additional comments are as follows:

With regards to regulatory authority for DEQ to allow or prevent the breakup of water utilities, and State vs. local decisions about cost effectiveness, it is important to note that when the DEQ permitted the water withdrawal for KWA (permit 2009-001) part of the decision making process (copy attached) included reasonable use and the balance of Economic Development, Social Development, and Environmental Protection. As part of the public participation process general comments were received (pages 6 & 7) regarding impacts on DWSD and rates to remaining customers. The Department's response to those comments stated:

"The DEQ is specifically precluded from using part 327 to "...diminish or create any existing authority of municipalities to require persons to connect to municipal water supply systems as authorized by law" (MCL 324.32726)."

And

"It is appropriately an issue for water service contract negotiations between the regional water system and its customers. To do otherwise invites unwanted intervention of the state into local decision making."

ODWMA cannot on its own assess an actual dollar value to any regional benefit for the City of Flint to remain a full customer of DWSD, but the following should be included in any additional analysis:

- The cost estimates provided in the TYJT report show a cost difference between full KWA and full DWSD participation of \$172 million over 30 years.
- The formation of KWA would itself be considered one of the largest regional drinking water authorities in the State in terms of capacity, and as such any regional benefits provided by DWSD may only be marginal in comparison.

Finally, we have additional questions for TYJT regarding the various DWSD supply options and the considerations they made in the operations of the Flint WTP. These considerations will have an impact on the cost estimates for DWSD options.

We look forward to further discussion of these comments during our meetings tomorrow, and please let us know if you have any additional questions for us between now and then.

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

From: Busch, Stephen (DEQ)
Sent: Tuesday, March 26, 2013 3:58 PM
To: Wyant, Dan (DEQ); Thelen, Mary Beth (DEQ); Sygo, Jim (DEQ)
Cc: Willard, Veronica (DEQ); Shekter Smith, Liane (DEQ)
Subject: RE: Flint Draft Response

I will provide additional follow up by tomorrow (Wed.) afternoon to my previous email below based on our discussion and the conference call with Andy Dillon earlier today.

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

From: Busch, Stephen (DEQ)
Sent: Tuesday, March 26, 2013 12:37 PM
To: Wyant, Dan (DEQ); Thelen, Mary Beth (DEQ); Sygo, Jim (DEQ)
Cc: Willard, Veronica (DEQ); Shekter Smith, Liane (DEQ)
Subject: Flint Draft Response

Director Wyant,

In preparation for our call today with Treasurer Dillon's office, ODWMA has developed the following for consideration. We can provide any additional info you require during the meeting.

ODWMA has reviewed the materials developed by the consultant Tucker, Young, Jackson, Tull, Inc. (TYJT) for Treasury regarding the City of Flint and potential alternatives for public water supply. Based on our reviews, we have developed the following comments to this point in our analysis:

1. The TYJT report does not contain the full scope of the Karegnondi Water Authority (KWA) raw water supply system. TYJT concerns over raw water supply redundancy and reliability are addressed to the satisfaction of ODWMA under the full KWA proposal. Please note some portions of the overall project are being financed independently by the Genesee County Drain Commission.
2. There are significant differences in contract language between KWA and Detroit Water and Sewerage Department (DWSD) with respect to the contracted maximum day demand capacity.
 - a. Under a KWA contract, a "maximum day" capacity of 18 million gallons per day (MGD) would fully satisfy current demands of the City of Flint, without the need to supplement raw water capacity using the Flint River. (18 MGD, average over a 30 day period).
 - b. Under a DWSD model contract, a "maximum day" capacity, even at 18 MGD, would not satisfy the current demands for the City of Flint. (18 MGD, over any 24 hour period).
3. Restrictions in contracted capacity that would prevent the City of Flint from meeting peak demand requirements present potential limits to economic development within the City of Flint, including possible connection bans and water system extension bans. This information was previously conveyed to the City of Flint by ODWMA staff.

4. All contract options with DWSD that are considered semi-competitive with the KWA contract do not fully supply the City of Flint, and would require the City of Flint to meet a significant, if not majority, of its water demands by treating water from the Flint River. Continuous use of the Flint River at such demand rates would:
 - a. Pose an increased microbial risk to public health (Flint River vs. Lake Huron source water)
 - b. Pose an increased risk of disinfection by-product (carcinogen) exposure to public health (Flint River vs. Lake Huron source water)
 - c. Trigger additional regulatory requirements under the Michigan Safe Drinking Water Act (LT2ESWTR)
 - d. Require significant enhancements to treatment at the Flint WTP, beyond those identified in the TYJT report (see item 5 below).
 - e. Water Resource Division is evaluating potential impacts to NPDES wastewater discharge permits in downstream segments of the Flint River, as a result of decreased river baseflow caused by Flint WTP use.
5. The TYJT report does not adequately address increased requirements and costs associated with using the Flint River as a significant source for the Flint WTP, which are not necessary under a Lake Huron source water scenario. This includes:
 - a. The need to provide softening treatment
 - b. Limitations on disposal options for lime softening sludge
 - c. Increased ozone capacity, UV disinfection
 - d. Additional backup power, more power required for Flint River operation
6. The Flint WTP must operate at some minimum level and within a range of flow rates to maintain treatment effectiveness. Currently that minimum level is 9 MGD. This level may be reduced with additional capital costs to modify the WTP, not addressed in the TYJT report.
7. Allowing Flint WTP to blend water with DWSD sets a new precedent that could pose future consequences with other DWSD customers.
8. Costs impacts to remaining DWSD customers would be similar under the proposed scenarios, only retaining 8 MGD of 30+ MGD total Flint/Genesee Co. demands, based on the following:
 - a. Genesee County distribution system demands are pulling out of DWSD regardless of the decisions by Flint WTP
 - b. Flint's need to utilize the Flint River as a source
9. ODWMA anticipates cost savings under the KWA proposal will be leveraged to provide additional improvements to the City of Flint water distribution system, improving efficiency and providing additional cost benefits. The KWA water withdrawal permit (2009-001) includes the required implementation of conservation measures that would also drive these distribution system improvements.
10. Major cost discrepancies in TYJT analysis
 - a. Engineering, Legal, Administration, Contingency – TYJT appears to have effectively double charged for these costs in their KWA estimates without adequate justification
 - b. Pumping facilities – TYJT cost estimate methodology does not appear to address localized market costs and does not distinguish fixed and variable costs in its comparison analysis.
11. Remaining DWSD customers in Lapeer County could potentially see water quality impacts as a result of Flint joining KWA, if they remain with DWSD. However, indications to ODWMA are that these communities are currently in final negotiations with KWA for service, which would make this a non-issue.
 - a. City Lapeer
 - b. City of Imlay City

Additional response to the TYJT report has also been provided by Rowe Engineering to Flint EFM, Mr. Ed Kurtz. (Copy Attached)

ODWMA has continued to meet on a regular basis with KWA, Genesee County, and the City of Flint regarding these water supply proposals.

ODWMA will continue to provide any additional detailed analysis requested by Treasury or the DEQ Executive Office.

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

**GENESEE COUNTY DRAIN COMMISSION
APPLICATION FOR A WATER WITHDRAWAL FROM LAKE HURON**

**PERMIT DECISION
And
RESPONSE TO PUBLIC COMMENTS**

August 28, 2009

**Michigan Department of Environmental Quality
Constitution Hall, 525 West Allegan
P.O. Box 30273
Lansing, Michigan 48909-7773**

EXECUTIVE SUMMARY

GENESEE COUNTY DRAIN COMMISSION APPLICATION FOR A WATER WITHDRAWAL FROM LAKE HURON

On February 12, 2009, the Department of Environmental Quality (DEQ) received from the Genesee County Drain Commission (GCDC) a permit application submitted under Section 32723 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). The permit application included a request that the DEQ begin the required evaluation and public notice under Part 327, Great Lakes Preservation, of NREPA for a proposed water withdrawal from Lake Huron.

Section 32723(4) of Part 327 requires that the DEQ provide for a public comment period of not less than 45 days before a permit application is acted upon. The DEQ invited public comment on the permit application via press release, public notice and website posting. The DEQ issued the press release on the permit application on May 27, 2009, and posted the public notice on the DEQ internet website the following day. A copy of the public notice was transmitted to the GCDC on May 28, 2009 for posting at the entrance to their premises and at the shoreline parcel where a "shore well and pumping station" are to be constructed. The press release and public notice announced the public comment period and requested that comment be submitted to the DEQ by July 15, 2009.

After considering the information submitted relevant to the factors used in determining the acceptability of a permit application and the comments received, the DEQ determined that the proposed GCDC withdrawal is in compliance with the applicable standards and should be issued.

On August 28, 2009, the DEQ rendered a decision in favor of issuing the permit concluding the GCDC proposed withdrawal would not likely cause an adverse resource impact and that all other factors in rendering a permit decision had been met.

This document includes the basis of decision for issuance of a permit to the GCDC for the future withdrawal of 85 MGD from Lake Huron. Responses are provided to comments received on the permit application during the public comment period that including concerns relating to the permit process, the environmental impact of the proposed water withdrawal, the legality of the proposed water use, and the applicability of laws and regulations to the proposed withdrawal.

Many of the early comments were critical of the public notice and comment period duration regarding the permit application. The DEQ is limited in its ability to provide public comment by a Part 327 statutorily required time frame for responding to the permit application. The DEQ recognizes that this is the first application for a permit to withdraw water from a Great Lake that is subject to the standards of Part 327, the Great Lakes Charter process, the standards-of-decision in the Great Lakes-St. Lawrence River Basin Water Resources Compact, and the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement. Therefore, the DEQ reviewed additional comments received after the public comment period for consideration in application and functionality of the administrative process on this and future permit applications.

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I. BACKGROUND

Proposed Withdrawal

The proposed 85 million gallons per day (MGD) water withdrawal is from a Lake Huron water intake. The permit applicant, Genesee County Drain Commission (GCDC), proposes to use the withdrawal water for a community public water supply system, to be owned and operated by a collection of municipalities organized as the Karegnondi Water Authority (KWA). The proposed withdrawal will be via a Lake Huron water intake located approximately 3.5 miles offshore and a shore well and pumping facilities located in the south of section 31 and 32, Worth Township, T.9N, R.17E, Sanilac County, Michigan. The maximum proposed withdrawal of 85 MGD, corresponds to a maximum pumping rate of ~59,000 gallons per minute (gpm).

Public water supply is a use that the DEQ estimates to be 10 percent consumptive. While 90 percent of the water will remain in the Lake Huron watershed, the consumptive use estimate places the loss from the Great Lakes hydrologic system at 8.5 MGD.

II. STATUTORY STANDARD

A person who proposes to develop a new withdrawal of 2 MGD or more from the waters of the state to supply a common distribution system, is required to obtain a water withdrawal permit prior to making the withdrawal (MCL 324.32723[1]).

Application Submittal

A person proposing a withdrawal from the surface waters of the state is required to apply for a permit by submitting an application for the withdrawal to the DEQ containing the following information (MCL 324.32723[2]):

- Capacity of equipment used to make the withdrawal,
- Location of the withdrawal,
- Withdrawal source,
- Amount and rate of withdrawal,
- Intended maximum monthly and annual volumes and rates, if different from the capacity of equipment used to make the withdrawal,
- Relevant information related to seasonal use,
- Description of how the water will be used and location, amount and rate of return flow,
- Any other information the person would like the DEQ to consider.

The application is required to include an evaluation of existing hydrological and hydrogeological conditions and a detailed description of proposed preventative measures where relevant. In addition, the applicant is required to submit an application fee in the amount of \$2000.00

Administrative Requirements

MCL 324.32723 requires the department to determine whether a permit application is administratively complete. The DEQ has 30 days to make this determination, unless the applicant is notified of deficiencies in the application requiring additional information. Once an application is determined to be administratively complete, the DEQ is required to provide a public comment period of not less than 45 days and render a decision on the permit application within 120 days from the completeness determination.

The DEQ received the original permit application from the GCDC on February 12, 2009. The information was submitted in accordance with Part 327, and "proposals subject to prior notice and consultation" of The Great Lakes Charter, Principles for the Management of Great Lakes Water Resources (The Charter). On March 4, 2009 the DEQ requested additional information to better fulfill the information requirements of The Charter essential to the administrative

process. Upon receipt of the additional information the DEQ sent a letter to the GCDC dated April 24, 2009 notifying them of the completeness of the application package.

The DEQ invited public comment on the permit application via press release, public notice and website posting. The press release was issued on May 27, 2009, and the posting of the public notice on the DEQ internet website on May 28, 2009. The GCDC was provided a copy of the public notice on May 28, 2009 for posting at the entrance to their premises and at the shoreline parcel where the proposed shore well and pumping station are to be constructed. The press release and public notice announced the 45-day public comment period and requested that comments be submitted to the DEQ by July 15, 2009.

The consumptive use estimate of 8.5 MGD exceeds the 5 MGD threshold established in the Charter for proposed withdrawals requiring Prior Notice and Consultation with the other Great Lakes states and provinces. In the spirit of the companion legislation adopted by the state of Michigan in conjunction with the Great Lakes-St. Lawrence River Basin Water Resources Compact (Compact), and pursuant to the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement (Agreement), the DEQ's Office of the Great Lakes provided notice of the proposed withdrawal on May 26, 2009. The complete application packet was transmitted to the other Great Lakes states, the Canadian provinces of Ontario and Quebec, and the Great Lakes first nation and federally recognized tribes, with a request that comments be provided by July 20, 2009 in order for the DEQ to meet the statutory obligations of Part 327.

Conditions Required for Issuance of a Permit

The DEQ is required to issue a permit for a water withdrawal if all of the following conditions are met (MCL 324.32723[6]):

- All water withdrawn, less any consumptive use, is returned to the source watershed;
- The withdrawal is implemented to insure there is no individual or cumulative adverse resource impact (ARI). Cumulative impacts are to be evaluated based upon available information gathered by the DEQ;
- The withdrawal will be implemented in compliance with all applicable local, state, and federal laws, as well as all legally binding regional interstate and international agreements;
- The proposed use is reasonable;
- The permit applicant certifies compliance with the environmentally sound and economically feasible water conservation measures for the applicable water use sector; and
- The proposed withdrawal does not violate public or private rights and limitations imposed by Michigan water law or other common law duties.

Parallel requirements for approval are spelled out in Section 4.11, Decision Making Standard, of the Compact. Section 4.11(5) of the Compact provides greater specificity on reasonable use conditions and requires the parties to consider efficient use of the water; efficient use of existing water supplies; the balance between economic and social development and environmental protection as they relate to other planned withdrawals and uses sharing the same source; supply potential; the degree and duration of likely adverse impacts and the restoration of hydrologic conditions.

III. DECISION MAKING PROCESS

Consumptive Use Considerations

The consumptive use calculation was based upon a consumptive use coefficient of 10 percent. The DEQ relied primarily upon the United State Geological Survey publication "Consumptive Water-Use Coefficients for the Great Lakes Basin and Climatically Similar Areas," Scientific Investigation Report 2007-5197. There is a relatively narrow range of coefficients for public water supplies in comparison with many of the other types of uses. Further, it is generally conceded the range is 10 to 15 percent as identified in Table 3-1, Consumptive-use coefficient used by Great Lakes jurisdictions, by water use category of the report. Upon review of the aforementioned report, the DEQ ultimately decided that 10 percent was the best estimate of consumptive use. This is the published value for the public water supply sector in Table 3-2, Total water use by category for the Great Lakes Basin, by year, from the Great Lakes Commission annual reports, 1998-2002. Based upon the 10 percent coefficient for consumptive use, the proposed withdrawal is projected to have a maximum consumptive use of 8.5 MGD.

Adverse Resource Impacts

Section 32721(1) of Part 327 prohibits a person from making a "...new or increased large quantity withdrawal from the waters of the state that causes an adverse resource impact." Section 32701(1)(a)(vii) defines an adverse resource impact (ARI) for a surface water body as "decreasing the level of a lake or pond with a surface area of 5 acres or more through a direct withdrawal from the lake or pond in a manner that would impair or destroy the lake or pond or the uses made of the lake or pond, including the ability of the lake or pond to support characteristic fish populations, or such that the ability of the lake or pond to support characteristic fish populations is functionally impaired." For flowing streams and rivers an ARI is defined as decreasing the flow by part of the index flow such that the ability of the stream to support the characteristic fish population is functionally impaired.

Part 327 establishes specific flow reduction as constituting an ARI for some stream types. No specific flow reductions are established for the Great Lakes or their connecting channels. In that case, a comparison of the proposed withdrawal to the water availability from the GL or connecting channel from which the withdrawal originates is one means of assessing the likelihood of an ARI. The proposed withdrawal of 85 MGD corresponds to a daily withdrawal of 1.136×10^7 cubic feet per day (ft^3/day) or 4.148×10^9 cubic feet per year (ft^3/year). The area of Lake Huron and Lake Michigan, which hydraulically act as a single source at the same elevation, possess a combined surface area of 45,300 square miles, or 1.263×10^{12} ft^2 . Based upon a consumptive use of 10 percent a withdrawal of 4.148×10^9 cubic feet per year (ft^3/year) would result in a projected loss of water from the Great Lakes Basin of 4.148×10^8 ft^3/year . Assuming no recharge to lakes Michigan and Huron the consumptive use loss is projected to cause a reduction in lake levels of 0.0003284 feet (0.004 inches or 0.01 centimeter). Accordingly, the DEQ concludes the impact of the proposed 85 MGD withdrawal on lake levels and the corresponding impact to the characteristic fish population would not result in an ARI as defined in Part 327.

A comparison of the proposed withdrawal to flows immediately down stream of the proposed intake in the St. Clair River provides another reasonable measure of water availability and the potential for impact. The United States Geological Survey has published average flows for the St. Clair River in excess of 183,000 cubic feet per second, corresponding to a daily flow of ~118,268 MGD. When consideration is given to return flows and consumptive use, the water theoretically lost from Lake Huron of 8.5 MGD corresponds to 0.0072 percent of the total flow.

The DEQ concludes from this comparison that the proposed withdrawal would be insufficient to cause an ARI as defined in Part 327.

Applicable Local, State and Federal Laws

To be approved, the proposed withdrawal must be in compliance with all applicable local, state, and federal laws as well as legally binding interstate and international agreements, including the boundary waters treaty of 1909. Section 32726 governing local ordinances, specifically prohibits a local unit of government from enacting, or enforcing an ordinance that regulates a large quantity withdrawal. The information contained within the permit application indicates the withdrawal would be implemented in compliance with applicable state and federal laws (Part 327) and applicable international agreements. The Boundary Waters Treaty of 1909 was agreed to by the U.S. and Canada to provide a mechanism for the resolution of disputes over waters bordering the two countries and to insure the waters of the Great Lakes remain navigable. Nothing related to the GCDC proposed withdrawal volumes would be in violation of the treaty.

Reasonable Use

Part 327 requires that a proposed use be reasonable. As noted above the specific criteria for consideration the efficient use of the water and the efficient use of existing water supplies; a consideration of the balance between economic development, social development and environmental protect, supply potential; the degree and duration of likely adverse impacts and the restoration of hydrologic conditions. These considerations are consistent with Michigan's test for determining a reasonable use as set forth in Michigan Citizen for Water Conservation V. Nestle Waters of North America, Inc. [Michigan Citizens for Water Conservation v Nestlé Waters N America Inc, 269 Mich App 25; 709 NW2d 174 (2005)]. The considerations are addressed as follows:

Efficient Use of the Water: This requirement is directly tied to the user's commitment to Environmentally Sound and Economically Feasible Water Conservation Measures. (Conservation Measures) In the application the GCDC identified the Conservation Measures applicable to the public water supply sector that they are currently employing. A more comprehensive discussion is provided in the section entitled Conservation Measures on page 6.

Efficient Use of Existing Water Supplies: The language of the Compact specifies efficient use as a consideration when an increased withdrawal is proposed. The Compact language is intended to assure that water from various sources is being efficiently used by a large quantity user before they are granted approval for an increased withdrawal. Since the GCDC proposal is for a new withdrawal, this criterion does not apply.

Balance between Economic Development, Social Development and Environmental Protection: Reasonableness of a water use as it relates to the balance between economic development, social development and environmental protection is an important consideration in the acceptability of a proposed withdrawal.

Creation of a water authority and construction of the pipeline and treatment plants would enhance economic development in a variety of ways. During the 5-year construction period there project would provide an estimated \$100 million in skilled trades work, \$200 million in manufacturing of pipe and other equipment and 30 million in engineering and design services. Once on line the new pipeline and associated facilities is estimated to create over 50 new jobs necessary to the operation and maintenance treatment facilities, the Great Lakes intake, pipeline, and pump stations. Improving system reliability, as discussed below will also encourage economic development in the affected communities.

From a social standpoint, the proposed withdrawal and related facilities would benefit the area by enhancing the health, safety and security of area residents. The DEQ, Water Bureau (WB)

has identified deficiencies in the GCDC system primarily related to reliability. Significant effort will be placed on improving current system reliability in the design of system components associated with the proposed withdrawal. These efforts will meet with the requirements of the Safe Drinking Water Act. With the construction of new facilities the GCDC would also be improving system reliability for surrounding public water supply systems by offering emergency inter-connects and entering into mutual aid agreements.

Lastly, given the net effect of the withdrawal on the water resources as described above, these economic and social benefits to the area would be obtained without a perceptible impact on the environment.

Supply Potential: Supply potential consideration requires the DEQ look at the impact of the withdrawal on the quantity, quality, reliability, and safe yield of hydrologically interconnected water sources. The proposed withdrawal does not present any known or anticipated threat to the quantity or quality of Lake Huron as a water source. Also, the proposed withdrawal would have no impact on the reliability or the safe yield of the source as it relates to others using Lake Huron or hydrologically connected sources, such as the St. Clair/Detroit river systems.

Degree and Duration of Likely Adverse Impacts: The DEQ concluded the proposed withdrawal would not cause an ARI.

Restoration of Hydrologic Conditions: The water withdrawn by the GCDC, less consumptive use, would all be returned to the source watershed via treated wastewater discharges to the Flint River. The consumptive use losses for inside Great Lakes Basin uses are considered reasonable. Under Part 327 the restoration of hydrologic conditions does not apply to the proposed withdrawal.

Conservation Measures

For permit applications received on or after January 1, 2009, the applicant must self-certify that they are in compliance with Conservation Measures. More specifically they must certify that they are in compliance with the Conservation Measures developed by the applicable water user's sector or developed for the water use associated with that specific withdrawal (MCL 324.32723[6(e)]).

The GCDC has certified that they are in compliance with the accepted practices as developed and submitted to the DEQ for the public water supply sector by the Michigan Section of the American Water Works Association and set a goal of a less than 5 percent system wide water loss. GCDC further certifies to the promotion of educational programs related to lawn sprinkling and other outside uses, and the implementation of programs to promote water re-use and other water conservation measures by commercial and industrial facilities. The GCDC also practices "flat rate water billing," meaning large users do not pay proportionally less as their water use goes up. All water uses served by the GCDC are metered and billing is commensurate with the metered water usage. Lastly, the GCDC employs a local ordinance restricting outdoor water use during periods of peak use.

Public or Private Rights, Limitations and Common Law

The issuance of a permit on the proposed withdrawal must not violate public or private rights or interfere with limitations imposed on the use of the resource by Michigan water law or other common law decisions. Specifically, the DEQ must ascertain if the issuance of the permit would interfere with the principle that certain natural resources, which in this case is Lake Huron, are preserved for public use, and that the state is required to maintain the resource for the public's reasonable use. The issuance of a permit for the proposed withdrawal would not interfere with the public's access to Lake Huron, the public interest in Lake Huron as a natural resource, or maintenance of Lake Huron for drinking and recreational purposes.

VI. PUBLIC PARTICIPATION PROCESS

The DEQ invited public comment on the permit application via press release, public notice and website posting. The press release was issued on May 27, 2009, and the posting of the public notice on the DEQ internet website on May 28, 2009. The web posting included the permit application packet for the proposed withdrawal and the public notice announcement. The press release and public notice announced the public comment period and requested comments be submitted to the DEQ by July 15, 2009.

The Office of the Great Lakes provided notice of the proposed withdrawal on May 26, 2009, to the other Great Lakes states, provinces and federally recognized tribes and first nations. The notice included a request that comments be provided by July 20, 2009.

The remainder of this document summarizes the comments received based on the proposed 85 MGD withdrawal by the GCDC and the DEQ response to the comments on the basis of applicable rule, policy, and procedure in administration of the permit application and review process under Part 327, Great Lakes Preservation, of NREPA.

General Comments

Many of the comments were specific to ongoing negotiations between the GCDC and the City of Detroit relative to the continued provisions for water supply service from the Detroit Water and Sewer Department (DWSD).

It was expressed by some commenters that the GCDC proposal underestimates the reliability of the DWSD public water supply system noting that DWSD possesses sufficient capacity and has an approved proposal to provide the GCDC the desired redundancy. Conversely, it was claimed the request for redundancy was made in 1965 with reciprocal commitment to construct the necessary infrastructure over the past 30 years.

A comment was made that constructing a new intake does not appropriately address deficiencies in either the GCDC or DWSD systems. As an example, there was a reference to ongoing system losses for the GCDC and DWSD of 5 percent versus 20 percent of water pumped.

Multiple comments were received with regards to the impact on water rates for DWSD customers if the KWA member municipalities were to withdraw from the DWSD system. Rate increases for the remaining DWSD customers was estimated at approximately 6 percent. A counter argument was made that the loss of a customer should not affect remaining customer rates as costs are presumably based on "cost of service."

There was a claim that the cost of the intake structure, transmission line, and separate treatment facilities for the KWA would be much greater than provided in the preliminary estimates. Conversely, The GCDC claims that all potential KWA members are aware of the cost estimates. The intake and pipeline costs are estimated at 75 percent of costs, including plans for redundancy while the treatment costs will be 25 percent of costs. GCDC also noted that separate studies on the cost of various water supply alternatives should have no bearing on the permit decision.

Response to Comments: The DEQ does not consider any comments on the relative position of the DWSD and GCDC water supply system to be legally relevant to a decision as to whether or not a permit should be issued to the GCDC for the proposed 85 MGD withdrawal from Lake Huron. Part 327 specifically requires the DEQ to issue a permit if on the basis of the submitted material the proposed water withdrawal meets the decision making criteria. The DEQ is specifically precluded from using part 327 to "...diminish or create any existing authority of municipalities to require persons to connect to municipal water supply systems as authorized by law" (MCL 324.32726).

Any addition or loss of a major customer of a regional public water system has the likelihood of affecting water rates – clearly a major addition or loss affects both the revenues and costs of operation. Water rates and the basis for establishing water rates are not an issue under Part 327. It is appropriately an issue for water service contract negotiations between the regional water system and its customers. To do otherwise invites unwanted intervention of the state into local decision making. There is nothing in Part 327 or any provisions of the Agreement and Compact that would either mandate connection to a regional water system or bind a customer permanently to a regional water system.

Applicability of Law and Regulations

Comments criticized the GCD's application under Part 327. As a community public water supply the commenter believes the application would have been more appropriately made under the Michigan Safe Drinking Water Act, Act 399, as amended and rules. A submittal of plans and specifications under Act 399 would have provided greater clarity as to the reasonableness of the water use and the applicant's intent relative to applicable Conservation Measures.

Other comments cited the application of requirements in the Compact and expressed the opinion that the GCD's proposal did not meet the applicable standards. Most frequently referenced were the standards identified in *Section 4.11, Decision Making Standard* and *Section 4.12, Applicability* of the Compact. Relative to the former, comments suggested the proposed use is not reasonable based on efficient use of existing water supplies, balance between economic and social development, environmental protection, use of same source by multiple users, and the probable degree of adverse impacts. Relative to the latter requirements, it was implied that the Compact provides the Originating Party (i.e. Michigan) with the power to apply a much more stringent standard.

Response to Comments: Part 327 and the companion amendments to Act 399 do not provide any restrictions as to who may apply for a permit to make a large quantity water withdrawal nor specify how one must go about obtaining a permit. GCD's stated that they submitted their request for approval through Part 327 in large part to obtain the appropriate authorization of the withdrawal before investing a significant amount of money in developing plans and specification for the water works systems. Conformity with the Decision Making Standard of the Compact is, in part, the basis for the DEQ's decision on the permit application.

New Withdrawal and Consumptive Use

A number of comments focused on the fact that approval of the GCD's proposal would not result in a decrease in Detroit's ability to pump water and solicit new customers to maintain their current rate of use. As a result commenters concluded that the GCD's proposal should be treated as a new withdrawal. A corollary to this criticism was the observation that the total water withdrawal from the Great Lakes Basin would increase and that approval of the proposal would encourage other users to pursue similar use of Great Lakes waters. Some comments questioned the water use projections by the GCD's for the years 2014 to 2039. GCD's projected water use to increase by 42 percent. There was also concern that projected demand was 78.7 MGD, yet the request is for 85 MGD. There were requests that the proposed new withdrawal should be considered unacceptable unless the Detroit withdrawal was reduced by a corresponding amount.

Concern was also expressed over an increase in consumptive use. The fact that there would be an increase in use would result in additional consumptive use loss from the Great Lakes Basin. Numerous comments, particularly from other states questioned the use of 10 percent as the consumptive use coefficient indicating it should be higher. USGS publications cite consumptive use on public water supply systems in the range of 10 to 15 percent.

Response to Comments: Comments on the increased use must be addressed within the context of public water supply system operation, in particular when the increase in use is based upon population projections over a period of years. GCDC conducted a study to obtain the projected use of 78.7 MGD by 2039 based upon population and water use trends for the area currently served by the GCDC system. The GCDC explains that the request for 85 MGD provides a slight buffer over that which would be needed to account for water use in KWA member water treatment plants for such things as filter backwash. Additional buffer is provided to account for system losses. The GCDC as previously noted has set a goal of 5 percent for system losses. The DEQ determined the 85 MGD request is appropriate relative to the projected use, system operation and system water losses.

The DEQ has projected an increase in consumptive use of 8.5 MGD because the GCDC proposal is a new withdrawal. The GCDC proposed withdrawal does not affect the baseline capacity of the DWSD system or DWSD's future use of their existing baseline capacity. In the short term, the combined use of water for both the DWSD and GCDC systems will not significantly increase, because GCDC presently receives their water from DWSD. The proposed withdrawal was evaluated by the DEQ on the basis of DWSD maintaining their existing baseline capacity and evaluating the impact of a new 85 MGD withdrawal by GCDC from Lake Huron.

The consumptive use coefficient of 10 percent was obtained from *Table 3-2. Total water use by category for the Great Lakes Basin, by year, from the Great Lakes Commission annual reports, 1998-2002* in the USGS publication Consumptive Water-Use Coefficients for the Great Lakes Basin and Climatically Similar Areas, Scientific Investigations Report 2007-5197. Consumptive use coefficients for public supply over the years cited (1998-2002) were 10 and 11 percent, with 10 percent cited as the consumptive use over the entire period in question. The DEQ deemed this reference to be the most reasonable estimate of consumptive use.

Conservation Measures

There were multiple criticisms of the GCDC's commitment to water conservation. Specifically, that the GCDC identified no measures aimed at water use reduction noting that water conservation on new systems should be aggressive. Comments cited the published water conservation measures applicable to the public water supply sector noting that the GCDC has not made a commitment to each and every conservation measure. Specifically, their description of conservation measures did not include measures that promote water use conservation and the reduction of system leaks. Lastly, none of GCDC proposed wholesale or municipal customers provided information on compliance with Conservation Measures.

Commenters also expressed concern that the conservation measures identified by the GCDC were not consistent with the requirements of the Agreement and/or Compact. Plans for water use reduction or conservation were characterized as inadequate as nothing was mentioned relative to targeting system leaks and the promotion of efficient water use, in particular those leaks mentioned for the Detroit system. It was expressed that no new withdrawals should be approved until Detroit's leak problems are addressed. Some indicate there should be no approval of the withdrawal without a "water master plan" including impacts of current conservation and efficient use measures that have reduced total use and consumption. Commenters questioned whether there would be a continuation of conservation efforts made to date or whether there efforts would be improved upon. It was noted that a projected increase in population does not necessarily correspond to a projected increase in use, if one assumes more efficient use and conservation. Some commented that additional documentation is needed on water conservation measures including clear goals, targets and means of assessment.

Response to Comments: After January 1, 2009 permit applicant's are required to "self-certify" that they are in compliance with conservation measures developed by the applicable water

user's sector or developed for the water use associated with that specific withdrawal. The GCDC certified to the promotion of educational programs related to lawn sprinkling and other outside water uses, implementation of programs to promote water re-use and promotion of other water conservation measures by commercial and industrial facilities, and has set a goal of a less than 5 percent for system wide water losses. The GCDC practices "flat rate water billing," meters all water uses and bills commensurate with the metered water usage. The GCDC employs a local ordinance restriction on outdoor water use during periods of peak use.

The DEQ acknowledges the GCDC has not certified as to employing each and every water conservation measure identified for the public water supply sector, and notes there is not a requirement in Part 327 that they do so. The DEQ does commit to working with public water supplies to further water conservation efforts and will do so with the GCDC. Relative to the GCDC customers, the GCDC is making application on behalf of member communities of the KWA. All KWA members would participate in the implementation of the identified conservation measures. References to fixing deficiencies in the DWSD system are not germane to the GCDC permit application.

Reasonableness of Proposed Withdrawal

A number of comments were received relative to the reasonableness of the proposed withdrawal noting that any proposal must be considered on the basis of its purpose, suitability of use to location, the extent and amount of harm, benefits, necessity and manner of use, and other factors. The Agreement and Compact also require consideration of the economic and social value relative to potential environmental impacts and other factors. Generally, comments on the reasonableness of the proposed withdrawal focused on:

- The environmental harm that might be caused by the return of treated wastewater, and
- The necessity and amount of the withdrawal given the availability of Detroit system.

Specifically, on the issue of return flow there is a concern that points of discharge and downstream segments would be incapable of absorbing the projected 42 percent increase in discharge (based on future growth projection) without adverse impact. Commenter's claim numerous combined sewer overflows have occurred and requested verification that discharges are operating in compliance with existing laws.

Regarding the availability of the Detroit system, many comments made reference to the fact that the efficient use of existing systems is a required demonstration of reasonableness. There were claims the GCDC application should be rejected since the GCDC failed to rule out the option of using the existing DWSD system. Comments indicated that DWSW currently has the capacity to meet the needs of the GCDC and its customer municipalities, is already providing service to the proposed service area, and alleges to having made a commitment to providing reliability.

A few comments related to the economic and social value criteria of the Agreement and Compact, which requires consideration of the balance between economic development and social development and environmental protection on planned withdrawals from the same source

Response to Comments: There are four wastewater discharges by the City of Flushing, City of Flint, Genesee County's "Ragnone Plant" and the City of Lapeer. The four wastewater treatment plants are in the process of reducing infiltration and inflow from their collection systems. The National Pollutant Discharge Elimination System (NPDES) permits for the Flint and Genesee Ragnone plants discharges require treatment facility and collection system capacity analyses. The City of Lapeer proposes to rehabilitate their plant to increase the treatment capacity and accommodate an increase in population and service area. All are operating and are in compliance with the parameters stipulated by their respective NPDES permits. If the GCDC service area demands increase in the future, or if the service area expands, the DEQ will use the standard NPDES permit review/reissuance cycle (5-years) to

evaluate any impacts from increases in wastewater flow. That process will include public participation.

The efficient use of existing systems is an applicable consideration when a proposal for an increased withdrawal and consumptive use is before the DEQ for approval. That is to say, an existing system must demonstrate that it is not wasteful of its water before a request for an increase in use can be approved. Because this is a new withdrawal the requirement for efficient use of existing systems, specifically the efficient use of a system owned and operated by another party (DWSD), is not germane to the permit decision.

As a consideration on the reasonableness of a water use, social and economic development considerations must be balanced against environmental impact of the proposed withdrawal. The GCDC outlined the potential benefits including enhanced public safety, security and health that would be provided to area communities served by the proposed withdrawal. Many of the social benefits would arise as a direct outcome of the new intake, pipeline, shore well and treatment facilities correcting existing system deficiencies identified by the DEQ. The GCDC projects the proposed construction of facilities would provide a direct infusion of money, jobs and manufacturing opportunities to the area. The DEQ determined there would likely be no ARI to the commonly shared water source as the withdrawal is not of sufficient magnitude to perceptibly lower the levels of Lake Michigan and Lake Huron. Accordingly, the DEQ concludes the GCDC proposal meets the reasonableness criteria relative to social development, economic development, and environmental impact.

Adverse Impact and Requirements for Ecological Improvement

Comments pointed out that the Great Lakes states and provinces have agreed to protect, conserve, restore and improve the Great Lakes resources. Some additional analysis recommended that the DEQ ascertain if there might be a cumulative ARI and questioned why the DEQ has not required the submittal of proposed restorative measures as part of the application packet. Comment pointed out that the application packet included no information as to whether Detroit will reduce its water use, whether GCDC will remain a DWSD customer for backup, and whether DWSD will seek additional customers. Commenters indicated that if there is no net reduction in use cumulative impacts need to be addressed. Some believe what was referred to as a diversion could have a significant impact on the levels of the Great Lakes and set precedent for other large scale diversions. Eleven comments focused solely on the impact the withdrawal would have on lake levels.

Response to Comments: The DEQ has determined there would be no ARI caused by the impact of the proposed withdrawal, and no perceptible impact on the levels of the Great Lakes or connecting channels. Given the likely near term affect of the proposed withdrawal on the volume of the DWSD withdrawal, there is no identifiable issue of cumulative impacts. Part 327, ~~which is~~ the guiding legislation in the issuance of the permit, requires "preventative measures" be submitted as part of a permit application only when necessary to preclude an otherwise prohibited environmental impact. As a proposed new withdrawal, the DEQ evaluated the GCDC withdrawal without assuming there would necessarily be any change to DWSD capacity to withdraw water from the Great Lakes.

Diversion or Intra-Basin Transfer

A number of comments assumed that the proposed withdrawal constitutes a diversion, or intra-basin transfer, precluding DEQ approval under Part 327, the Agreement and Compact. Comments indicated the need for the GCDC to better identify the current and proposed service area. This was especially true in dealing with service to Shiawassee County as portions of the county are in both the Lake Michigan and Lake Huron watersheds. There was also concern that some of the service area and return flow might be to the St. Clair/Detroit River watershed, or discharged to the Lake Erie watershed resulting in an intra-basin transfer. There was concern

that approval of the withdrawal would set a dangerous precedent for the review of diversion and intra-basin transfers in the future.

Response to Comments: In accordance with Part 327, the Agreement and Compact, the DEQ has determined the proposed withdrawal would not constitute a diversion or intra-basin transfer. Portions of Shiawassee County lie in both the Lake Michigan and Lake Huron watersheds. However, Section 4.12.9 of the Compact states that Lake Michigan and Lake Huron are to be considered a single hydrologic unit and watershed. And therefore the transfer of water between Lake Michigan and Lake Huron watersheds is not considered a diversion under the Compact. None of the proposed service area lies within the watershed of the connecting channel or Lake Erie. Connecting channels are those waters and associated watershed that lie between any two of the Great Lakes. Section 4.12.7 of the Compact treats connecting channels as though they are part of both the Great Lake watersheds above and below the connecting channel.

In summary, within the applicable definitions of Part 327, the Agreement, and Compact the proposed withdrawal would not constitute a diversion or intra-basin transfer. It is a proposal potentially subject to Prior Notice and Consultation under the Charter because it is proposed as an in basin use with the only loss of Great Lakes waters due to the associated consumptive use.

Inadequate Information

A number of comments criticized the adequacy of the submitted information. Some suggested more information was needed on the movement of ground water and surface water to determine if the proposal will result in an intra-basin transfer or cause an adverse impact to the quantity and quality of Great Lakes basin waters. There were claims the proposal did not meet the requirements, spirit or intent of Agreement or Compact. The presumed inadequacy of information led to concern over consumptive use, service area information and water loss. There was also concern over inconsistencies in the information such as references to the new capacity of 85 MGD, a maximum capacity of 110 MGD and a firm capacity of 88 MGD. There were questions as to the relationship between the various cited capacities.

Others acknowledged the effort made to demonstrate consistency with the Agreement and/or Compact while noting information deficiencies. In a few instances commenter's requested information concurrent with a request for extension of the public comment period.

Response to Comments: A permit applicant under Part 327 is required to submit information including pumping capacity; location of withdrawal; withdrawal source; amount and rate of withdrawal; the maximum monthly and annual volumes and rates; relevant information related to seasonal use; a description of how the water will be used; the location, amount and rate of return flow; and an evaluation of existing hydrological and hydrogeological conditions. Other information may be provided at the discretion of the applicant with a description of preventative measures required where relevant.

Due to the magnitude of the withdrawal and its qualifying as a proposal potentially subject to Prior Notice and Consultation under the Charter, the DEQ requested the submittal of additional information. Extensive information was provided to meet information requirements in accordance with the Charter, the Agreement and Compact. The DEQ deemed the information sufficient and notified the GCDC of such on April 24, 2009.

Regarding the request for an extension of the public comment period, Part 327 contains a statutory limit on the time the DEQ may give to the consideration of a permit application. Once the applicant is notified of the completeness of application the DEQ has 120 days in which to render a decision. Given the time constraints and the adequacy of the application packet, the DEQ denied requests to grant an extension to the public comment period.

V. Summary of DEQ Position

The DEQ has determined the application for the GCDC proposed withdrawal of water from Lake Huron was submitted in accordance with the permit requirements of Part 327. Further, the proposed withdrawal is deemed not likely to cause an ARI and, as proposed, meets the intent of the Great Lakes Charter and the decision making standards of the Agreement and Compact. The DEQ based this determination on a review of the information and data pertinent to the factors used in making a decision on a permit application which included a thoughtful consideration of the comments received from the public, the other Great Lakes states, the Canadian provinces of Ontario and Quebec, and federally recognized tribes and first nations on the permit application, as made available for public review.

The authorized withdrawal capacity is 85 million gallons per day (maximum withdrawal in any single day). The DEQ will assure that capacity is not exceeded in the issuance of the required Michigan Safe Drinking Water Act construction permits (1976 P.A. 399, as amended). In addition, the DEQ will require as a condition of this Part 327 authorization that the participating members of the Karegnondi Water Authority be committed to a water conservation/water use efficiency program consistent with the water sector guidelines accepted by the state under Part 327, and posted on the DEQ website.



ROWE PROFESSIONAL SERVICES COMPANY

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January 7, 2013

Mr. Edward Kurtz, Emergency Financial Manager
City of Flint
1101 S. Saginaw Street
Flint, MI 48502

Subject: Review of December 21, 2012 Presentation – City of Flint Water Supply Assessment

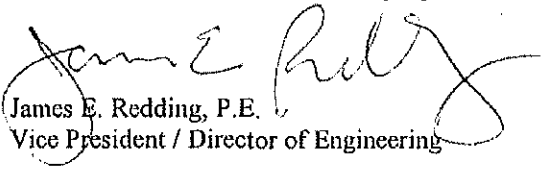
Dear Mr. Kurtz:

As requested, we have reviewed the analysis of water supply alternatives for the City of Flint which was presented to the State Department of Treasury by Tucker, Young, Jackson, and Tull, Inc. (TYJT) on December 21, 2012. Our review is attached and summarizes the primary differences between the TYJT assessment and our previous studies and provides explanations of why we believe there are differences.

We have also reviewed the options for continued DWSD supply included in the TYJT presentation. It is not clear whether these are presented as specific offers on behalf of DWSD or included as examples for analysis, but we have noted some items which we believe should be addressed and considered as these options are compared.

If there are questions, please contact me.

Sincerely,
ROWE Professional Services Company


James E. Redding, P.E.
Vice President / Director of Engineering

Attachment

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**Review of TYJT December 21, 2012 Presentation
City of Flint Water Supply Assessment
Prepared by Rowe Professional Services Company**

DWSD Supply (Slides 7 through 9)

1. The 8 mgd maximum day supply by DWSD options can result in periods during the summer when most of the water to meet demands will be supplied by the City from the river. To aid in maintaining a consistent water quality, softening of the water from the river should be provided with this option, greatly increasing the City's costs.
2. Upgrades to Flint's WTP and dams will be needed for options requiring blending, since the WTP will be required to provide continuous, reliable service and compliance with recent surface water treatment regulations.
3. The rates for the options analyzed are shown on Slide 9 as "TYJT Estimates". Options and rates shown are different than presented by DWSD previously.

	DWSD 11/29/2012	TYJT Estimates
18 mgd Maximum Day - P&B	\$16.24	\$16.37
12 mgd Maximum Day - P&B	\$16.30	\$16.31
8 mgd Maximum Day -P&B		\$12.68
12 mgd Maximum Day - Imlay	\$14.38	\$14.38
8 mgd Maximum Day - Imlay		\$11.11

4. Since the rates used in the analyses are shown as estimates, are they actual offers or just presented as "what if" scenarios?
5. We assume that the Imlay options are based on transfer of the 72" main through Lapeer County to Flint. The analyses show a capital cost of \$4.7 million; we assume that this is the proposed purchase / lease cost to Flint. This should be clarified along with pertinent details.
6. If the transmission main is transferred to Flint, what are Flint's responsibilities regarding service to the Lapeer County customers? If they remain DWSD customers, then Flint should receive some revenue for the use the main. It does not appear this is included in the TYJT analyses.
7. If the transmission main is transferred to Flint, we assume that the city will be responsible for the maintenance of the 50 year old main. The TYJT analysis did not include this.
8. Do the rates shown include the credit for "reliability" which had been discussed with DWSD?
9. If the point of commerce is changed from Baxter and Potter to Imlay, a new meter pit will be required. The cost of this does not appear to be included in the TYJT cost analyses.

Flint River Supply (Slide 10)

1. If any of the "blending" options are chosen, it will be necessary to upgrade the Flint WTP and dams to provide reliable, continuous service and compliance with recent surface water treatment regulations.

Data Collected (Slide 14)

1. The slide notes that Flint blending is based on DWSD supplying 2/3 and Flint supplying 1/3 of 12 MGD ADD. For the maximum day demand (18 mgd), if DWSD supplies a maximum of 8 mgd, Flint will supply 10 mgd or 56% of the total. However, such a large portion will make it more difficult to blend and achieve consistent water quality. Flint will need to soften water for these options.

Benchmarking Comparisons (Slide 16)

1. The slide subtitles are "KWA O&M Inflation Factor" and "DWSD and Flint Rate Inflation Factor". It seems appropriate to benchmark O&M costs for the KWA, because future costs of service will be dependent on how operating costs are impacted by inflation. For Flint, it does not seem appropriate that "rate inflation" from other utilities be used to determine the impact of inflation on future cost of service. Rates are impacted by inflation, but also by other factors such as debt and customer base. O&M expenses and rates are different and care should be exercised not to mix the two during analyses. The TYJT analyses apply an inflation factor (based on rates from other utilities) to the Flint WTP operating expenses, which does not seem to be consistent.
2. The KWA will supply raw water; SOCWA and YUCA both supply finished water. Regulations impact the O&M for finished water suppliers but should not impact the KWA O&M. The use of data from SOCWA and YUCA does not seem like a comparable comparison with the KWA. Finished water suppliers will have increased costs due to regulatory compliance, which really are not due to "inflation" of the costs of wages, power, chemicals, etc.
3. DWSD has a history of rates to Flint and other suburban wholesale customers. Rates tend to be quite specific to each utility, based on much more than just the costs of operating and maintenance. It appears that DWSD historical rates have not been considered in projecting future DWSD rate increases.

Capital Financing (Slide 17)

1. KWA bonds are planned to be general obligation bonds, backed by member counties.

O&M Inflation Factor (Slide 20)

1. SOCWA and YUCA are finished water suppliers; ever-changing regulatory requirements will impact their operating costs more than a raw water supplier, such as KWA.
2. KWA will be a supplier of raw water. O&M costs should primarily be limited to power and labor, with a little chemical use for zebra mussel control. KWA will not provide treatment of the water.

3. The KWA study assumed power, labor, and chemical costs increase at an annual average of 3%. TYJT indicated this is too low and suggested 5%.
4. Following are examples of historical inflation, which support the 3% as a reasonable assumption for O&M expenses (not rates)
 - a. Labor- GCDC-WWS labor costs have increased at an annual average rate of 2.5% since 2003
 - b. Electricity Rates in Michigan (per U.S. Energy Information Administration) have increased an average of 3.2% since 1999.
 - c. The U.S. Bureau of Labor Statistics indicates that the inflation rate over the last 30 years has been an average of 2.8%.

Finished Water Rate Inflation (Slide 21)

1. TYJT bases their assumptions for rate inflation on a survey of rates from three other water suppliers, but ignored the actual rate history of DWSD. TYJT assumed DWSD rate increases of 4.4% annually (if water is purchased from P&B) and 2.9% annually (if water is purchased from Imlay). Based on the actual charges by DWSD to Flint, DWSD historical rates are as follows:
 - a. 10 year increase in DWSD rates to Flint:: 10.5% annually
 - b. Average annual increase through 45 year history: 6.7%
2. Note that for the KWA analyses, an inflation factor has just been applied to power, labor, and chemicals. Although higher prices for labor, power, and chemicals impacts utility rates; rates are impacted by many other factors, many of which are not related to inflation. Rate inflation will likely be different than O&M inflation. Other factors impacting rates:
 - a. Debt – the amount of debt varies widely between utilities
 - b. Number of customers / quantity of water sold – there are many fixed expenses with a utility, that if are distributed amongst more users/more gallons sold will result in lower rates. Conversely, if there are fewer users or less water sold, the rates are higher. Assumptions regarding future water consumption will have a great impact on “rate inflation”.
3. Unlike KWA and Flint operating expenses which will increase over time based on inflation, the cost of continued DWSD service should be based on the inflation of DWSD rates, to include the increasing cost of other DWSD expenses such as debt and the impact of reduced customers / demands in addition to increasing O&M expenses.
4. Even though there could be a one-time reduction in DWSD rates through adopting the model contract, limiting peak demands, and or changing the point of commerce; it doesn't seem reasonable to assume that subsequent annual increases will only average 4.4% through the 30 year period of analysis. This is significantly less than historical performance (yet TYJT suggests that inflation for KWA O&M expenses will increase at almost double the rate of historical indicators).

purchased, so purchase prices are known. It will be necessary to obtain easements for only two miles of pipeline construction. All land costs are now estimated at \$1.25 million.

4. Engineering, Legal, Administration & Contingencies

- a. The October 2012 KWA estimate provided an allowance of 25% of construction cost to cover engineering, legal, administration, and contingencies (ELAC). This was reduced from the 38% allowance used in the 2009 Study because ongoing planning and design have firmed up many of the details of the project, including:
 - i. The intake design has been completed and all regulatory permits obtained.
 - ii. The transmission main route has been determined. Meetings with road agencies have firmed up the requirements for construction and restoration within rights-of-way. Environmental review and permitting are in process.

- b. TYJT costs for Intake Crib, Pump Stations, and Transmission Mains (Slide 30) include a 30% allowance for ELAC. These allowances (from Slides 26 through 28) total \$72,139,566. In addition, Slide 30 provides the following additional ELAC costs in the project total:

Design Engineering / Pump Stations	\$16,939,581
Construction Management	\$14,434,410
Administration	\$ 349,440
Legal	\$ 831,000
Total	\$32,554,431

- c. Combining this with the \$72,139,566 totals \$104,693,997 or 43% of the estimated construction cost. We believe that such a high allowance for ELAC is not appropriate for a project of this magnitude where preliminary engineering and some design have already been completed.

Cost Comparison (Slide 30)

1. The TYJT pump station price is too high based on costs of similar projects; costs used by KWA are based on costs of recent local projects. The KWA estimate is believed to be sufficient for the proposed pumping stations.
2. Redundant power is not required; this does not need to be included in the TYJT estimate.
3. Land for LHPS – actual price is \$360,000
4. Design Engineering / PS and Transmission – KWA included engineering in the 25% ELAC allowance included in the \$207,752,895 estimated cost of transmission mains; TYJT included engineering in their 30% ELAC allowance included in the \$218,811,559 estimated cost. By adding \$16,939,581 for design engineering, \$14,434,609 for construction administration, \$349,440 for administration, and \$831,000; it seems that ELAC is being “double-counted”. The TYJT 43% allowance for ELAC seems unwarranted for a project with a great deal of preliminary and design engineering completed. The 25% KWA allowance is believed to be sufficient.
5. Easements and land (other than LHPS) should total \$1,140,000, based on current options and specific needs for easements.

Capital Financing with Revenue Bonds (Slide 24)

1. Note that the KWA bonds will be general obligation bonds backed by the member counties.
2. The 2009 KWA Study assumed 6%, 25 year financing. The interest rate for planning was reduced in the 2012 Study update to 5%, which is still higher than if bonds were sold today.
3. Financial consultants determined the charges for purchasing capacity in the KWA supply based on the estimated project cost plus appropriate financing costs. Based on 60 units of capacity, \$538,764,000 will be generated for repayment of debt and project costs using the capacity charges in the KWA capacity agreement.

25 years * 60 units * \$355,300 / unit =	\$532,950,000
3 years * 60 units * \$32,300 / unit =	<u>\$ 5,814,000</u>
	\$538,764,000
4. For a KWA project cost of \$272,421,558, total P&I is \$483 million. The difference of \$55,500,000 is available for financing expenses (capitalized interest, bond issuance costs, etc.) and additional contingencies.
5. Bond holder reserve is not a requirement for general obligation bonds.
6. TYJT assumed that 3% interest would be earned on the bond holder reserve during the 25 year bond period. Current interest rates are less than 1% and it seems inappropriate to assume such a high rate will be earned on retained funds.
7. Bondholder reserve, if provided, should be applied against the last couple of P&I payments. The TYJT did not apply it. This will reduce their project costs.

KWA Construction (Slides 26 through 29)

TYJT has indicated that the KWA construction cost estimate is too low. The primary differences in cost estimates for the project appear to be the following components:

1. Pump Stations (Slide 27) – The TYJT estimate for the pump stations is more than double that used by the KWA (\$54,573,314 vs. \$24,618,080). KWA estimates were based on actual construction costs from recent projects completed by Genesee County within the last eight years.
 - a. 32mgd water pump station including two-10 MG ground storage tanks - \$13.4 million
 - b. 80 mgd wastewater pump station, 50 feet deep wetwell – \$8.3 million
 - c. 30 mgd wastewater pump station, 50 feet deep wetwell – \$9.4 million

The KWA budgeted amount seems reasonable for two pumping stations as currently planned and to be constructed in rural areas (not southeast Michigan).

2. Redundant Power – There is no need for redundant power; other provisions will provide reliability of supply.
3. Land – Preliminary engineering has continued so earlier budgets established for planning for land acquisition can be greatly reduced. Options have been obtained on all properties which must be

Other Considerations – Redundancy / Reliability (Slide 33)

1. Unfunded Mandates/ Future Regulations
 - a. The proposed KWA supply will deliver raw water; it is not anticipated to be affected by future changes to regulations. Regulations will impact the City of Flint with respect to treatment and/or distribution of finished water. The City will be subject to these requirements with any of the DWSD blending options, just as they will be responsible for them if supplied by KWA. Some compliance costs may actually be less with the higher quality Lake Huron water rather than Flint River water as the source.
2. State Goals
 - a. The TYJT presentation indicates that creation of a new raw water supply is contrary to the governor's goals as suggested. However, the development of a new raw water supply provides new opportunities. Communities in Sanilac, St. Clair, and Lapeer counties will have the option to join a regional water supply and replace their small local supplies where limited supplies and high concentrations of arsenic have been a concern. The new water supply also provides great economic development opportunities. The raw water supplied by KWA will make a new commodity, raw water, available to the region. A large, low-cost supply of raw water can be a valuable resource for industries and agribusinesses. The development of a new water supply will also create construction jobs through the short term period of building the new water supply and subsequently over a longer period as new businesses and industries are developed in the area.
 - b. The City of Flint and area communities will benefit as permanent jobs are created for operating and maintaining the local treatment facilities.
3. Redundancy
 - a. We agree that the KWA and DWSD options are similar with respect to redundancy. Both provide the primary water supply; customers are responsible for their backup supply.

Other Considerations – Cost Slide 34

1. TYJT indicates that the DWSD 8 mgd supply option is the least cost alternative.
 - a. The TYJT analysis does not include the cost of needed upgrades to the City's WTP or increased operating costs in their analysis. During summer months, water from the river will need to be softened before blending. More than half of the water supplied will be provided from the river. When the cost of upgrades to the WTP and the increased operating costs (for softening) are added to the TYJT analysis, the KWA option is less than the DWSD 8 mgd option.
2. For any of the DWSD "blending" options, upgrades will need to be made at the WTP to provide for continuous, reliable operation and compliance with new surface water treatment rules. Increased capital and operating costs for treating water from the river should be added to the TYJT costs for comparison with the other options.
3. Water from the river will require greater effort to treat than water from Lake Huron (more chemicals, power, and residuals). The TYJT analysis shows about the same O&M costs for the Flint WTP, regardless of water source. It seems that the WTP O&M costs for the KWA options should be reduced to reflect the savings from treating Lake Huron water.

4. The TYJT presentation noted that the KWA analysis did not include allowances for mechanical and process improvements within the planning period. The KWA will supply raw water. The facilities consist of pipe, pumps, and a tank. There are no treatment facilities which would be susceptible to future regulatory changes. The only improvements that seem likely would be the need to provide additional capacity. Capacity expansion is planned to be financed through capacity charges to new users.
5. The provision for redundant connections between the City's water system and the GCDC system was included in the most recent water supply agreement between the two, in 2011. Although not a KWA cost, the cost of the redundant connections should be considered with all options.
6. The \$2.3 million budgeted for land by KWA was intended to cover all land requirements. Since the October update, options have been obtained on all land to be purchased and the locations of easements needed has been finalized. Total land costs are now estimated to be about \$1.5 million.
7. The 2004 study included a 47% allowance for engineering, legal, administration, and contingencies (ELAC). The 2009 study reduced the allowance for ELAC to 37% because many of the details since the 2004 conceptual study had been better defined. For the October 2012 update, the allowance for ELAC was reduced to 25% because continued planning and preliminary engineering further addressed details from the earlier concepts.
 - a. The detailed design (plans and specifications) and permitting have been completed.
 - b. The transmission main route has been finalized. Meetings with road agencies have established requirements for construction and restoration within road rights-of-way. Environmental permitting is in process. The primary remaining unknown is pipe sizing, which is largely dependent on Flint's participation.

It is our experience that the 25% ELAC allowance is appropriate for a project of this magnitude at this stage in the planning / design stage. The 43% ELAC allowance recommended by TYJT is excessive for a project in the design phase.

8. Flint's WTP as a backup to the KWA will be less difficult to provide for than the current arrangement as a backup to DWSD. We believe there is potential for challenges with chemistry and treatment for the proposed DWSD blending options, too.
9. It doesn't seem that oversizing the KWA capacity is a good solution for the city's water loss problems, if that is what is being suggested.
10. Yes, it would be nice if the KWA system could be constructed to firmly determine its cost and time to complete before making a decision about water supply alternatives. However, a decision is needed regarding Flint's participation so that the sizing and design can be completed, before it can be built.

Project Costs - TYJT Slides 26 through 30

	KWA	TYJT
Intake and Crib		
Construction	\$22,076,850	\$22,076,850
ELAC	\$5,519,213	\$5,519,213
Property	\$2,300,000	\$2,300,000
Pumping Stations		
Construction	\$24,618,080	\$54,573,314
Land		\$75,000
ELAC	\$6,154,520	\$16,394,494
Transmission Mains		
Construction	\$166,202,316	\$167,419,530
ELAC	\$41,550,579	\$50,225,859
Easements		\$1,166,170
Engineering		
Design Engineering		\$16,939,581
Construction Management		\$14,434,609
Administration		\$349,440
Legal / Easements / Contracts		\$831,000
Power	\$4,000,000	\$4,000,000
Redundant Power		\$1,273,200
Total Construction	\$212,897,246	\$244,069,694
Total ELAC	\$53,224,312	\$104,694,196
Total Land / Property / Easements	\$2,300,000	\$3,541,170
Total Power	\$4,000,000	\$4,000,000
Total Redundant Power	\$0	\$1,273,200
Total	\$272,421,558	\$357,578,260
ELAC as % of Construction	25.0%	42.9%

Option	TYJT Total Cost	TYJT minus additional costs of river treatment	TYJT minus additional costs of river treatment plus redundant Flint-GCDC connections	TYJT minus additional costs of river treatment plus redundant connections less KWA reserve	TYJT minus additional costs of river treatment plus redundant connections less TYJT financing	TYJT plus Flint WTP	Adjusted Total Cost	Ranking
1 Flint WTP Only	\$590,441,893						\$590,441,893	3
2 DWSD 8 MGD Max Day at Imlay	\$621,211,298					\$771,289,948	\$771,289,948	5
3 KWA 10/31/12 Update	\$649,775,166	\$534,615,996	\$554,555,960				\$554,555,960	1
4 DWSD 8 MGD Max Day at P&B	\$657,167,877					\$807,246,527	\$807,246,527	6
5 KWA-1	\$707,279,715	\$592,120,545	\$612,060,509		\$572,731,459		\$572,731,459	2
6 DWSD 12 MGD Max Day at Imlay	\$707,994,386					\$858,073,036	\$858,073,036	8
7 DWSD 12 MGD Max Day at P&B	\$742,168,081					\$892,246,731	\$892,246,731	9
8 KWA - 2	\$766,784,313	\$651,625,143	\$671,565,107	\$654,706,341			\$654,706,341	4
9 DWSD 18 MGD Max Day at P&B	\$791,202,885					\$812,337,848	\$812,337,848	7

Option for Water Supply	TYJT Projected 30 Year Total Cost	30 Year O&M Reduction for Treating Lake Huron Water	25 Year Bond Cost for Redundant Connections	Eliminate KWA Reserve	Use KWA 25 Year Capital Charge \$355,300 / MGD	25 Year Bond Cost for Flint WTP Upgrades	Adjusted 30 Year Total Cost	Rank (Least to Highest Cost)
1 Flint WTP Only	\$590,441,893		Included				\$590,441,893	3
2 DWSD 8 MGD Max Day at Imlay	\$621,211,298		Note 1			\$150,078,650	\$771,289,948	5
3 KWA 10/31/12 Update	\$649,775,166	-\$115,159,170	\$21,134,963				\$555,750,960	1
4 DWSD 8 MGD Max Day at P&B	\$657,167,877		Note 1			\$150,078,650	\$807,246,527	6
5 KWA-1	\$707,279,715	-\$115,159,170	\$21,134,963		-\$39,329,050		\$573,926,459	2
6 DWSD 12 MGD Max Day at Imlay	\$707,994,386		Note 1			\$150,078,650	\$858,073,036	8
7 DWSD 12 MGD Max Day at P&B	\$742,168,081		Note 1			\$150,078,650	\$892,246,731	9
8 KWA - 2	\$766,784,313	-\$115,159,170	\$21,134,963	-\$16,858,766			\$655,901,341	4
9 DWSD 18 MGD Max Day at P&B	\$791,202,885		\$21,134,963				\$812,337,848	7

Representative Genesee County Water and Wastewater Projects

Project	Description	All Engineering Fees	Engineer's Estimate	Bid Price	Final Construction Cost	Engineering & Contingency %
Fox Pump Station	30 mgd wastewater pump station & forcemain	\$1,829,259		\$12,394,273	\$12,074,223	
		15.2%				
NEES Project	60" Relief Sewer - included tunneled sections		\$54,707,212	\$55,985,672	\$69,999,429	
					28.0%	
North Water Loop	23 miles 36" and 48" transmission main, pump station, & 20 MG Reservoir	\$4,102,610	\$29,200,000	\$23,570,110	\$25,798,529	2.4%
		15.9%			-11.6%	
Henderson Road PS	32 MGD Water Pump Station & Two-10 MG Tanks		\$12,046,368	\$12,846,077	\$13,517,582	
					12.2%	
Pump Station #1	80 MGD wastewater pump station	\$1,735,063	\$10,269,000	\$8,225,400	\$8,292,277	-2.4%
		20.9%			-19.2%	

Notes:

Engineering Fees include all planning, soils investigation, design, construction inspection & testing, and construction management costs

Engineering Fees % is based on final construction cost

Engineering and Contingency % is based on engineering fees + amount final construction cost exceeds estimate

Final Construction Cost % is based on difference between final construction cost and engineer's estimate

NEES Project Contractor went out of business during project - increasing cost to finish project

Projects constructed within last ten years

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, March 13, 2015 4:09 PM
To: 'Wurfel, Brad (DEQ) (WurfelB@michigan.gov)'
Subject: Pigging Info and Videos
Attachments: Pigging Information; Pipe Pigging Videos

Brad,

In case you get further requests regarding the Flint water distribution system attached is some info and videos on line cleaning using pigging equipment.

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

Rennaker, Joanne (DEQ)

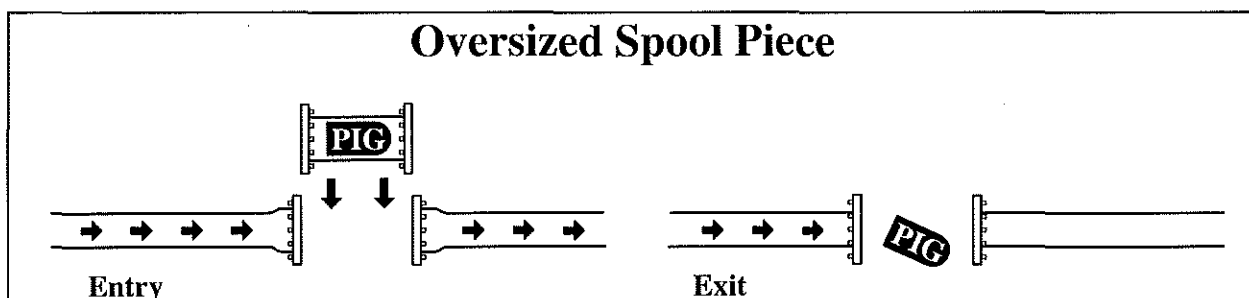
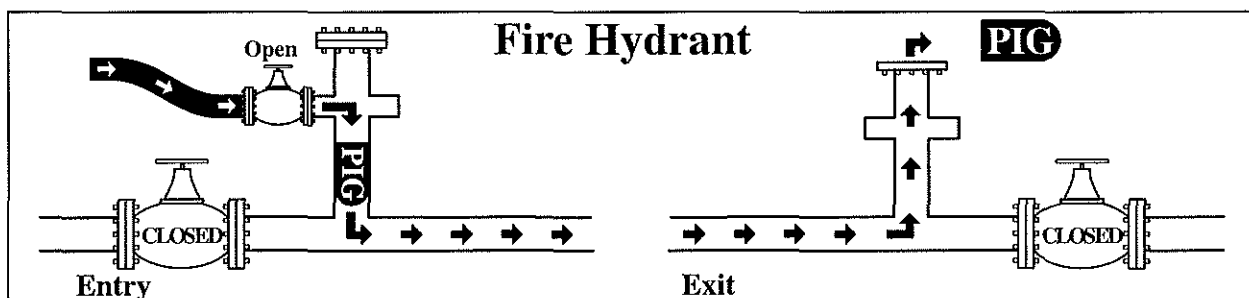
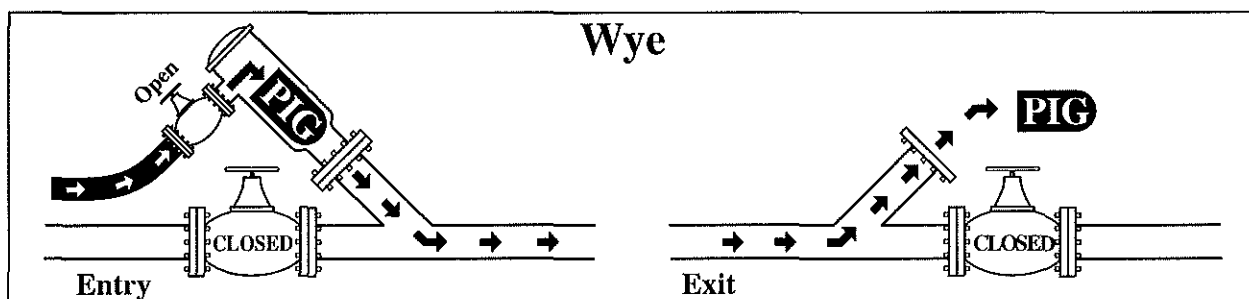
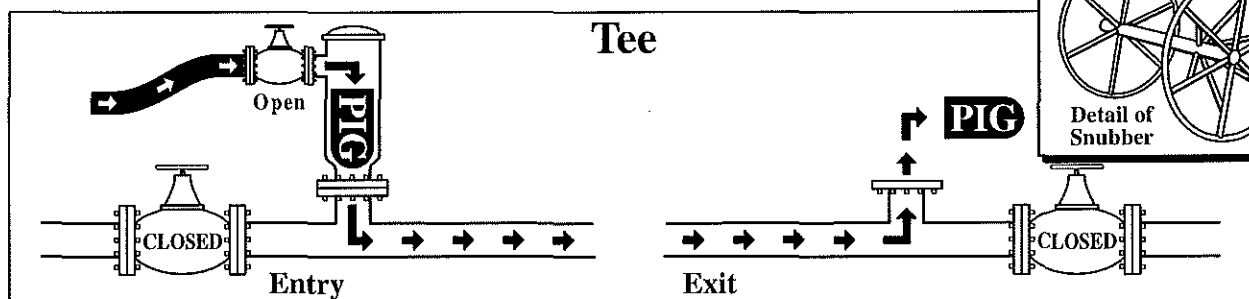
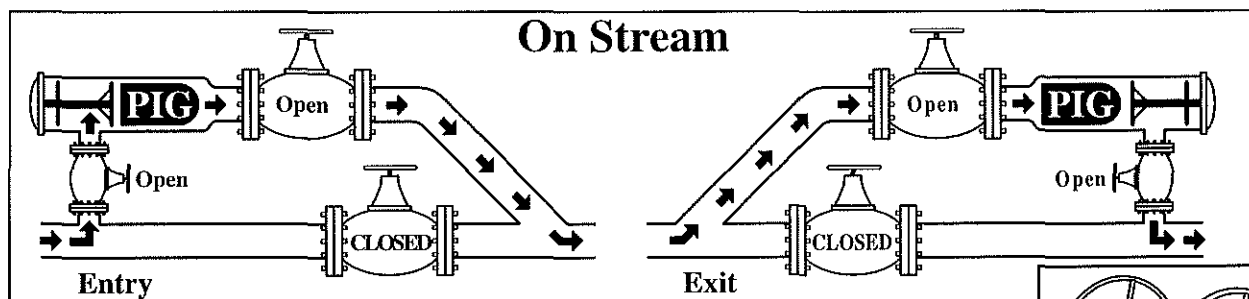
From: Busch, Stephen (DEQ)
Sent: Monday, March 09, 2015 8:41 AM
To: Busch, Stephen (DEQ)
Subject: Pigging Information
Attachments: Launch_and_Retrieval_Methods.pdf; OTsp07_TB.pdf;
PotableWaterSeweragePipeLines.pdf; PPP_General_Brochure.pdf; USG Advanced Pipe
Cleaning (Ice Pigging).pdf; 0707_036.pdf; 039204epadwctr.pdf;
FlowmoreBrochure2009.pdf

See Attached.

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

Pipeline Pigging Products Inc.

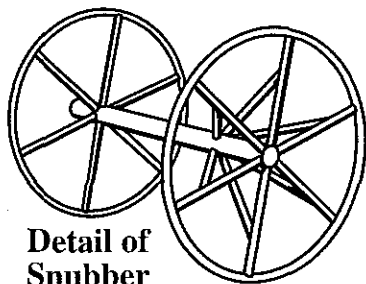
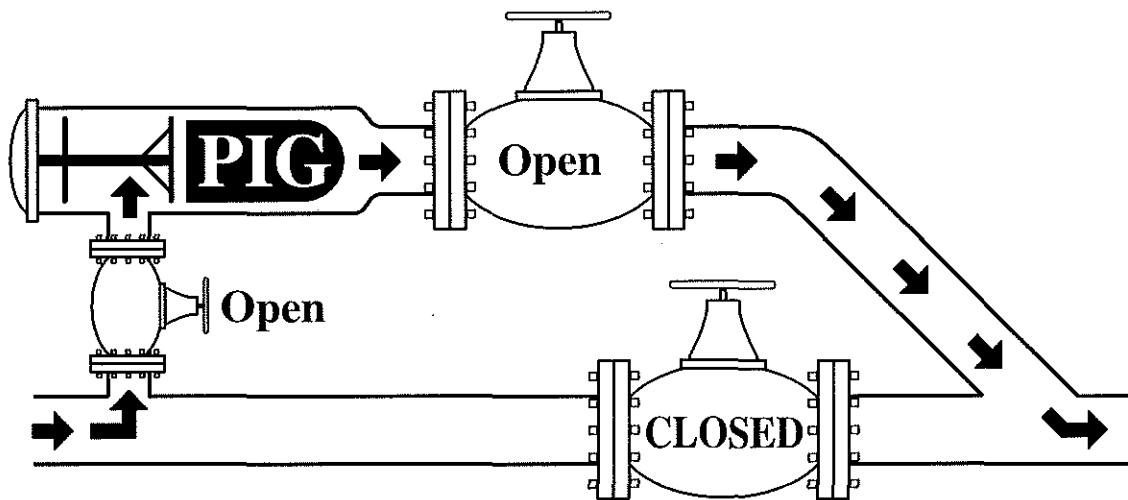
LAUNCH & RETRIEVAL METHODS



Pipeline Pigging Products Inc.

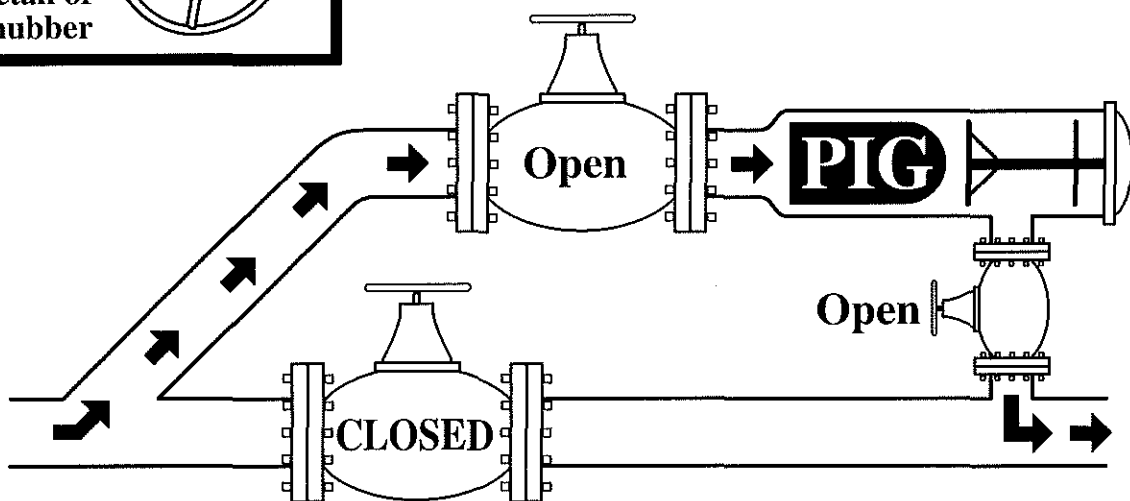
LAUNCH & RETRIEVAL METHODS

On Stream Entry



Detail of
Snubber

On Stream Exit



Tech Brief

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Line Pigging

By **Zane Satterfield, P. E.**, NESC Engineering Scientist

Summary

Line pigging is an internal pipe-cleaning process used to remove biofilms or other foreign matter from the inside of water pipes. If performed correctly, line pigging will renew the flow rates to restricted piping systems and reduce pumping pressures. This Tech Brief discusses some of the techniques and processes used in cleaning waterlines in distributions systems.

Line Pigging

Line pigging (or line swabbing, as it sometimes known), is the process of cleaning distribution lines by inserting a small device known as a pig into the lines and pushing it through them. The term "pigging" originated in the gas and oil industry, where metal discs connected by a rod were moved through the oil pipelines to remove buildup of paraffin wax on the internal wall of the pipe. The action of metal on metal made a squealing noise like a pig and the name stuck. More and more, pigs are being used to clean pipelines in all types of industry including waterlines in municipal distribution systems.

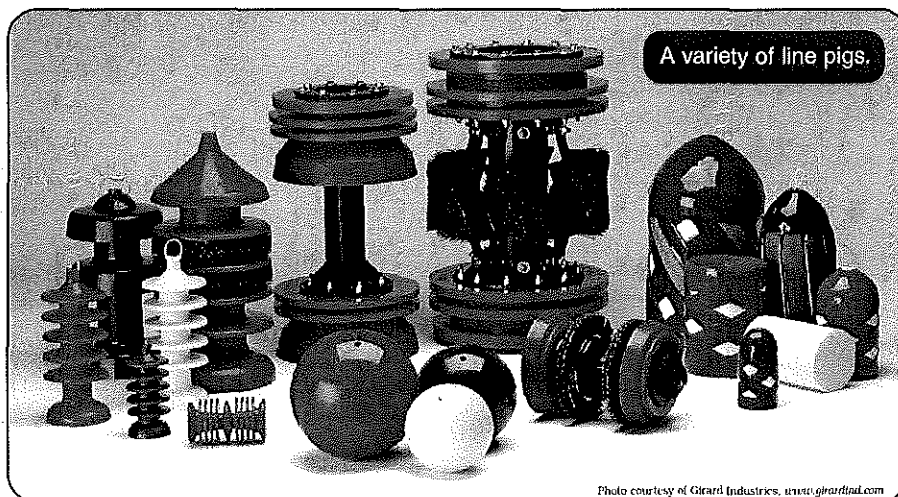
Pigs range in size from 2- to 48-inches in diameter and can be made to order in varying lengths, styles, and configurations for specific applications. Not only are pigs used for cleaning but also for inspecting the inside of pipelines and determining interior dimensions.

Is pigging waterlines really necessary?

States and municipalities typically do not require regular pigging or swabbing of distribution lines in water systems. Some may only require pigging after initial construction of a new line to remove any debris left in the line because flushing alone will not always clean the dirt and debris out of the line.

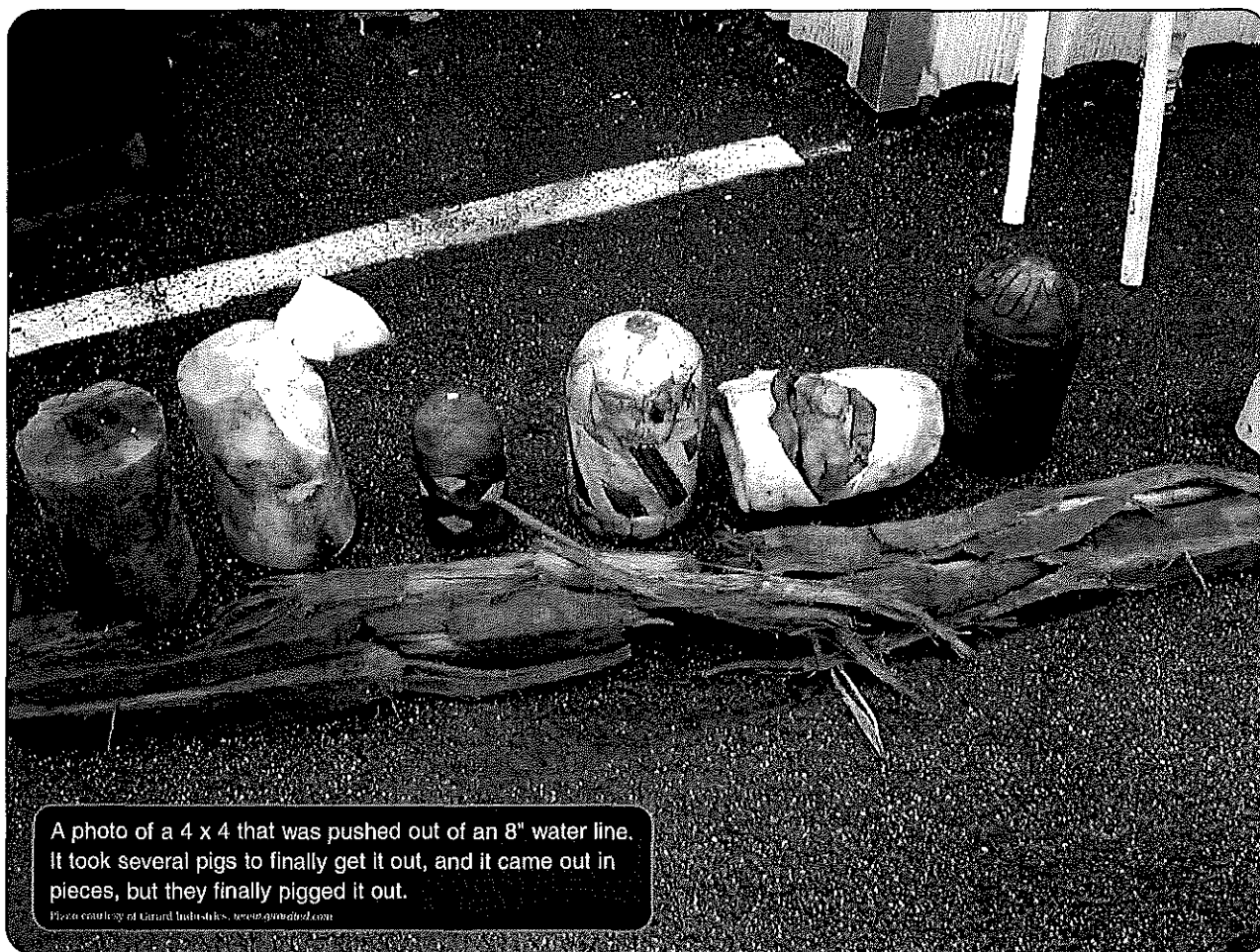
What is a pig?

A pig is the object, usually bullet shaped, that is pushed by the water in the pipe in the direction of normal flow. The pig can be made of different materials (foam, steel, plastic, polyurethane), but generally is food-grade silicon, which is tough yet flexible and safe to be in contact with drinking water.



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A photo of a 4 x 4 that was pushed out of an 8" water line. It took several pigs to finally get it out, and it came out in pieces, but they finally pigged it out.

Photo courtesy of Girard Industries, www.girardind.com

One reason to pig a waterline is that all distribution lines tend to have a biofilm coating the inside of the pipe. The bacteria are dormant until certain conditions activate the bacteria, causing problems. Regular flushing will not eliminate this biofilm. Regular pigging with flushing will reduce or eliminate biofilms.

A second reason to pig a line is inadequate water flow. More flow (volume) of water may be needed to support development or a growing population in the water system or to provide adequate water for fire fighting. In areas of water systems where increased development has caused water demand to surpass the flow output of an existing line, the system will usually need to replace the existing waterline with a line that can support the demand needed. If the existing flow is restricted due to excessive deposits, however, pigging may be the solution to the problem.

Third, most states require a minimum of a 6-inch diameter waterline when connecting a fire hydrant to provide adequate flow. After years of service, the inside of the pipe can become

restricted with deposits making the fire hydrant less effective if not useless for its intended job. If fire flow is needed, the solution in the past has been to replace the whole waterline, which is very costly and time consuming. Pigging may restore adequate flow for fighting fires at a fraction of the time and cost.

Finally, pigging waterlines may lessen complaints from water customers regarding the very same deposits that have or can restrict fire flow. These deposits are unwanted foreign matter such as iron oxide (red water), alum, calcium carbonates, barium sulfide and sediment. Pigging, in most cases, provides a solution. Cleaning these deposits can also reduce pumping pressures in areas of water systems that have booster pump stations. Increased pumping pressures can result in line leaks and pipe failures.

Procedure

The procedure starts by determining if the waterline can be pigged. Not every water line is a candidate for line pigging. Is the water line so corroded that pigging can cause failure?

Does the waterline have reducers (i.e., the line getting smaller) that can cause the pig to get stuck? Does the line have increased pipe diameter sizes where the water pressure would be insufficient to move the pig?

One of the main things to look at is the condition of the interior of the pipe. If the pH of the water is low, the interior of the line could be so corroded that pigging could result in failure. If in doubt about the condition of the line, refer to past line repairs or talk to operators who have worked on any repairs of the particular line.

Much of this information can be obtained from as-built drawings or operators who have fixed leaks or installed the original water line. The line will have to be dug up to launch the pig. At that time, a visual inspection should be done to determine if pigging is possible. Another option is to use a low density foam pig in any unknown line and examine the foam pig for wear patterns, tears, or gouges. This may even help determine if the line can be successfully cleaned with a pig.

Before the pigging begins, it's useful to have information about the line:

1. Locate and mark all valves and meters.
2. Approximate all elbows and fittings in the line (again, refer to the as-built drawing if available).
3. Know the pressure and flows in the lines. This will also help determine if any flow increase and possibly pressure decrease was achieved by the pigging.

The more you know before you start, the fewer surprises you'll encounter once you start pigging.

Once the line has been inspected and appears suitable, the actual pigging begins. A pig is inserted into the line to be cleaned by means of a launcher. This is simply an oversized barrel with a reducer mating to the existing line. This allows for easy insertion of the pig, because the pig's outer diameter is larger than the pipe's internal diameter to maintain a good seal. Once in the launcher, clean water is introduced to send the pig on its way. This is usually the same water that is in the line from a nearby flushing hydrant or fire hydrant, or a tanker truck. The pig's path is determined by direction of flow and by isolating the line to be cleaned by closing valves to laterals, if present.

If the waterline is in service, you must notify your customers about the water interruption and possible dirty water after bringing the line back in service. If the water line has a lot of unwanted deposits, it may be wise to pull all water meters just before the pigging process starts and flush at the connection at the end of the process before you replace the meters. Foreign matter could stop-up the meter or cause the meter to malfunction. The debris could also get into the customers' plumbing and cause problems such as plugging the aerators on the faucets, dishwashers, or washing machines.

If the waterline to be pigged has severe scaling (tuberculation) due to iron oxide (red water), alum, calcium carbonates, barium sulfide, or sediment, a progressive or stepped approach must be taken to avoid getting a pig stuck or losing a pig. This approach is simply using a smaller diameter pig at first and working your way up incrementally to the inside diameter of the pipe. The stepped technique will minimize the risk of the pig getting stuck or large amounts of debris plugging the line by cleaning a little bit at a time.



Articles about locating distribution lines and valve exercising programs are available on the National Environmental Services Center Web site at www.nesc.wvu.edu/hdwc.

Smart Pigs

There are many different types and sizes of pigs. For waterline use, some nonstandard pigs include:

- Gauging pigs are mainly used after constructing the pipeline or before pigging an old line to determine if there are any obstructions in the pipeline.
- Profile pigs are gauging pigs with multiple gauging plates used to help map the inside condition of the pipe walls.
- Magnetic cleaning pigs are used to pick up ferrous debris left in the pipeline.
- Transmitter pigs or detector pigs are used to map out the location of pipeline or help locate a stuck pig.
- Spheres are round for ease in negotiating short radius 90-degree elbows, irregular turns, bends, and sweeps.

Dealing with a Stuck or Lost Pig

If a pipeline has not been pigged on a routine basis or has never been pigged, a pig can get stuck. If a pig becomes stuck, the first priority



A pipeline prior to line pigging.

Photo courtesy of Girard Industries, www.girardind.com

is to find and retrieve it, but you must identify the cause. Usually one of two conditions exists when a pig is stuck: fluid bypassing around the pig (not pushing the pig) or a blockage of the flow.

In water distribution systems that have loops and multiple tee connections a pig can find its way out of the work area and get lost. It is important to locate all valves and close off the lines that are not being pigged and know the direction of water flow.

If you lose a pig, a smart pig such as a detector pig or transmitter pig can be launched to help find the lost pig. A transmitter can also be installed in the cleaning pig so that a second pig does not have to be launched to help locate it if it should get lost or stuck. Sometimes a pig gets stuck because of a broken or shut gate valve.

Procedures for dealing with a stuck pig or fluid going around the pig:

1. Increase the line pressure and flow rate, but do not exceed the safe limits of the pipeline allowing for age and/or condition of the line. The flow rate and pressure can be increased with a pumper and tanker fire truck.
2. Release pressure from the line and drain the line back toward the launcher. Releasing pressure allows the pig to relax to its normal shape and may even cause the pig to back up in the line. After pressure has dissipated completely for several minutes, re-pressurize the line in an attempt to drive the pig through the restriction. This may be repeated two or three times.
3. For a bypass situation, run a soft swab in behind the stuck pig to try and create

a positive seal, stopping the bypass. Repeat step one above.

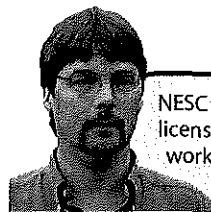
4. Back the pig up by applying pressure from the opposite end of the waterline using a pump or possibly a pumper fire truck.
5. If a foam pig is used and gets stuck a super-chlorinate mixture (3,000 to 5,000 ppm) in a slug form can be used to dissolve the pig. The line must be flushed and tested to be sure the chlorine residual is allowable limits after the super chlorination.

Water systems are advised not to undertake line pigging on their own. Shop around and find a reputable company with experience in line pigging with water lines. Start with an area of the water system that the line location, size, type, and condition are all known and the lines can be dug up easily if needed.

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Special thanks to Jim Duris at Girard Industries for his assistance.

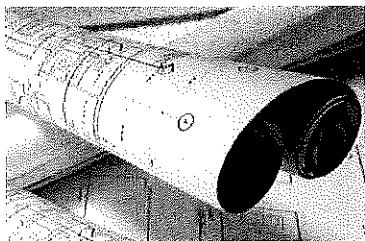


NESC Engineering Scientist **Zane Satterfield** is a licensed professional engineer and previously worked for the West Virginia Bureau of Public Health, Environmental Engineering Division.

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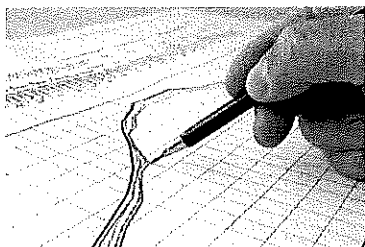
TECHNICAL SPECIFICATIONS FOR THE INTERNAL CLEANING OF POTABLE WATER AND SEWAGE PIPE LINES

EXECUTION:

•Pipeline shall be cleaned to remove most dirt, sludge, tuberculation and other foreign matter buildup from the interior wall of the pipeline. Equipment selected shall be capable of performing such cleaning. Satisfactory precautions shall be taken to prevent scratching or scraping of interior wall surfaces or other damage to pipes that might be inflicted by the improper use of cleaning equipment.

PIGGING:

•Prior to the use of plastic foam type pigs, a swab made of soft plastic foam shall be sent through the piping to insure that the piping systems fittings, valves and interior dimensions will allow the initial cleaning pig to pass through it without being trapped within the system. Upon examination of this initial swab, subsequent pigs of varying diameters and/or densities shall be sent through the piping system until desired results are readied.

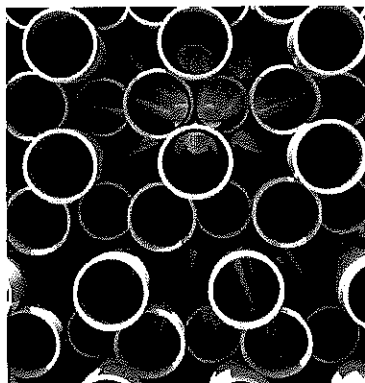


PIGS:

•Pigs shall be manufactured of an open cell polyurethane foam body. Densities may range between 1 1/2# per cubic foot up to 8# per cubic foot density. Some pigs may be wrapped with polyurethane spiral bands, as well as abrasives for longer life or removal of harder scale. Pigs should be able to pass through reduction of up to 60% to 65% of cross sectional area of nominal pipe. Pigs shall be able to traverse standard piping configurations such as 90° elbows, tees, crosses, wyes, gate valves, and ball valves.

CONTRACTOR REQUIREMENTS:

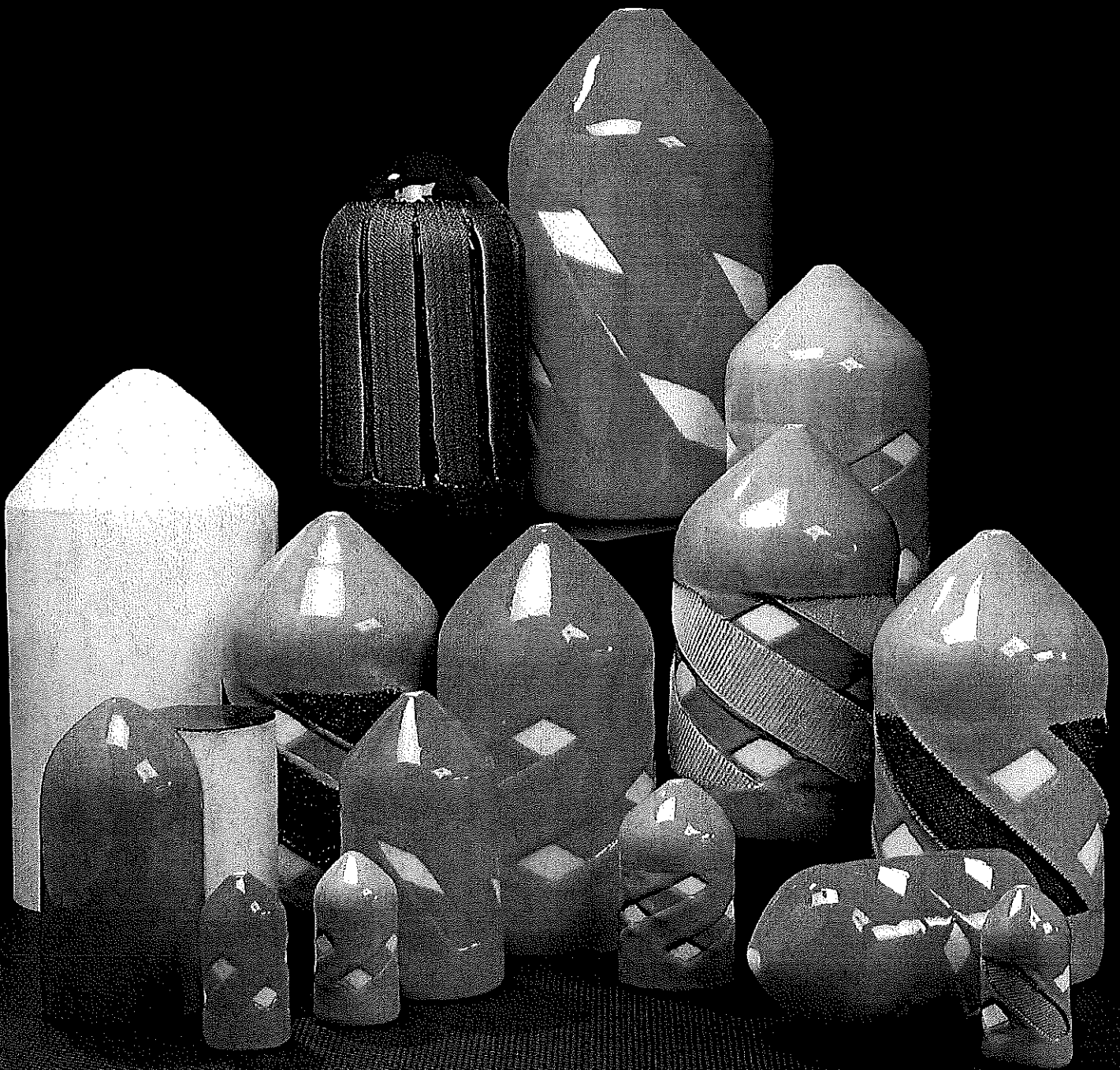
•Contractor shall submit evidence of qualifications to include a list of ten (10) projects of equal or greater scope. Project list shall state the following: dates, feet of pipe, project cost, location, contact person, telephone number. Qualification submittal shall include three (3) letters on client letterhead from stated contact person from the above list of ten (10) projects. All projects must have been completed within the last three years. All contractors must submit valid certification of training issued by an established pig manufacturer:



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Pipeline Pigging Products

INCORPORATED



PIPELINE PIGGING PRODUCTS INDUSTRY

EXPERIENCE, RESEARCH, KNOW HOW



Pipeline Pigging Products is a manufacturer of internal pipeline cleaners referred to in the trade as "Poly Pigs."

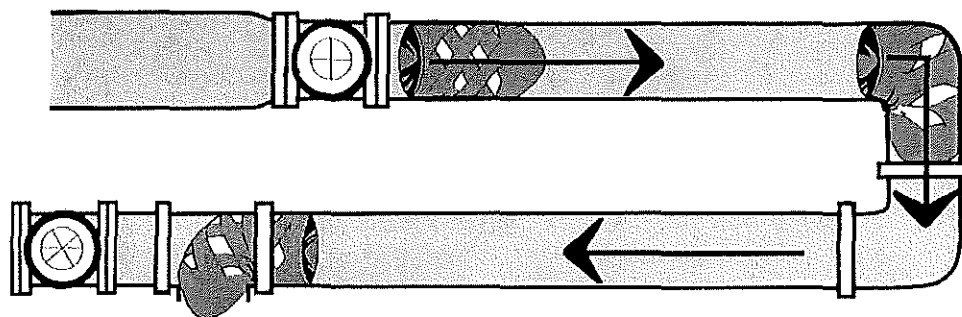
Constructed of flexible open cell polyurethane foam and various external wrappings, Poly Pigs have the ability to negotiate short radius bends, ells, tees, multi-dimensional piping and reduced port valves. The slightly oversized Poly Pig forms a "sliding seal" in the pipe, and is designed to remove product buildup, foreign matter and loose sediment.

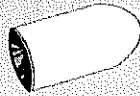
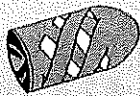
A few of the benefits that Poly Pigs can offer are:

- Increased pipeline carrying capacity
- Improved product quality
- Power savings by reducing pump pressure
- Confirmation of pipe and flow integrity

Pipeline Pigging Products offers Poly Pigs in a wide variety of styles (drying, wiping and scraping) to accommodate almost any application, such as oil & gas transmission, municipal, petro chemical, pulp and paper and process piping systems.

With over 60 years of combined experience in manufacturing, research and application, our knowledge of Poly Pigs is unsurpassed in the industry.

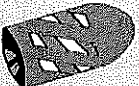


MUNICIPAL SERIES				
APPEARANCE	STYLE	TYPE	DENSITY	APPLICATIONS
	B1	Swab	$\frac{1-2 \text{ lbs. cubic foot}}{(16 - 32 \text{ Kg/M}^3)}$	Proving; Sweeping; Sealing
	B2*	Coated Swab	$\frac{1-2 \text{ lbs. cubic foot}}{(16 - 32 \text{ Kg/M}^3)}$	Light Wiping
	B3	Bare	$\frac{5-7 \text{ lbs. cubic foot}}{(80 - 112 \text{ Kg/M}^3)}$	Light Cleaning
	B4*	Coated	$\frac{5-7 \text{ lbs. cubic foot}}{(80 - 112 \text{ Kg/M}^3)}$	Cleaning
	B5*	Wire	$\frac{5-7 \text{ lbs. cubic foot}}{(80 - 112 \text{ Kg/M}^3)}$	Scraping

*Available with Rotating Pattern (see back page)

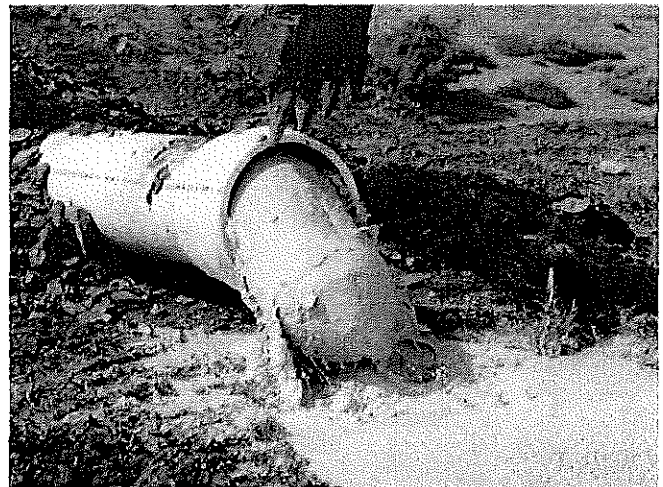
INDUSTRIAL SERIES				
APPEARANCE	STYLE	TYPE	DENSITY	APPLICATIONS
	C3	Bare	$\frac{8-10 \text{ lbs. cubic foot}}{(128 - 160 \text{ Kg/M}^3)}$	Heavy Duty Drying
	C4*	Coated	$\frac{8-10 \text{ lbs. cubic foot}}{(128 - 160 \text{ Kg/M}^3)}$	Heavy Duty Wiping
	C5*	Wire	$\frac{8-10 \text{ lbs. cubic foot}}{(128 - 160 \text{ Kg/M}^3)}$	Heavy Duty Scraping
	C6*	Carbide (Strap)	$\frac{8-10 \text{ lbs. cubic foot}}{(128 - 160 \text{ Kg/M}^3)}$	Heavy Duty Scraping
	RX3	Bare	$\frac{5-7 \text{ lbs. cubic foot}}{(80 - 112 \text{ Kg/M}^3)}$	Regular Duty Drying
	RX4*	Coated	$\frac{5-7 \text{ lbs. cubic foot}}{(80 - 112 \text{ Kg/M}^3)}$	Regular Duty Wiping
	RX5*	Wire	$\frac{5-7 \text{ lbs. cubic foot}}{(80 - 112 \text{ Kg/M}^3)}$	Regular Duty Scraping
	RX6*	Carbide (Grain)	$\frac{5-7 \text{ lbs. cubic foot}}{(80 - 112 \text{ Kg/M}^3)}$	Regular Duty Scraping
	G1	Swab	$\frac{1-2 \text{ lbs. cubic foot}}{(16 - 32 \text{ Kg/M}^3)}$	Light Duty Drying
	G2*	Coated Swab	$\frac{1-2 \text{ lbs. cubic foot}}{(16 - 32 \text{ Kg/M}^3)}$	Light Duty Wiping
	G6*	Carbide (Grain)	$\frac{1-2 \text{ lbs. cubic foot}}{(16 - 32 \text{ Kg/M}^3)}$	Light Duty Scraping
SPECIAL APPLICATION SERIES				
	PB	Power Brush™	$\frac{8-10 \text{ lbs. cubic foot}}{(128 - 160 \text{ Kg/M}^3)}$	Maximum Scraping
	CPB	Plastic Brush	$\frac{8-10 \text{ lbs. cubic foot}}{(128 - 160 \text{ Kg/M}^3)}$	Light Wiping
	RXSS	Single Spiral	$\frac{5-7 \text{ lbs. cubic foot}}{(80 - 112 \text{ Kg/M}^3)}$	Economical Wiping

*Available with Rotating Pattern (see back page)

	Rotating Pattern	— Promotes longer even wear in most applications Available on all coated and wire styles
	Rope Loop(s) Cable Loop(s)	— For handling; pulling Available on all styles
	Double Dish	— Liquid removal; bi-directional runs Available on all styles
	Double Nose	— Bi-directional runs with pipe reductions Available on all styles
	Cavity	— For housing electronic tracking transmitter Available on all styles
	Stud Pig	— Extra hard scale removal



1. Poly Pig exits potable water piping system after traveling 1,300'.



2. A 12" Poly Pig exits piping system after traveling several miles.

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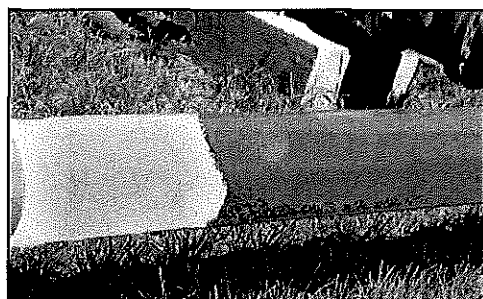
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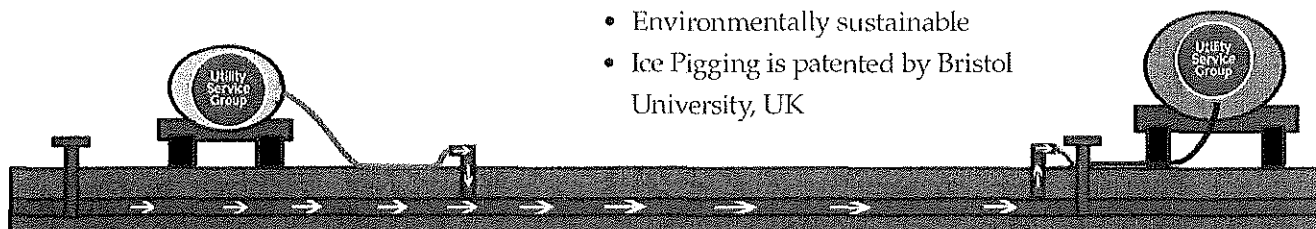


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VALUE OF UTILITY SERVICE GROUP ICE PIGGING PROGRAM:

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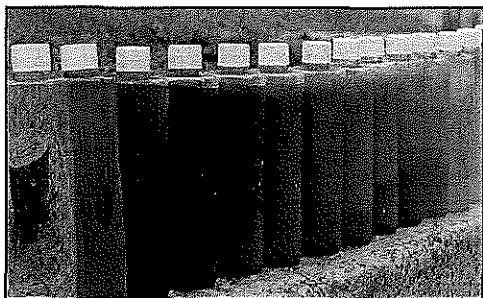
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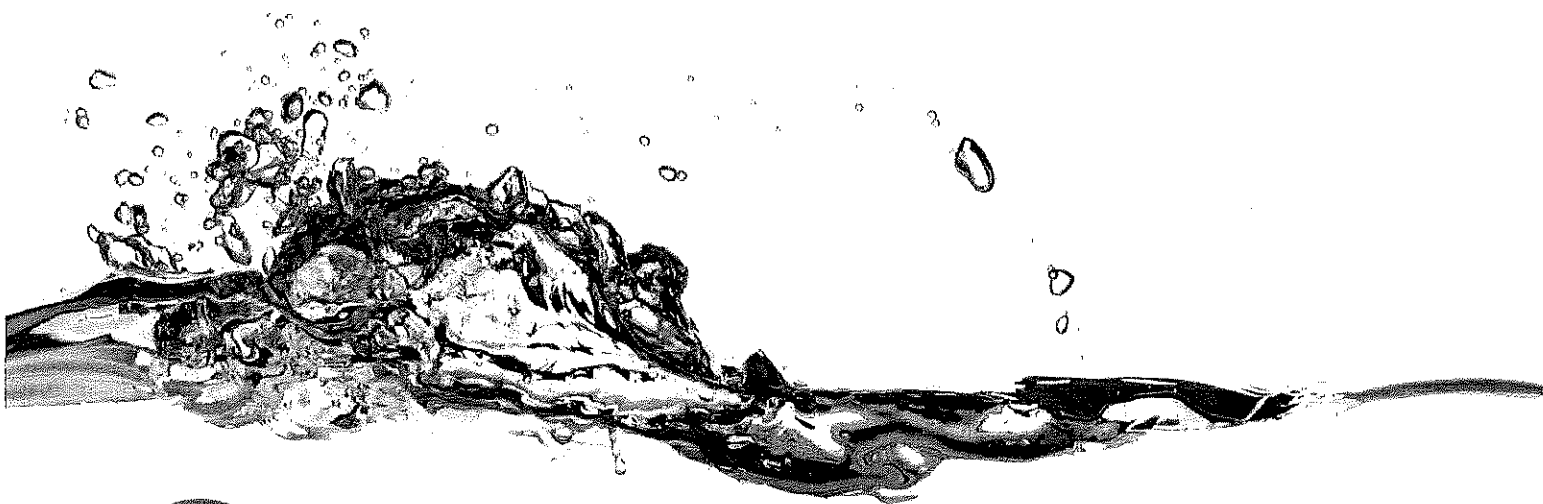
UTILITY SERVICE GROUP ICE PIGGING PROGRAM INCLUDES:

- Combines operational advantages of flushing with cleaning impact of soft pigging
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by Gary Armentrout

Flushing and pigging: basic waterline maintenance

The daily operation of a public water system involves different aspects of many separate business and technical disciplines. In the course of a normal workday, operators will take a minimum of one to as many as 10 or 12 water samples. They may look for a water leak somewhere in the distribution system and will talk to three, four or more system customers about a variety of subjects. Operators may change out or add a customer water meter, repair a water leak, discuss purchases with sales reps and recheck meter readings on customer meters because "they just couldn't have used that much water." They might also have discussions with the project

engineer about an upcoming project, and still make time to do some maintenance to the distribution system and equipment.

Speaking of maintenance, there are many different types of equipment maintenance. They go by the

more mundane maintenance monikers of "Before Operations Maintenance Checks," or "During Operations Maintenance Checks" and the not to be left out, "After Operations Maintenance Checks." There is also the entirely separate category of "Preventive Maintenance Checks."

"Maintenance Shmaintenance," it all means the same thing!

Maintenance has to be performed on trucks, cars, meters, pumps, hand tools, power tools. It must also be performed on computers, buildings, wells, towers, clear wells, clarifiers and just about every component in

pipelines are buried in the cool, dark, damp underground. It is the wish and hope of everyone involved that they stay there, causing no problems – in total silence.

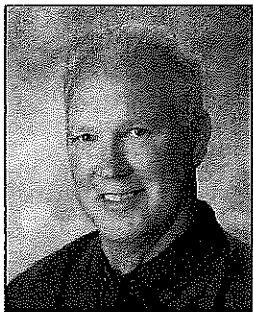
.....
Unwanted buildup on the inside of most water distribution systems has been going on since the day the first valve was turned, and water started to flow through the system.

the entire system that has zero or more moving parts. Operators need to take care of system equipment if it is to provide long and reliable service.

In this article, the focus is on the part of the system that is nearly invisible and out of sight. It is the distribution system. These

Unwanted buildup on the inside of most water distribution systems has been going on since the day the first valve was turned, and water started to flow through the system. How does a system avoid this buildup or deal with it?

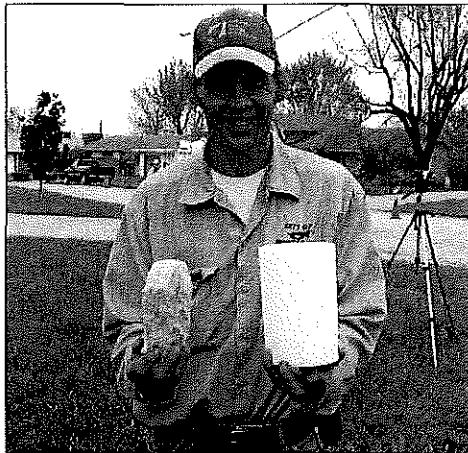
There are many things that can be done to correct this problem.



Gary Armentrout
Technical Assistant



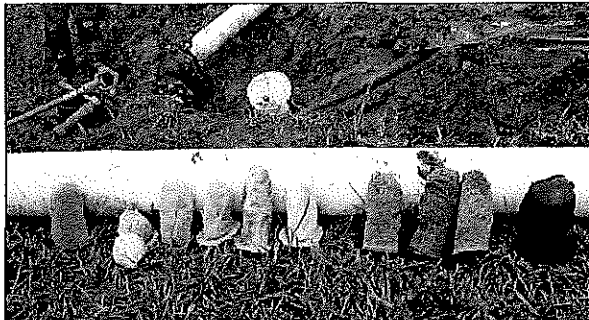
A Fort Scott, Kan. city crew inserts a soft pig into a 4-inch ductile iron line.



Some actions include changing the pH of the water, adding certain types of chemicals, and cleaning the inside of the pipe.

Flushing, as a prevention

The purpose of flushing of a water system is to remove any accumulated sediments or other impurities that have been deposited in the pipe. Flushing can also improve the flow of water, in effect, restoring the pipeline to its original capacity. Flushing is performed by



Left: The before and after look of a soft pig in the hands of Fort Scott Water Distribution Supervisor Bill Lemke.

Above: Pigs in a row, 10 of 12 pigs used in a water line maintenance operation. The missing two pigs came out in pieces less than a quarter dollar in size.

isolating sections of the distribution system and then opening flush or fire hydrants to allow a large volume of water to move through the isolated pipeline and scour out any sediment.

Pigging, as a remedy

Water mains may also be mechanically cleaned with the use of swabs or pigs, as well as a variety of other means. KRWA has published numerous articles on

the topic of pigging, describing the benefits of the projects from improved water quality to greater energy efficiency,

Pigs are devices that are forced through a section of line to scrape the accumulated

deposits off the inside of the pipe. Pigging is now routinely conducted at the time of installing new waterlines. While some might contend that a requirement to pig a pipeline adds to the cost, I respectfully suggest that if project circumstance were to prohibit a contractor from pigging, the cost should increase. It's been proven that pigging newly installed pipelines reduces water loss due

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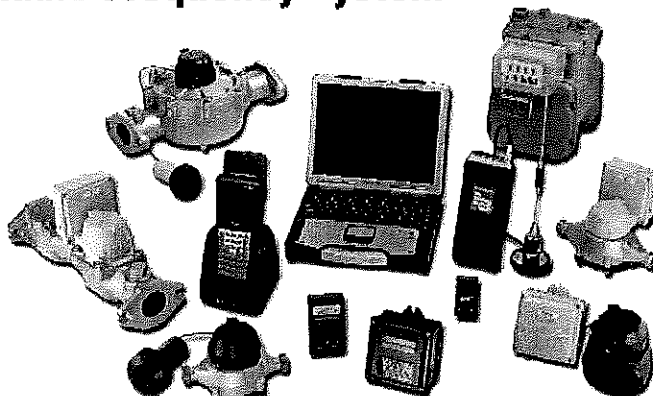
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Flushing and pigging . . .



The concentration of buildup is evident coming from the inside of a ductile iron main. After years of operation and depending on water quality, excessive mineral deposits often build up inside waterlines. Pigging can often remove the deposits, improving water quality and flow characteristics.

When there is a buildup inside water lines that cannot be removed by simple flushing, pigging is a cost efficient, effective and environmentally friendly alternate. Most important, it is an economical alternate to

to flushing by 75%, to say nothing for the reduction of labor to complete the process of getting a new extension or pipeline into service.

line replacement. No matter what type of pipe is in the distribution system, there is a pig to do the job as needed. There are four basic types of pigs used today. Each pig

is designed for a specific job.

They are the polyurethane foam pigs, mandrel or mechanical pigs, solid cast urethane pigs and the high tech "smart pigs." If a system's water lines are cast iron or ductile iron, there is a very good chance of needing to pig at least some sections. The deposits in the pipelines can cause enough restriction that flow will be reduced. PVC lines normally are not subjected to the same degree of buildup as cast iron or ductile iron pipelines. PVC however will often have sediment at the bottom of the pipeline along with a thin coating covering the entire inside. A foam pig can normally remove this type of buildup. This type of pig can also be reused after traversing segments of PVC pipe. If, on the other hand the pig is used in a cast or ductile iron pipe, it is usually torn to shreds as it moves through the line. It is KRWA's experience that pigging small diameter iron pipelines may not be practical if there is a high degree of buildup. It may be impossible to remove hardened deposits from small diameter lines of one to four inches. KRWA techs have experienced pigging projects where a city system had some 4-inch pipeline with so much buildup that no daylight could be seen through even a 20-foot section.

Pipe maintenance is a very important part of the overall maintenance program of any water system. I suggest that systems practice flushing as a preventive measure and pigging as a remedy. If assistance is needed in setting up a maintenance program for a city or RWD, or there is a need to discuss flushing or pigging, contact KRWA at 785/336-3760 or e-mail KRWA at krwa@krwa.net.



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Environmental Technology Verification Protocol

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Prepared by



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Under a Cooperative Agreement with
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PROTOCOL FOR EQUIPMENT VERIFICATION TESTING
FOR INACTIVATION OF MICROBIOLOGICAL CONTAMINANTS**

Prepared by:
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Recommended by
the Steering Committee for the Verification of
Package Drinking Water Treatment Systems/Plants
on August 9, 1999
Modified in January 2003

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Throughout its history, the U.S. Environmental Protection Agency (EPA) has evaluated technologies to determine their effectiveness in preventing, controlling, and cleaning up pollution. EPA is now expanding these efforts by instituting a new program, the Environmental Technology Verification Program---or ETV---to verify the performance of a larger universe of innovative technical solutions to problems that threaten human health or the environment. ETV was created to substantially accelerate the entrance of new environmental technologies into the domestic and international marketplace. It supplies technology buyers and developers, consulting engineers, states, and U.S. EPA regions with high quality data on the performance of new technologies. This encourages more rapid availability of approaches to better protect the environment.

ETV Drinking Water Systems Center:

Concern about drinking water safety has accelerated in recent years due to much publicized outbreaks of waterborne disease and information linking ingestion of arsenic to cancer incidence. The U.S. EPA is authorized through the Safe Drinking Water Act to set numerical contaminant standards and treatment and monitoring requirements that will ensure the safety of public water supplies. However, small communities are often poorly equipped to comply with all of the requirements; less costly package treatment technologies may offer a solution. These package plants can be designed to deal with specific problems of a particular community; additionally, they may be installed on site more efficiently---requiring less start-up capital and time than traditionally constructed water treatment plants. The opportunity for the sales of such systems in other countries is also substantial.

The EPA has partnered with NSF, a nonprofit testing and certification organization, to verify performance of small drinking water systems that serve small communities. It is expected that

both the domestic and international markets for such systems are substantial. EPA and NSF have formed an oversight stakeholders group composed of buyers, sellers, and states (issuers of permits), to assist in formulating consensus testing protocols. A goal of verification testing is to enhance and facilitate the acceptance of small drinking water treatment equipment by state drinking water regulatory officials and consulting engineers while reducing the need for testing of equipment at each location where the equipment use is contemplated. NSF will meet this goal by working with equipment manufacturers and other agencies in planning and conducting equipment verification testing, evaluating data generated by such testing, and managing and disseminating information. The manufacturer is expected to secure the appropriate resources to support their part of the equipment verification process, including provision of equipment and technical support.

The verification process established by the EPA and NSF is intended to serve as a template for conducting water treatment verification tests that will generate high quality data for verification of equipment performance. The verification process is a model process that can help in moving small drinking water equipment into routine use more quickly. The verification of an equipment's performance involves five sequential steps:

1. Development of a verification/Product-Specific Test Plan;
2. Execution of verification testing;
3. Data reduction, analysis, and reporting;
4. Performance and cost (labor, chemicals, energy) verification;
5. Report preparation and information transfer.

This verification testing program is being conducted by NSF International with participation of manufacturers, under the sponsorship of the EPA Office of Research and Development (ORD), National Risk Management Research Laboratory, Water Supply and Water Resources Division (WSWRD) - Cincinnati, Ohio. NSF's role is to provide technical and administrative leadership and support in conducting the testing. It is important to note that verification of the equipment does not mean that the equipment is "certified" by NSF or EPA. Rather, it recognizes that the performance of the equipment has been determined and verified by these organizations.

Partnerships

The U.S. EPA and NSF cooperatively organized and developed the ETV Drinking Water Systems Center to meet community and commercial needs. NSF and the Association of State Drinking Water Administrators have an understanding to assist each other in promoting and communicating the benefits and results of the project.

ORGANIZATION AND INTENDED USE OF PROTOCOL AND TEST PLANS

NSF encourages the user of this protocol to also read and understand the policies related to the verification and testing of package drinking water treatment systems and equipment.

The first Chapter of this document describes the Protocol required in all studies verifying the performance of equipment or systems inactivating microbiological contaminants, the public health goal of the Protocol. The remaining chapters describe the additional requirements for equipment and systems using specific technologies to attain the goals and objectives of the Protocol: the inactivation of microbiological contaminants.

Prior to the verification testing of a package drinking water treatment systems, plants and/or equipment, the equipment manufacturer and/or supplier must select an NSF-qualified Field Testing Organization (FTO). This designated FTO must write a "Product-Specific Test Plan". The equipment manufacturer and/or supplier will need this protocol and the test plans herein and other ETV Protocols and Test Plans to develop the Product-Specific Test Plan depending on the treatment technologies used in the unit processes or treatment train of the equipment or system. More than one protocol and/or test plan may be necessary to address the equipment's capabilities in the treatment of drinking water.

Testing shall be conducted by an NSF-qualified FTO that is selected by the Manufacturer. Water quality analytical work to be completed as a part of an ETV Testing Plan shall be contracted with a laboratory that is certified, accredited or approved by a State, a third-party organization (i.e., NSF), or the U.S. EPA. For information on a listing of NSF-qualified FTOs and State, third-party organization (i.e., NSF), or the U.S. EPA- accredited laboratories, contact NSF.

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The U.S. EPA and NSF would like to acknowledge those persons who participated in the preparation, review and approval of this Protocol. Without their hard work and dedication to the project, this document would not have been approved through the process which has been set forth for this ETV project.

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CHAPTER 1
EPA/NSF ETV
PROTOCOL FOR EQUIPMENT VERIFICATION TESTING FOR
INACTIVATION OF MICROBIOLOGICAL CONTAMINANTS
REQUIREMENTS FOR ALL STUDIES

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1.0 INTRODUCTION

This document is the protocol to be used for verification testing of equipment designed to achieve inactivation of microbiological contaminants. The equipment Field Testing Organization (FTO) must adhere to the requirements of this protocol in developing a Product-Specific Test Plan (PSTP). The final submission of the PSTP shall:

- include the information requested in this protocol;
- conform to the format identified herein; and
- conform to the specific NSF International (NSF) Equipment Verification Testing Plan or Plans related to the statement or statements of objectives that are to be verified.

The testing of new technologies and materials that are unfamiliar to the NSF/EPA will not be discouraged. It is recommended that resins or membranes or any other material or chemical in the equipment conform to NSF International/American National Standards Institute (NSF/ANSI) Standard 60 and 61.

The PSTP may conform to the requirements of more than one Testing Plan. For example, testing might be undertaken to verify performance of a system employing oxidants or mixed disinfection processes, ultraviolet (UV) radiation (thermal or light irradiation), or other processes for inactivation of microbiological contaminants.

This protocol document is presented in two fonts. The non-italicized font provides the rationale for the requirements and background information that the Field Testing Organization may find useful in preparation of the PSTP. *The italicized text indicates specific study protocol deliverables that are required of the Field Testing Organization and that must be incorporated in the PSTP.*

The following glossary terms are presented here for subsequent reference in this protocol:

- Distribution System - a system of conduits by which a potable water supply is conveyed to consumers, typically by a network of pipelines.
- EPA - The United States Environmental Protection Agency, its staff or authorized representatives.
- Equipment - Testing equipment for use in the Verification Testing Program may be defined as either a package plant or modular system.
- Field Testing Organization (FTO) - An organization qualified to conduct studies and testing of package plants or modular systems in accordance with protocols and test plans. The role of the Field Testing Organization is to complete the application on behalf of the company; to enter into contracts with NSF, as discussed herein, arrange for or conduct the skilled operation of a package plant or modular system during the intense period of testing during the study and the tasks required by the protocol.
- Manufacturer - a business that assembles and/or sells package plant equipment and/or modular systems. The role of the Manufacturer is to provide the package plant and/or modular system and technical support during the Verification Testing Program. The

Manufacturer is also responsible for providing assistance to the third party testing organization during operation and monitoring of the package plant or modular system in the Verification Testing Program.

- Modular System - A functional assembly of components for use in a drinking water treatment system or packaged and/or modular plant, each part of which provides a limited form of treatment of the feedwater(s) and which is discharged to another packaged and/or modular plant module or the final step of treatment.
- NSF - NSF International, its staff, or other authorized representatives.
- Plant Operator - the person working for a small water system who is responsible for operating water treatment equipment to produce treated drinking water. This person may also collect samples, record data and attend to the daily operations of equipment throughout the testing periods.
- Package plant - a complete water treatment system including all components from connection to the feedwater(s) through discharge to the distribution system.
- Product-Specific Test Plan (PSTP) - A written document of procedures for on-site/in-line testing, sample collection, preservation, and shipment and other on-site activities described in the EPA/NSF ETV Protocol(s) and Test Plan(s) that apply to a specific make and model of a package plant/modular system.
- Protocol - A written document that clearly states the objectives, goals, and scope of the study as well as the test plan(s) for the conduct of the study. Protocol will be used for reference during Manufacturer participation in Verification Testing Program.
- Report - A written document that includes data, test results, findings, and any pertinent information collected in accordance with a protocol, analytical methods, procedures, etc., in the assessment of a product whether such information is preliminary, draft or final form.
- Testing Plan - A written document that describes the procedures for conducting a test or study for the application of water treatment technology. At a minimum, the test plan will include detailed instructions for sample and data collection, sample handling and sample preservation, precision, accuracy, and reproducibility goals, and quality assurance and quality control requirements.
- Testing Laboratory - An organization certified by a third-party independent organization, federal agency, or a pertinent state regulatory authority to perform the testing of drinking water samples. The role of the testing laboratory in the verification testing of equipment is to analyze the water samples in accordance with the methods and meet the pertinent quality assurance and quality control requirements described in the protocol, test plan and PSTP.
- Verification - to establish the evidence on the range of performance of equipment and/or devices under specific conditions following a predetermined study protocol.

- Verification Statement - A written document that summarizes a final report reviewed and approved by NSF on behalf of the EPA or directly by the EPA.
- Water System - the water system that operates using water treatment equipment to provide potable water to its customers.

1.1 Objectives

The scope of this protocol is designed to address drinking water systems that use innovative technologies to achieve inactivation of microbiological contaminants. The specific objectives of the verification testing may be different for each system, depending upon the statement of objectives of the specific equipment to be tested. The performance objectives are used to establish data quality objectives (DQOs) in order to develop the experimental design of the verification test. The broader the performance objectives, the more comprehensive the PSTP must become to achieve the DQOs. Verification testing conducted at a single site may not represent every environmental situation which may be acceptable for the equipment tested, but it will provide data of sufficient quality to make a judgment about the application of the equipment under conditions similar to those encountered in the verification testing. The objectives developed by each Manufacturer will be defined and described in detail in the PSTP developed for each piece of equipment. The objectives of the equipment verification testing may include:

- Generation of field data appropriate for verifying the performance of the equipment;
- Evaluation of new advances in equipment and equipment design.

An important aspect in the preparation of verification testing is to describe the procedures that will be used to develop field data, and verify performance, reliability, and costs of the water treatment equipment. The PSTP shall incorporate the Quality Assurance/Quality Control (QA/QC) elements needed to provide data of appropriate quality sufficient to reach a defensible position regarding the equipment performance. A Quality Assurance Project Plan (QAPP) shall describe quality control and assurance procedures in detail and shall be provided by the Field Testing Organization as part of the PSTP.

1.2 Scope

This protocol outlines the verification process for equipment designed to achieve inactivation of microbiological contaminants. The scope of this protocol includes Testing Plans for drinking water treatment systems designed to achieve inactivation of microbiological contaminants. These contaminants include but are not limited to protozoa, bacteria and viruses. Verification of the inactivation of protozoan cyst and oocyst contaminants may be performed but methods for determining the viability of cysts and oocysts are interim and subject to change.

An overview of the verification process and the elements of the PSTP to be developed by the Field Testing Organization are described in this protocol. Specifically, the PSTP shall define the following elements of the verification testing:

- Roles and responsibilities of verification testing participants;
- Procedures governing verification testing activities such as equipment operation and process monitoring; sample collection, preservation, and analysis; and data collection and interpretation;

- Experimental design of the Field Operations Procedures;
- Quality assurance and quality control (QA/QC) procedures for conducting the verification testing and for assessing the quality of the data generated from the verification testing; and,
- Health and safety measures relating to biohazard, chemical hazard, electrical, mechanical and other safety codes.

Content of Product-Specific Test Plan:

The structure of the PSTP must conform to the outline below. The required components of the PSTP are described in greater detail in the sections following the outline. The required content of the PSTP and the responsibilities of participants are listed at the end of each section.

- *TITLE PAGE*
- *FOREWORD*
- *TABLE OF CONTENTS - The Table of Contents for the PSTP should include the headings provided in this document although they may be modified as appropriate for a particular type of equipment to be tested.*
- *EXECUTIVE SUMMARY - The Executive Summary describes the contents of the PSTP (not to exceed two pages). A general description of the equipment and the statement of performance objectives which will be verified during testing shall be included, as well as the testing locations, a schedule, and a list of participants.*
- *ABBREVIATIONS AND ACRONYMS - A list of the abbreviations and acronyms used in the PSTP should be provided.*
- *EQUIPMENT VERIFICATION TESTING RESPONSIBILITIES (described in the sections below)*
- *EQUIPMENT CAPABILITIES AND DESCRIPTION (described in the sections below)*
- *EXPERIMENTAL DESIGN (described in the sections below)*
- *FIELD OPERATIONS PROCEDURES (described in the section below)*
- *QUALITY ASSURANCE PROJECT PLAN (described in the section below)*
- *DATA MANAGEMENT AND ANALYSIS (described in the section below)*
- *HEALTH AND SAFETY PLAN (described in the section below)*

2.0 EQUIPMENT VERIFICATION TESTING RESPONSIBILITIES

2.1 Verification Testing Organization and Participants

Manufacturers and their designated Field Testing Organization shall provide a table including the name, affiliation, and mailing address of each participant, a point of contact, description of participant's role, telephone and fax numbers, and e-mail address in the PSTP.

The equipment provided by the Manufacturer shall explicitly meet all the requirements of Occupational Safety and Health Association (OSHA), National Electrical Manufacturers Association (NEMA), Underwriters Laboratory (UL), NSF and other appropriate agencies in order to ensure operator safety during Verification Testing.

2.2 Organization

The Field Testing Organization in its application on behalf of the Manufacturer shall provide the organizational structure for the verification testing showing lines of communication.

2.3 Verification Testing Site Name and Location

This section discusses background information on the verification testing site(s), with emphasis on the quality of the feedwater, which in some cases may be the source water at the site. The PSTP must provide the site names and locations at which the equipment will be tested. In some cases, the equipment will be demonstrated at more than one site. The equipment may be tested under different conditions of feedwater quality (or source water quality) and a range of seasonal climate and weather conditions.

2.4 Site Characteristics

The PSTP must include a description of the test site. This shall include a description of where the equipment will be located. If the feedwater to the equipment is the source water for an existing water treatment plant, describe the raw water intake, the opportunity to obtain raw water without the addition of any chemicals, and the operational pattern of raw water pumping at the full-scale facility (is it continuous or intermittent?). If applicable, the Field Testing Organization shall also describe in the PSTP how the water flow to the test equipment will be separated from the existing treatment facilities with such equipment as backflow preventers, air gaps, break tanks, etc.

The source water characteristics shall be described and documented. The PSTP shall also describe facilities to be used for handling the treated water and wastes (i.e., residuals) produced during the Verification Testing. Can the required water flows and waste flows produced be dealt with in an acceptable way? Are water and air pollution discharge permits needed?

2.5 Responsibilities

This section identifies the organizations involved in the testing and describes the primary responsibilities of each organization. The responsibilities of the Manufacturer will vary depending on the type of verification testing. Multiple Manufacturers testing at one time is also an option.

The Field Testing Organization shall be responsible for:

- Providing needed logistical support, establishing a communication network, and scheduling and coordinating the activities of all verification testing participants;
- Ensuring that locations selected as test sites have feedwater quality consistent with the objectives of the verification testing (Manufacturer may recommend a verification testing site(s));
- Managing, evaluating, interpreting, and reporting on data generated by the verification testing;

- Evaluating and reporting on the performance of the microbiological inactivation technologies.

The manufacturer shall be responsible for provision of the equipment to be evaluated.

Content of PSTP Regarding Equipment Verification Testing Responsibilities:

The Field Testing Organization, shall be responsible for including the following elements in the PSTP:

- *Definition of the roles and responsibilities of appropriate verification testing participants;*
- *A table which includes the name, affiliation, and mailing address of each participant, a point of contact, description of participant's role, telephone and fax numbers, and e-mail address;*
- *Organization of operational and analytical support;*
- *List of the site name(s) and location(s);*
- *Description of the test site(s), the site characteristics and identification of where the equipment will be located.*

Manufacturer Responsibilities:

- *Provision of complete, field-ready equipment for verification testing;*
- *Provision of logistical, and technical support, as required;*
- *Provision of technical assistance to the qualified testing organization during operation and monitoring of the equipment undergoing verification testing.*

3.0 EQUIPMENT CAPABILITIES AND DESCRIPTION

3.1 Equipment Capabilities

The Manufacturer and their designated Field Testing Organization shall identify the water quality objectives to be achieved in the statement of performance objectives of the equipment to be evaluated in the verification testing. The statement of performance objectives shall be clearly stated in the PSTP. The statement of performance objectives must be specific and verifiable by a statistical analysis of the data. An example of a satisfactory statement of performance objectives would be:

*"This system is capable of achieving inactivation of 99.9% (3-log removal) of *Giardia muris* protozoa in feedwaters with total organic carbon concentrations less than 5.0 mg/L and turbidities less than 1 NTU (Nephelometric turbidity units)."*

A statement of performance objectives such as: "This system will achieve inactivation of microbiological contaminants in accordance with the requirement of the Surface Water Treatment Rule on a consistent and dependable basis," would not be acceptable.

The Manufacturer shall be responsible for identification of which microbiological contaminants shall be monitored for inactivation under the statement of performance objectives. The statement

of performance objectives prepared by the Field Testing Organization in collaboration with the Manufacturer shall also indicate the range of water quality under which the equipment can be challenged while successfully treating the feedwater. Statements of performance objectives that are too easily met may not be of interest to the potential user, while performance objectives that are overstated may not be achievable. The statement of performance objectives forms the basis of the entire equipment verification testing and must be chosen appropriately. Therefore, the design of the PSTP should include a sufficient range of feedwater quality to permit verification of the statement of performance objectives.

Statements should also be made in the PSTP regarding the applications of the equipment, the known limitations of the equipment and what advantages it provides over existing equipment.

3.2 Equipment Description

Description of the equipment for verification testing shall be included in the PSTP. Data plates shall be permanent and securely attached to each production unit. The data plate shall be easy to read in English or the language of the intended user, located on the equipment where it is readily accessible, and contain at least the following information:

- a. Equipment Name
- b. Model #
- c. Manufacturer's name and address
- d. Electrical requirements - volts, amps, and Hertz
- e. Serial Number
- f. Warning and Caution statements in legible and easily discernible print size
- g. Capacity or output rate (if applicable)

In addition, the equipment provided by the Manufacturer shall be provided with all OSHA required safety devices (e.g., safety shields or shrouds, emergency shut-off switches, etc.).

Content of PSTP Regarding Equipment Capabilities and Description:

The PSTP shall include the following documents:

- *Description of the equipment to be demonstrated including photographs from relevant angle or perspective;*
- *Brief introduction and discussion of the engineering and scientific concepts on which the microbiological inactivation capabilities of the water treatment equipment are based;*
- *Description of the equipment and each process included as a component in the modular system including all relevant schematics;*
- *Brief description of the physical construction/components of the equipment, including the general environmental requirements and limitations, required consumables, weight, transportability, ruggedness, power and other needed, etc.;*
- *Statement of typical rates of consumption of chemicals, a description of the physical and chemical nature of wastes, and rate of waste generation (concentrates, residues, etc.);*
- *Definition of the performance range of the equipment;*
- *Identification of any special licensing requirements associated with the operation of the equipment;*
- *Description of the applications of the equipment and the inactivation capabilities of the treatment system relative to existing equipment. Comparisons shall be provided in such*

areas as: treatment capabilities, requirements for chemicals and materials, power, labor requirements, suitability for process monitoring and operation from remote locations, ability to be managed by part-time operators;

- *Discussion of the known limitations of the equipment. The following operational details shall be included: the range of feedwater quality suitable for treatment with the equipment, the upper limits for concentrations of microorganisms that can be inactivated to concentrations below the manufacturer-specified level, level of operator skill required to successfully use the equipment.*

Manufacturer Responsibilities:

- *Provision of complete, field-ready equipment with the following information explicitly provided: Equipment Name, Model #, Manufacturer's name and address, Electrical requirements (e.g., volts, amps, and Hertz), Serial Number, Warning and Caution statements in legible and easily discernible print size, Capacity or output rate (if applicable)*
- *Provision of equipment complete with all OSHA required safety devices (e.g., safety shields or shrouds, emergency shut-off switches, etc.) verification testing.*

4.0 EXPERIMENTAL DESIGN

This section discusses the objectives of the verification testing, factors that must be considered to meet the performance objectives, and the statistical analysis and other means that NSF will use to evaluate the results of the verification testing.

4.1 Objectives

The objectives of verification testing are to evaluate equipment in the following areas: 1) performance relative to the manufacturer's stated range of equipment objectives; 2) the impacts of variations in feedwater quality (such as turbidity, particle concentration, background microbial concentration, temperature, pH, alkalinity, iron, manganese and/or other appropriate inorganics, etc.) on equipment performance; 3) the logistical, human, and economic resources necessary to operate the equipment; and 4) the reliability, ruggedness, cost, range of usefulness, and ease of operation.

A PSTP shall include those treatment tests (seeding studies) listed in ETV test plans that are most appropriate. For example, if equipment is only intended for inactivation of viruses, there would be no need to conduct testing to evaluate the inactivation of *Giardia* and *Cryptosporidium*.

The Field Testing Organization must prepare a statistical design of experiments which identifies independent and dependent variables, numbers of experimental runs to be performed, QA/QC of the data, and statistical techniques that will be used to analyze the data and draw meaningful conclusions. This design will be evaluated by NSF staff to insure that it can adequately address the statement of performance objectives stated in the PSTP.

4.2 Equipment Characteristics

This section discusses factors that will be considered in the design and implementation of the equipment verification testing. These factors include ease of operation, degree of operator attention required, response of equipment and treatment process to changes in feedwater quality, electrical requirements, system reliability features including redundancy of components, feed flow requirements, discharge requirements, spatial requirements for the equipment (footprint), unit processes included in treatment train, chemical consumption requirements, and the response of the treatment process and equipment to intermittent operation.

Verification testing procedures must simulate routine conditions. This can be achieved by field testing or by laboratory testing under conditions that simulate field operations as closely as possible.

4.2.1 Qualitative Factors

Some factors, while important, are difficult or impossible to quantify. These are considered qualitative factors. Important factors that cannot easily be quantified are the portability of equipment, the modular nature of the equipment, the safety of the equipment and the logistical requirements necessary for using it.

Typical qualitative factors to be discussed are listed below, and others may be added. The PSTP shall discuss those factors that are appropriate to the test equipment.

- Reliability or susceptibility to environmental conditions
- Equipment safety
- Effect of operator experience on results.

4.2.2 Quantitative Factors

Many factors of the equipment characteristics can be quantified by various means in this Verification Testing Program. Some can be measured while others cannot be controlled. Typical quantitative factors to be discussed are listed below, and others may be added. The PSTP shall discuss those factors that are appropriate to the test equipment.

- Power and consumable supply (such as chemical and materials) requirements
- Cost of operation, expendables, and waste disposal
- Hydrodynamics of equipment
- Length of operating cycle
- Estimated labor hours (and labor classification) for operation and maintenance.

These quantitative factors will be used as an initial benchmark to assess equipment performance.

4.2.3 Evaluation of Reactor Hydrodynamics

Characterization of the reactor hydrodynamics within each system is essential to define the contact time of feedwaters with chemical or physical mechanisms for microbiological inactivation. This characterization shall be accomplished through tracer tests conducted on each component of the inactivation equipment under the flow, temperature, and water quality conditions that shall be employed during microbiological inactivation experiments.

The Manufacturer shall propose a tracer test methodology in the PSTP that shall be used to demonstrate the flow conditions through the microbiological contaminant inactivation equipment. It is recommended that the tracer testing be conducted using a pulse-feed (slug-dose) method, with a known volume of an appropriate tracer material. The goal of tracer testing is to provide a profile of the tracer concentration as a function of time through the reactor. For appropriate tracer test methods, the Manufacturer is referred to the American Water Works Association Research Foundation (AWWARF) study "Experimental Methodologies for the Determination of Disinfection Effectiveness" (Haas et al., 1993) and to Appendix C of the Guidance Manual (GM) for Compliance with the Filtration and Disinfection Requirements of the Surface Water Treatment Rule for Public Water Systems using Surface Water Sources (USEPA, 1989). The latter Appendix document provides a discussion of alternative tracer test methods and indicates the frequency at which samples shall be taken to adequately define the residence time distribution.

The duration of each tracer test shall be based on the expected hydraulic conditions within the reactor. It is difficult to precisely determine the tracer testing duration for a particular reactor *a priori*, because the hydrodynamic characteristics of a particular reactor are not known until tracer testing is conducted. Therefore, tracer studies conducted in this Verification Testing Program shall be performed to include sampling over a minimum time period of three Hydraulic Detention Times (HDTs). Details of each tracer study shall be addressed in individual equipment Testing Plans.

4.3 Water Quality Considerations

The primary treatment goal of the equipment employed in this Verification Testing Program is to achieve inactivation of microbiological contaminants found in feedwaters (or raw waters) such that product waters are of acceptable microbiological quality. The experimental design in the PSTPs shall be developed so the relevant questions about water treatment equipment capabilities can be answered.

Manufacturers should carefully consider the capabilities and limitations of their equipment and assist the Field Testing Organization in preparing PSTPs that sufficiently challenge their equipment. The Manufacturer should adopt an experimental approach to verification testing that would provide a broad market for their products, while recognizing the limitations of the equipment, and not conducting microbiological inactivation testing that would be beyond the capabilities of the equipment. A wide range of contaminants or water quality problems that can be addressed by water treatment equipment varies, and some treatment equipment can address a broader range of problems than other types. Manufacturers shall use ETV Testing Plans as the basis for the specific PSTPs.

4.3.1 Feedwater Quality

One of the key aspects related to demonstration of equipment performance in verification testing is the range of feedwater quality that can be treated successfully. The Manufacturer and Field Testing Organization should consider the influence of feedwater quality on the quality of treated waters produced by the equipment, such that product waters meet the microbiological water quality goals or regulatory requirements. As the range of feedwater quality that can be treated by the equipment becomes broader, the potential applications for treatment equipment with verified performance objectives may also increase.

The specific water quality parameters to be monitored in the Verification Testing Program shall be specified by the Field Testing Organization in the PSTP. The following feedwater quality constituents may be important for treatment equipment intended to inactivate microbiological contaminants:

- density (concentration) of microorganisms (bacteria, viruses and protozoa)
- turbidity, particles
- dissolved organic carbon (DOC), total organic carbon (TOC), or UV-254 absorbance
- biological dissolved organic carbon (BDOC) or assimilable organic carbon (AOC)
- temperature, with temperatures near freezing having potential for the most difficult treatment conditions
- pH and alkalinity
- total Kjeldahl nitrogen (TKN), ammonia nitrogen
- total dissolved solids (TDS), and other individual inorganic parameters
- presence of background microbial populations including algae and other organisms
- iron, manganese, and hardness

4.3.2 Treated Water Quality

Production of treated water of a high quality in terms of microbiological constituents shall be the primary goal of the water treatment systems included in this Equipment Verification Program. The statement of performance objectives provided by the Field Testing Organization shall be related to the inactivation of viruses and bacteria.

In addition, the Field Testing Organization may wish to make a statement about performance objectives of the equipment for removal or inactivation of other contaminants. Other water quality parameters that are useful for assessing equipment performance may be considered in the Field Testing Organization's statement of objectives. These may include:

- particle count or concentration
- total and fecal coliform bacteria
- heterotrophic plate count bacteria (HPC)
- concentrations of disinfectant by-products (i.e., trihalomethanes (THMs) haloacetic acids (HAAs), aldehydes)

- BDOC or AOC
- *Giardia* and *Cryptosporidium* inactivation

Furthermore, some water treatment equipment can be used to meet aesthetic goals. Water quality considerations that may be important for some small systems include:

- color, taste and odor
- total dissolved solids
- iron and manganese
- corrosivity

4.3.3 Analysis of Disinfectant Residuals

In the case that chemical disinfectants are employed in the microbiological contaminant inactivation equipment, measurement of chemical disinfectant residuals shall be performed on the treated waters where appropriate. Methods for water sampling and the analysis of disinfectant residuals (as well as disinfectant by-products) shall be included in the PSTP. At a minimum, measurement of chemical disinfectant residuals shall be performed at times corresponding to the initial, midpoint, and final times for each microbiological inactivation experiment, with testing at additional intermediate times as deemed necessary. Where appropriate, techniques included in *Standard Methods for the Examination of Water and Wastewater* shall be employed for measurement of disinfectant residuals. Analysis of Disinfection By-Products for this Verification Testing Program shall be conducted according to the appropriate Standards Methods or EPA laboratory techniques.

4.4 Microbial Inactivation Challenge Organisms

The general types of microbiological challenge organisms for which the inactivation protocol may be demonstrated are listed below:

- bacteria or bacterial spores
- viruses
- protozoan cysts or oocysts (only interim non-standard methods available)

In the Product-Specific Test Plan, the Field Testing Organization shall indicate which microorganisms will be used as test organisms for the microbiological inactivation challenge studies. *Cryptosporidium* and *Giardia* may be obtained from: Waterborne Inc., 6047 Hurst Street, New Orleans, LA 70118-6129 or equivalent. Bacteria, viruses and phages shall be obtained from: American Type Culture Collection (ATCC), 12301 Parklawn Drive, Rockville, MD 20852 or equivalent. The following criteria are recommended for demonstrating equivalency:

- (a) use of the same isolate strain
- (b) use of the same host species
- (c) use of same processing and cleanup techniques
- (d) demonstration of comparable ID₅₀ value

Appropriate methodologies for handling and spiking of microorganisms is provided in the section below. The PSTP shall state a standard method for assessing the viability of the

microbiological species (only non-standard methods available for protozoan cysts or oocysts) employed for inactivation challenge experiments prior to initiation of the seeding studies. Requirements for determination of microbial viability are discussed further in Section 6.5 of this Protocol and the notice below. The procedures for evaluation of microbial viability shall be thoroughly described by the Field Testing Organization in the PSTP. Analysis for detection, enumeration and viability of microbiological contaminants shall be performed according to standard or EPA-approved methodologies, at a state-certified or third party- or EPA-accredited laboratory.

A peer-reviewed standard method is not available for protozoan cyst or oocyst inactivation. At present, animal infectivity is considered the gold standard and will be the only method that will be accepted for ETV testing. Use of an alternate method, such as cell culture, will be considered if sufficient data is presented to demonstrate the equivalency of this method to animal infectivity for the intended application. Guidelines for demonstrating method equivalency are available from EPA's Alternative Test Procedure (ATP) protocol.

The animal infectivity protocol used by the FTO must be described in the FOD and must meet the following minimum requirements:

- (1) The source of the oocysts and cysts must be fully documented with respect to: (a) inoculum isolate used; (b) breed, strain, age and supplier of host animal; (c) harvesting and cleanup techniques used, age of cyst/oocysts used in the disinfection experiments; (d) how the cysts/oocysts were stored and maintained prior to use. Cysts/oocysts should be no more than four weeks old at the time of the disinfection studies and the viability of the cysts/oocysts used in pilot-scale or full-scale seeding studies must be demonstrated. This demonstration must be performed by verifying that the positive control data obtained by infectivity measurements is at least 80 percent of the hemacytometer count data.
- (2) The mechanics of the assay procedure must be fully documented with respect to the breed and strain and age and supplier of the host animals receiving the inoculant, inoculant procedures, the cohort size used for each experimental condition, the date of inoculation and sacrifice of host animals, the portion of the animal and processing used for isolation of cysts/oocysts, and the microscopy technique used to determine presence of cysts/oocysts.
- (3) The host infectivity dose-response model must be fully described. Either a linear transformation of a logistic dose-response with model parameter estimation using maximum likelihood (Finch et al., 1994) or a Most Probable Number (MPN) method with MPN calculations made using the Thomas formula approximation or solution of the full MPN equation (Oppenheimer et al., 2000) must be used. For either method, it is imperative that the ID₅₀ value required to calculate the concentration of cysts/oocysts is either directly measured for each batch of cysts/oocysts utilized, or that only reduction of infectivity before and after disinfection is reported from the dose-response data. Because this reduction is based on the ID₅₀ value appearing in both the numerator and the denominator, it is not necessary to know the actual value, provided that the same batch of cysts/oocysts is used with and without disinfection.
- (4) The QA/QC criteria must be fully detailed and all data produced outside of these criteria must be flagged as suspect. The following minimum checks must be performed: (a) each disinfection study must include a positive control; (b) the assay calculated value of

“infectious” cysts/oocysts for the positive control must fall within one log of the hemacytometer counts for total number of cysts/oocysts spiked; (c) hemacytometer counts must be performed for all disinfection samples and these counts should not differ by more than 0.25 log.

NOTICE:

An expert workshop on the state of disinfection research for the control of *Cryptosporidium* in drinking water was convened under the auspices of the U.S. Environmental Protection Agency (EPA) and the AWWA Research Foundation (AWWARF) in Washington, DC, from January 12 to 14, 1998. Information on this workshop can be found on the internet at the web site: <http://www.awwarf.com/newprojects/crypwksp/crypwksp.htm>

The goals and objectives for this workshop were:

- Discuss the existing data on *Cryptosporidium* inactivation;
- Determine a common frame of reference for the variety of studies;
- Determine what information is missing or controversial.

Among other issues discussed was the definition of viability:

“For no microorganism, is the definition of viability unambiguous. Different endpoints may yield different results. Hence a procedure for incorporating experimental data obtained using different endpoints would be desired.

“Animal infectivity is a reference method. There is a pressing need for developing a secondary reference method for disinfection testing that is easier to perform and less costly to maintain.

“Interpretation of data taken by alternative (non-reference) methods must be grounded in the development of a quantitative relationship between a reference method and the alternative methods.”

4.5 Spiking of Challenge Organisms for Seeding Studies

In the PSTP, the Field Testing Organization shall thoroughly describe the methodology to be used for conducting any microbiological inactivation challenge studies with the equipment. In this section, a general protocol for conducting microbiological contaminant seeding or challenge studies is described below, as based upon the methods developed in the AWWARF study “Experimental Methodologies for the Determination of Disinfection Effectiveness” (Haas et al., 1993).

In spiking of challenge microorganisms to the inactivation equipment, a concentrated mixture of microorganisms shall be prepared and fed to the main water stream at a known feed rate. The dilution of the concentrated microbial suspension is based upon the density of microorganisms in the concentrated mixture, the flow rate of water to the equipment, and the desired concentration of microorganisms in the disinfection reactor. The following equation shall be used by the Field Testing Organization prior to initiation of the seeding studies in order to provide a crude estimation of the appropriate flowrate and concentration of enumerable challenge organisms to be employed during the spiking of challenge microorganisms:

$$Q_m = \left[\frac{D_m}{C_m - D_m} \right] \sum_{i=1}^n Q_{wi}$$

- where: Q_m is the flow rate of concentrated microbiological contaminant suspension (L/min)
 Q_{wi} is the sum of the flow rates of raw water and any other added flows to the equipment ($Q_{w1}, Q_{w2}, \dots, Q_{wn}$) such as disinfectant solutions (L/min)
 D_m is the desired initial steady-state concentration of microorganisms in the disinfection reactor following dilution and prior to any inactivation (infectious units/L)
 C_m is the concentration of enumerable microorganisms in the feed suspension (infectious units/L)

The appropriate flowrate and concentration of enumerable microorganisms shall be initially estimated based upon Equation 1; however, the final influent density of microorganisms shall be measured directly from the feedstream to the disinfection system.

A control experiment with the challenge microorganisms in the absence of disinfectant shall be conducted in order to obtain a mass balance on microorganisms through the inactivation equipment, and to evaluate the potential losses of microorganisms through the system. The Field Testing Organization shall provide an SOP as an Appendix to the PSTP that confirms with the outline provided below.

SOP for Conducting Microbial Challenge Tests

Stated Objective: The stated objective must agree with the statement of performance objectives to be verified provided in the PSTP. It must specify:

- the reactor to be tested (manufacturer, model, and scale),
- the flowrate(s) to be challenge tested,
- the number of lamps and lamp settings to be challenge tested,
- the challenge organism,
- the targeted level of inactivation.

Description of the Challenge Organism:

- Discuss the rationale for utilizing the selected organism,
- Safety factors and precautions needed in working with the organism,
- Supplier and catalog number or host and harvest and processing protocols,
- Proper storage, handling, and disposal techniques,
- Methodology of verifying the viability throughout usage.

Description of the Spiking Protocol:

- Quantity of organisms or criteria for quantity of organisms required per seeding,
- Duration of each seeding experiment and required feed stock volume,
- Detailed descriptions of challenge organism feed storage and mixing conditions and injection techniques,
- Flow measurement techniques and target flow values for feed stock and influent to achieve steady state conditions,
- Requirement for any modifications to influent water quality (i.e. dechlorination, pH adjustment, etc.),
- Cleaning protocols for all equipment utilized in challenge study.

Description of the Challenge Protocol:

- (a) Number of replicates and sample collection points,
- (b) Time and cleaning required between seedings to achieve uncontaminated steady state,
- (c) Sample collection techniques and containers,
- (d) Chain of custody protocols and handling requirements and holding times,
- (e) Name and credentials of laboratory performing analysis,
- (f) Citation of analytical methodology,
- (g) Total number of replicates and experimental conditions to be tested.

Description of Experimental Quality Control

- (a) Required number and type of positive and negative controls (at least one negative control with reactor non-operational, one positive control verifying feed stock concentration, and one trip blank per day's operation is required),
- (b) Discussion of schedule and sequence for collection of controls during performance challenge experiments,
- (c) Laboratory precision and accuracy acceptance criteria for release of data.

4.6 Recording Data

For all microbiological challenge experiments, data should be maintained on the pH, temperature and other water quality parameters listed in Sections 4.3.1 and 4.3.2 above. The following items of information shall also be maintained for each experiment:

- Disinfectant type and dose. In the case where multiple chemical disinfectants are used, the type of disinfectants must also be specified (e.g. ozone, chlorine, monochloramine, etc.);
- Water type (raw water, pretreated feedwater, product water, waste water);
- Experimental run (e.g. 1st run, 2nd run, 3rd run, etc.);
- Contact time; initial time is considered the time at which microorganisms and disinfectant come into contact with reactor vessel. If reactor vessel is not appropriate terminology, Manufacturer shall explain mechanism of inactivation and design of inactivation chamber;
- UV intensity readings; UV intensity shall be recorded at the time each sample is withdrawn from the reactor for processes that rely on UV irradiation.
- Residual; residual disinfectant concentrations are measured for each sample withdrawn from the reactor vessel. This is only applicable to technologies that use a residual for disinfection. Not applicable for UV irradiation or other non-chemical disinfection techniques;
- Microbiological Contaminant Concentration; this value is a derived quantity equal to the number of organisms divided by the equivalent volume examined;
- Dilution factor; for the microbial analytical techniques the dilution or concentration factor should be expressed as a decimal fraction (0.2 means that one volume of the diluted material is equivalent to 0.2 volumes of original material);
- Analyzed volume of sample actually plated or examined for microorganism counts; this volume of sample is important for accurate reporting of microbial analytical techniques.
- Number of organisms; the counted number of bacterial colonies, plaque forming units or cysts shall be recorded;
- Power input where appropriate for selected microbiological inactivation techniques;

- Power fluctuations (surges, brown outs, etc.) during testing; these power factors are particularly important for determining the inactivation effectiveness of electrotechnologies.

4.7 Recording Statistical Uncertainty for Assorted Water Quality Parameters

For the analytical data obtained during verification testing, 95% confidence intervals shall be calculated by the Field Testing Organization for the log transformation of the inactivation data (i.e., $\log\{N/N_0\}$) and also for water quality parameters in which eight or more samples were collected. The specific testing plans shall specify which water quality parameters shall be subjected to the requirements of confidence interval calculation. Data quality objectives and the vendor's performance objectives shall be used to assess which water quality parameters are critical and thus require confidence interval statistics.

For the broad range of water quality parameters, the consistency and precision of water quality data can be evaluated with use of the confidence interval. As the name implies, a confidence interval describes a population range in which any individual population measurement may exist with a specified percent confidence. The following formula shall be employed for confidence interval calculation:

$$\text{confidence interval} = \bar{X} \pm t_{n-1, 1-\frac{\alpha}{2}} \left(S / \sqrt{n} \right) \quad (2)$$

where: X is the sample mean;

S is the sample standard deviation;

n is the number of independent measurements included in the data set;

t is the Student's t distribution value with n-1 degrees of freedom; and

α is the significance level, defined for 95% confidence as: $1 - 0.95 = 0.05$.

According to the 95% confidence interval approach, the α term is defined to have the value of 0.05, thus simplifying the equation for the 95% confidence interval in the following manner:

$$95\% \text{ confidence interval} = \bar{X} \pm t_{n-1, 0.975} \left(S / \sqrt{n} \right) \quad (3)$$

With input of the analytical results for pertinent water quality parameters into the 95% confidence interval equation, the output will appear as the sample mean value plus or minus the width of the confidence interval. The results of this statistical calculation may also be presented as a range of values falling within the 95% confidence interval. For example, the results of the confidence interval calculation may provide the following information: 520 +/- 38.4 mg/L, with a 95% confidence interval range described as (481.6, 558.4).

Calculation of confidence intervals shall not be required for equipment performance results (e.g., filter run length, cleaning efficiency, in-line turbidity or in-line particle counts, etc.) obtained during the equipment testing verification program. However, as specified by the Field Testing Organization, calculation of confidence intervals may be required for such analytical parameters as feedwater microbiological contaminant concentration, TOC, DOC, grab samples of turbidity, THMs, HAAs. In order to provide sufficient analytical data for statistical analysis, the Field Testing Organization shall collect three discrete water samples at one set of operational

conditions for each of the specified water quality parameters during a designated testing period. The procedures and sampling requirements shall be provided in detail in the Verification Testing Plan.

4.8 Verification Testing Schedule

Verification testing activities include equipment set-up, initial operation, verification operation, and sampling and analysis. Initial operations are intended to be conducted so that equipment can be tested to be sure it is functioning as intended. If feedwater (or source water) quality influences operation and performance of equipment being tested, the initial operations period serves as the shake-down period for determining appropriate operating parameters. The schedule of testing may also be influenced by coordination requirements with a utility.

For water treatment equipment involving chemical/physical inactivation of microbiological contaminants, an initial period of bench-scale testing of feedwater followed by treatment equipment operation may be needed to determine the appropriate disinfectant dosages, disinfectant type where appropriate, and pH values of feedwater that will result in successful functioning of the process train.

A minimum of one verification testing period shall be performed. Additional verification testing periods may be necessary to verify the manufacturer's objectives, such as in the treatment of surface water where additional testing during each season may assist in verifying an objective. For systems treating solely groundwater or surface waters of consistent quality due to pre-treatment, one verification testing period may be sufficient. If one verification testing period is selected, the feed water should represent the worst-case concentrations of contaminants which can challenge the manufacturer's objectives. For example, climatic changes between rainy and dry seasons may produce substantial variability in feedwater turbidity, TOC, and other water quality parameters. Cold weather operations will be an important component of seasonal water quality testing because of the impact of cold temperatures on water viscosity and inactivation efficacy. Cold water temperatures (1°C to 5°C) have been shown to have an adverse affect on some water treatment processes due to the increase in water viscosity and alteration of diffusional processes at cold temperatures. Cold temperature considerations may be particularly important for thermal inactivation processes. Although one testing period satisfies the minimum requirement of the ETV program, manufacturers are encouraged to use additional testing periods to cover a wider range of water quality conditions.

Content of PSTP Regarding Experimental Design:

The PSTP shall include the following elements:

- *Identification of the qualitative and quantitative factors of equipment operation to be addressed in the Verification Testing Program, including estimated costs of operation and labor.*
- *Detailed development of the statistical design for the Verification Testing with identification of dependent and independent variables, number of experimental runs to be performed, QA/QC of the data and statistical techniques that will be used to analyze the data.*
- *Description of hydrodynamic tracer study to be conducted on the microbial inactivation equipment;*

- *Identification and discussion of the particular water treatment issues and microbiological contaminants that the equipment is designed to address, how the equipment will solve the problem, and who would be the potential users of the equipment;*
- *Identification of the range of key water quality parameters, given in applicable ETV Testing Plans, which the equipment is intended to address and for which the equipment is applicable;*
- *Identification of the key parameters of treated water quality and analytical methods that will be used for evaluation of equipment performance during the inactivation of microbiological contaminants. Parameters of significance for treated water quality were listed above in Sections 4.3.2 and in applicable ETV Testing Plans;*
- *Description of data recording protocol for equipment operation, water quality parameters, and microbial water quality parameters;*
- *Description of the confidence interval calculation procedure for selected water quality parameters;*
- *Detailed description of the methodologies to be used for conducting the microbiological inactivation challenge studies with the equipment.*
- *Detailed outline of the verification testing schedule.*

5.0 FIELD OPERATIONS PROCEDURES

5.1 Equipment Operations and Design

The ETV Testing Plan specifies procedures that shall be used to ensure the accurate documentation of both equipment performance and treated water quality. Careful adherence to these procedures will result in definition of verifiable performance of equipment. The specific reporting techniques, methods of statistical analysis and the QA/QC of microbial data and inactivation procedures shall be stated explicitly by the Field Testing Organization in the PSTP before initiation of the Verification Testing Program. (Note that this protocol may be associated with a number of different ETV Testing Plans for different types of microbiological inactivation process equipment.)

The design aspects of water treatment process equipment often provide a basis for approval by state regulatory officials and can be used to determine if equipment evaluated in the Verification Testing Program can be employed under higher or lower flow rate conditions. The field operations procedures and testing conditions provided by the Field Testing Organization shall therefore be specified in the PSTP to demonstrate treatment capabilities over a broad range of operational conditions and feedwater qualities.

5.2 Communications, Documentation, Logistics, and Equipment

The successful implementation of the verification testing will require detailed coordination and constant communication between all verification testing participants.

All field activities shall be thoroughly documented. Field documentation will include field logbooks, photographs, field data sheets, and chain-of-custody forms. The Field Testing Organization shall be responsible for maintaining all field documentation. Field notes shall be kept in a bound logbook. Each page shall be sequentially numbered and labeled with the project name and number. Field logbooks shall be used to record all water treatment equipment

operating data. Completed pages shall be signed and dated by the individual responsible for the entries. Errors shall have one line drawn through them and this line shall be initialed and dated.

All photographs shall be logged in the field logbook. These entries shall include the time, date, direction, subject of the photograph, and the identity of the photographer. Any deviations from the approved final PSTP shall be thoroughly documented in the field logbook at the time of inspection and in the verification report.

Original field sheets and chain-of-custody forms shall accompany all samples shipped to the analytical laboratory. Copies of field sheets and chain-of-custody forms for all samples shall be provided at the time of the QA/QC inspection and included in the verification report.

As available, electronic data storage and retrieval capabilities shall be employed in order to maximize data collection and minimize labor hours required for monitoring. The guidelines for use of data-loggers, laptop computers, data acquisition systems etc., shall be detailed by the Field Testing Organization in the PSTP.

5.3 Initial Operations

Initial operations of the microbiological inactivation equipment will allow Field Testing Organizations to refine their operating procedures and to make operational adjustments as needed to successfully treat the feedwater. Information generated through this period of operation may be used to revise the PSTP, if necessary. A failure at this point in the verification testing could indicate a lack of capability of the process equipment and the verification testing might be canceled.

5.4 Equipment Operation and Water Quality Sampling for Verification Testing

All field activities shall conform to requirements provided in the PSTP that was developed and approved for the verification testing being conducted. All sampling and sample analysis conducted during the Verification Testing Program shall be performed according to the procedures detailed by the Field Testing Organization in the PSTP.

If unanticipated or unusual situations are encountered that may alter the plans for equipment operation, water quality sampling, or data quality, the Field Testing Organization must discuss the situation and planning modifications with the NSF technical lead. Any deviations from the approved final PSTP shall be thoroughly documented.

During routine operation of water treatment equipment, the total number of hours during which the equipment is operated each day shall be documented. In addition, the number of hours each day during which the operator was working at the treatment plant performing tasks related to water treatment and the operation of the treatment equipment shall be documented. Furthermore, the tasks performed during equipment operation shall be described by the Field Testing Organization, the Water System or the Plant Operator.

Content of PSTP Regarding Field Operations Procedures:

The PSTP shall include the following elements:

- *A table summary of the proposed time schedule for operating and testing,*
- *Field operating procedures for the equipment and performance testing, based upon the ETV Testing Plan with listing of operating parameters, ranges for feedwater quality, and the sampling and analysis strategy.*
- *Provision of detailed sampling and analysis plan for water quality and microbial parameters.*

Manufacturer Responsibilities:

- *Provision of all equipment needed for field work associated with this verification testing;*
- *Provision of a complete list of all equipment to be used in the verification testing. A table format is suggested;*
- *Provision of field operating procedures.*

6.0 QUALITY ASSURANCE PROJECT PLAN (QAPP)

The QAPP for this verification testing specifies procedures that shall be used to ensure data quality and integrity. Careful adherence to these procedures will ensure that data generated from the verification testing will provide sound analytical results that can serve as the basis for performance verification.

6.1 Purpose and Scope

The purpose of this section is to outline steps that shall be taken by operators of the equipment and by the analytical laboratory to ensure that data resulting from this verification testing is of known quality and that a sufficient number of critical measurements are taken.

6.2 Quality Assurance Responsibilities

A number of individuals may be responsible for monitoring equipment operating parameters and for sampling and analysis QA/QC throughout the verification testing. Primary responsibility for ensuring that both equipment operation and sampling and analysis activities comply with the QA/QC requirements of the PSTP (Section 6) shall rest with the Field Testing Organization.

QA/QC activities for the state-certified or third party- or EPA-accredited analytical laboratory that analyzes samples sent off-site shall be the responsibility of that analytical laboratory's supervisor. If problems arise or any data appear unusual, they shall be thoroughly documented and corrective actions shall be implemented as specified in this section. The QA/QC measurements made by the off-site analytical laboratory are dependent on the analytical methods being used.

6.3 Data Quality Indicators

The data obtained during the verification testing must be of sound quality for conclusions to be drawn on the equipment. For all measurement and monitoring activities conducted for

equipment verification, the NSF and EPA require that data quality parameters be established based on the proposed end uses of the data. Data quality parameters include four indicators of data quality: representativeness, accuracy, precision, and statistical uncertainty.

Treatment results generated by the equipment and by the laboratory analyses must be verifiable for the purposes of this program to be fulfilled. High quality, well documented analytical laboratory results are essential for meeting the purpose and objectives of this verification testing. Therefore, the following indicators of data quality shall be closely evaluated to determine the performance of the equipment when measured against data generated by the analytical laboratory.

6.3.1 Representativeness

Representativeness refers to the degree to which the data accurately and precisely represent the conditions or characteristics of the parameter represented by the data. In this verification testing, representativeness will be ensured by executing consistent microbiological challenge spiking procedures and consistent sample collection procedures, including sample locations, timing of sample collection, sampling procedures, sample preservation, sample packaging, and sample shipping. Representativeness also will be ensured by using each method at its optimum capability to provide results that represent the most accurate and precise measurement it is capable of achieving. For equipment operating data, representativeness entails collecting a sufficient quantity of data during operation to be able to detect a change in operations.

6.3.2 Accuracy

For water quality analyses, accuracy refers to the difference between a sample result and the reference or true value for the sample. Loss of accuracy can be caused by such processes as errors in standards preparation, equipment calibrations, loss of target analyte in the extraction process, interferences, and systematic or carryover contamination from one sample to the next. Loss of accuracy for microbial species can be caused by such factors as error in dilution or concentration of microbiological organisms, systematic or carryover contamination from one sample to the next, improper enumeration techniques, etc. The Field Testing Organization shall discuss the applicable ways of determining the accuracy of the chemical and microbiological sampling and analytical techniques in the PSTP.

For equipment operating parameters, accuracy refers to the difference between the reported operating condition and the actual operating condition. For water flow, accuracy may be the difference between the reported flow indicated by a flow meter and the flow as actually measured on the basis of known volumes of water and carefully defined times (bucket and stopwatch technique) as practiced in hydraulics laboratories or water meter calibration shops. For mixing equipment, accuracy is the difference between an electronic readout for equipment RPMs and the actual measurement based on counted revolutions and measured time. Accuracy of head loss measurement can be determined by using measuring tapes to check the calibration of piezometers for gravity filters or by checking the calibration of pressure gauges for pressure filters. Meters and gauges must be checked periodically for accuracy, and when proven to be dependable over time, the time interval between accuracy checks can be increased. In the PSTP, the Field Testing

Organization shall discuss the applicable ways of determining the accuracy of the operational conditions and procedures.

From an analytical perspective, accuracy represents the deviation of the analytical value from the known value. Since true values are never known in the field, accuracy measurements are made on analysis of QC samples analyzed with field samples. QC samples for analysis shall be prepared with laboratory control samples, matrix spikes and spike duplicates. It is recommended for verification testing that the PSTP include laboratory performance of one matrix spike for determination of sample recoveries. Recoveries for spiked samples are calculated in the following manner:

$$\% \text{ Recovery} = \frac{100(SSR - SR)}{SA}$$

where: SSR = spikes sample result
 SR = sample result
 SA = spike amount added.

Recoveries for laboratory control samples are calculated as follows:

$$\% \text{ Recovery} = \frac{100(\text{found concentration})}{\text{true concentration}}$$

For acceptable analytical accuracy under the verification testing program, the recoveries reported during analysis of the verification testing samples must be within control limits, where control limits are defined as the mean recovery plus or minus three times the standard deviation.

6.3.3 Precision

Precision refers to the degree of mutual agreement among individual measurements and provides an estimate of random error. Analytical precision is a measure of how far an individual measurement may be from the mean of replicate measurements. The standard deviation and the relative standard deviation recorded from sample analyses may be reported as a means to quantify sample precision. The percent relative standard deviation may be calculated in the following manner:

$$\% \text{ Relative Standard Deviation} = \frac{S(100)}{X_{\text{average}}}$$

where: S = standard deviation
 X_{average} = the arithmetic mean of the recovery values.

Standard Deviation is calculated as follows:

$$\text{Standard Deviation} = \sqrt{\frac{\sum_{i=1}^n (X_i - X)^2}{n-1}}$$

where: X_i = the individual recovery values

X = the arithmetic mean of then recovery values

n = the number of determinations.

For acceptable analytical precision under the verification testing program, the percent relative standard deviation for drinking water samples must be less than 30%.

6.3.4 Statistical Uncertainty

Statistical uncertainty of the water quality parameters analyzed shall be evaluated through calculation of the 95% confidence interval around the sample mean. Description of the confidence interval calculation is provided in Section 4.7 - Recording Statistical Uncertainty.

6.4 Water Quality and Operational Control Checks

This section describes the QC requirements that apply to both the treatment equipment and the on-site measurement of water quality parameters. It also contains a discussion of the corrective action to be taken if the QC parameters fall outside of the evaluation criteria.

The quality control checks provide a means of measuring the quality of data produced. The Manufacturer may not need to use all the ones identified in this section. The selection of the appropriate quality control checks depends on the equipment, the experimental design and the performance goals. The selection of quality control checks will be based on discussions among the Manufacturer and the NSF.

6.4.1 Quality Control for Equipment Operation

This section will explain the methods to be used to check on the accuracy of equipment operating parameters and the frequency with which these quality control checks will be made. If the quality of the equipment operating data cannot be verified, then the water quality analytical results may be of no value. Because water cannot be adequately treated if equipment is not operating within specifications, obtaining valid equipment operating data is a prime concern for verification testing.

An example of the need for QC for equipment operations is an incident of state rejection of test data because the treatment equipment had no flow meter to use for determining engineering and operating parameters related to flow.

6.4.2 Water Quality Data

After treatment equipment is operating within specifications and water is being treated, the results of the treatment are interpreted in terms of water quality. Therefore the quality of water sample analytical results is just as important as the quality of the equipment

operating data. Therefore, the QAPP must emphasize the methods to be employed for sampling and analytical QA. The important aspects of sampling and analytical QA are given below:

6.4.2.1 Duplicate Analysis of Selected Water Quality Parameters. Duplicate samples must be analyzed for selected water quality parameters to determine the precision of analysis. The procedure for determining samples to be analyzed in duplicate shall be provided with the frequency of analysis and the approximate number.

6.4.2.2 Method Blanks. Method blanks are used for selected water quality parameters to evaluate analytical method-induced contamination, which may cause false positive results. Method blanks shall not be employed for microbiological analyses.

6.4.2.3 Spiked Samples. The use of spiked samples will depend on the testing program, and the contaminants to be removed. If spiked samples are to be used specify the procedure, frequency, acceptance criteria, and actions if criteria are not met. Spiked samples shall not be employed for microbiological analyses.

6.4.2.4 Travel Blanks. Travel blanks for selected water quality parameters shall be provided to the analytical laboratory to evaluate travel-related contamination. Travel blanks shall not be employed for microbiological analyses.

6.4.2.5 Microbiological Travel Samples. If analysis is not conducted at the site of verification testing and sampling, the laboratory conducting microbiological analysis shall perform a travel viability and enumeration study at the start of the Verification Testing Program by shipping samples dosed with microbial concentrations to the test site and having the bottles returned after 24 hours on site. At the time of return receipt by the laboratory, the viability of the organisms shall be determined at this time.

6.4.2.6 Performance Evaluation Samples for On-Site Water Quality Testing. Performance evaluation (PE) samples are samples of unknown concentration prepared by an independent PE lab and provided as unknowns to an analyst to evaluate his or her analytical performance. Analysis of PE samples shall be conducted for selected water quality parameters before testing is initiated by submission of samples to the analytical laboratory. The control limits for the PE samples will be used to evaluate the equipment testing organization's and analytical laboratory's method performance. One kind of PE sample that would be used for on-site QA in most studies done under this protocol would be a series of either protozoa, bacteria or virus PE samples.

PE samples come with statistics about each sample which have been derived from the analysis of the sample by a number of laboratories using EPA-approved methods. These statistics include a true value of the PE sample, a mean of the laboratory results obtained from the analysis of the PE sample, and an acceptance range for sample values. The analytical laboratory is expected to provide results from the analysis of the PE samples that meet the performance objectives of the verification testing.

6.5 Microbial Viability

Control experiments for each test organism must be conducted to evaluate the stability of microbiological viability in the absence of any disinfectant. These control experiments shall be conducted in a manner identical to the disinfection experiments except that no disinfectant shall be added to the reactor. The results of the control experiments will allow for quantification of the microbiological viability in the absence of any disinfectant over the time course of the disinfection experiments. Microbial viability testing shall also be performed on microbiological travel samples in order to confirm viability of organisms from point of addition to laboratory analysis.

The Field Testing Organization shall establish procedural controls in terms of the level of acceptable microbial viability for the challenge experiments. Die-away of organisms during shipping is sometimes observed. However, if greater than one log of microbial die-away is observed through the microbiological travel sample study, then the procedures for provision of organisms to the site for seeding studies will be evaluated and corrective action will be taken.

6.6 Data Reduction, Validation, and Reporting

To maintain good data quality, specific procedures shall be followed during data reduction, validation, and reporting. These procedures are detailed below.

6.6.1 Data Reduction

Data reduction refers to the process of converting the raw results from the equipment into concentration or other data in a form to be used in the comparison. The procedures to be used will be equipment and data dependent. The purpose of this step is to provide data which will be used to verify the statement of performance objectives. These data shall be obtained from logbooks, instrument outputs, and computer outputs as appropriate. Microorganism data shall be transformed by taking the $\log_{10}$ of the data unless data analysis demonstrates an alternative distribution than a logarithmic distribution.

6.6.2 Data Validation

The operator shall verify the completeness of the appropriate data forms and the completeness and correctness of data acquisition and reduction. The field team supervisor or another technical person shall review calculations and inspect laboratory logbooks and data sheets to verify accuracy and completeness. Calibration and QC data will be examined by the individual operators and the laboratory supervisor. Laboratory and project managers shall verify that all instrument systems are in control and that QA objectives for accuracy, completeness, and method detection limits have been met.

Analytical outlier data are defined as those QC data lying outside a specific QC objective window for precision and accuracy as determined by the state-certified or third party- or EPA-accredited laboratory for a given analytical method. Should QC data be outside of control limits, the analytical laboratory or field team supervisor will investigate the cause of the problem. If the problem involves an analytical problem, the sample will be reanalyzed or another sample will be collected and analyzed. If the problem can be

attributed to the sample matrix, the result will be flagged with a data qualifier. This data qualifier will be included and explained in the final analytical report.

6.6.3 Data Reporting

The data reported during the Verification Testing Program shall be explicitly defined by the Field Testing Organization in the PSTP. At a minimum, the data tabulation shall list the results for feedwater and treated water quality analyses, the results of microbiological analyses ($\log_{10}$ data transformation), microbiological inactivation achieved ($\log_{10}$ data transformation) and equipment operating data. All QC information such as calibrations, blanks and reference samples are to be included in an appendix. All raw analytical data shall also be reported in an appendix. All data shall be reported in hardcopy and electronically in a common spreadsheet or database format.

6.7 System Inspections

On-site system inspections for sampling activities, field operations, and laboratories shall be conducted as specified by the ETV Testing Plan. These inspections will be performed by the NSF to determine if the ETV Testing Plan is being implemented as intended. Separate inspections reports will be completed after the inspections and provided to the participating parties.

6.8 Reports

6.8.1 Status Reports

The Field Testing Organization shall prepare periodic reports to pertinent parties, e.g., manufacturer, community. These reports shall discuss project progress, problems and associated corrective actions, and future scheduled activities associated with the verification testing. Each report shall include an executive summary at the beginning of the report to introduce the salient issues of the testing period. When problems occur, the Manufacturer and Field Testing Organization project managers shall discuss them, and estimate the type and degree of impact, and describe the corrective actions taken to mitigate the impact and to prevent a recurrence of the problems. The frequency, format, and content of these reports shall be outlined by the Field Testing Organization in the PSTP.

6.8.2 Inspection Reports

Any QA inspections that take place in the field or at the analytical laboratory while the verification testing is being conducted shall be formally reported by the Field Testing Organization to the Verification entity and Manufacturer.

6.9 Corrective Action

Each PSTP must incorporate a corrective action plan. This plan must include the predetermined acceptance limits of microbial viability and key analytical parameters (to be reviewed by NSF), the corrective action to be initiated whenever such acceptance criteria are not met, and the names of the individuals responsible for implementation.

Routine corrective action may result from common monitoring activities, such as:

- Performance evaluation inspections
- Technical systems inspections

Content of PSTP Regarding Quality Assurance Project Plan:

The PSTP shall include the following elements:

- *Description of methodology for measurement of accuracy;*
- *Description of methodology for measurement of precision;*
- *Description of the methodology for use of blanks, the materials used, the frequency, the criteria for acceptable method blanks and the actions if criteria are not met;*
- *Description of any specific procedures appropriate to the analysis of the PE samples. It has to be clear how these samples are going to be used in the verification testing;*
- *Outline of the procedure for determining samples to be analyzed in duplicate, the frequency and approximate number;*
- *Description of procedures to be used for determination of microbial viability and for the spiking of microorganisms over the equipment during control studies;*
- *Description of the procedures used to assure that the data are correct;*
- *Definition of data to be reported during the Verification Testing Program, in terms of analytical parameter type and frequency;*
- *Listing of techniques and/or equations used to quantify any necessary data quality indicator calculations in the analysis of water quality parameters, microbiological contaminants or operational conditions (e.g., flow rates, mixer speeds, detention times). These include: representativeness, completeness, accuracy, precision (e.g., relative percent deviation, standard deviation);*
- *Outline of the frequency, format, and content of reports in the PSTP;*
- *Development of a corrective action plan in the PSTP.*
- *Provision of all QC information such as calibrations, blanks and reference samples in an appendix. All raw analytical data shall also be reported in an appendix;*
- *Provision of all data in hardcopy and electronic form in a common spreadsheet or database format.*
- *Description of all techniques to establish (where applicable) the representativeness, completeness, accuracy and precision of methods in the analysis of water quality parameters, microbiological contaminants or operational conditions (e.g., flow rates, mixer speeds, detention times).*

7.0 DATA MANAGEMENT AND ANALYSIS, AND REPORTING

7.1 Data Management and Analysis

A variety of data will be generated during a verification testing. Each piece of data or information identified for collection in the ETV Testing Plan will need to be provided. The data management section of the PSTP shall describe what types of data and information needs to be collected and managed. It shall also describe how the data will be reported to the NSF for evaluation.

Laboratory Analyses: The raw data and the validated data must be reported. These data shall be provided in hard copy and in electronic format. As with the data generated by the innovative equipment, the electronic copy of the laboratory data shall be provided in a spreadsheet. In addition to the sample results, all QA/QC summary forms must be provided.

Other items that must be provided include:

- field notebooks;
- photographs, slides and videotapes (copies);
- results from the use of other field analytical methods.

7.2 Report of Equipment Testing

The Field Testing Organization shall prepare a draft report describing the verification testing that was carried out and the results of that testing. This report shall include the following topics:

- Introduction
- Executive Summary
- Description and Identification of Product Tested
- Procedures and Methods Used in Testing
- Results and Discussion
- Conclusions and Recommendations
- References
- Appendices
- PSTP
- QA/QC Results

Content of PSTP Regarding Data Management and Analysis, and Reporting:

The PSTP shall include the following:

- *Description of what types of data and information needs to be collected and managed.*
- *Description of how the data will be reported.*

8.0 HEALTH AND SAFETY MEASURES

The safety procedures shall address safety considerations, including the following as applicable:

- storage, handling, and disposal of hazardous chemicals including acids, caustic and oxidizing agents.
- conformance with electrical code
- chemical hazards and biohazards, if pathogenic microorganisms are used in testing
- ventilation of equipment or of trailers or buildings housing equipment, if gases generated by the equipment could present a safety hazard (one example is ozone).

Content of PSTP Regarding Safety:

The PSTP shall address safety considerations that are appropriate for the equipment being tested and for the challenge organisms, if any, being used in the verification testing.

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CHAPTER 2

EPA/NSF ETV

EQUIPMENT VERIFICATION TESTING PLAN FOR

OZONE AND ADVANCED OXIDATION PROCESSES FOR

INACTIVATION OF MICROBIOLOGICAL CONTAMINANTS

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1.0 APPLICATION OF THIS VERIFICATION TESTING PLAN

This document is the Environmental Technology Verification (ETV) Plan for evaluation of water treatment equipment utilizing ozone and advanced oxidation for inactivation of microorganisms. This Testing Plan is to be used as a guide in the development of the Product-Specific Test Plan (PSTP) for testing ozone and advanced oxidation equipment, within the structure provided by the "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies." This ETV plan is applicable only to water treatment systems that rely on ozone and advanced oxidation to inactivate microorganisms. Water treatment systems using ozone oxidation for reasons other than disinfection (i.e. taste and odor control, inorganics oxidation) are not required to conduct the experiments outlined in this ETV plan, as long as adequate disinfection is being achieved by other technologies (e.g., chlorine or chloramines). Ozone is sometimes combined with ultraviolet (UV) light or hydrogen peroxide to improve oxidation. These advanced oxidation processes (AOPs) can also be tested under this plan.

In order to participate in the equipment verification process for microbial inactivation by ozone and advanced oxidation, the equipment Manufacturer and their designated Field Testing Organization shall use the procedures and methods described in this test plan, and in the "Protocol for Equipment Verification Testing for Inactivation of Microbiological Contaminants: Requirements for All Studies" as guidelines for development of the PSTP.

This ETV test plan is applicable to the testing of water treatment equipment utilizing ozone and advanced oxidation for inactivation of microorganisms in drinking water. This plan is applicable to both surface water and ground water supplies.

2.0 INTRODUCTION

Ozone is a powerful oxidant that is applied during water treatment for microbial inactivation as well as oxidation of pesticides, metals, and taste and odor causing compounds. The use of ozone in potable water treatment in the United States has increased substantially in the last 20 years, due to its superior inactivation of microorganisms (e.g., cysts) relative to chlorine, chloramine, and chlorine dioxide.

Ozone is applied to drinking water as a gas, which is generated on-site. The ozone gas is transferred into a dissolved state by either bubbling or injecting ozone gas into the process stream. Ozone can be applied to untreated (raw) or treated (e.g., coagulated/settled or filtered) water.

In this ETV test plan, ozone or AOP equipment performance can be verified in one of two ways: 1) by achieving a certain level of "CT" [concentration, C (in mg/L), of ozone multiplied by contact time, T (in minutes)] during treatment; or 2) by conducting microbial seeding or challenge testing by measuring the microbial inactivation (for a variety of microorganisms) achieved by the ozone or by AOPs.

Ozone CT values have been established by the USEPA for virus and *Giardia* cyst inactivation for use in guiding state regulatory agencies in the implementation of the filtration and disinfection rules. While the USEPA has not yet established CT requirements for *Cryptosporidium* inactivation, CT values can be determined in this ETV plan to establish the level of CT that can be achieved with the ozone or some types of AOP equipment. Thus, many ozone systems will be able to use the CT approach in this ETV plan.

AOPs convert dissolved ozone to hydroxyl radicals, a process which occurs more rapidly as pH is elevated (e.g., varying from a slow reaction at pH 6 and below, to an instantaneous reaction at pH 9 and above). The ability of hydroxyl radicals to inactivate microbes is not well defined, and specific CT values for AOPs have not been developed because (a) the half-life of hydroxyl free radicals is on the order of microseconds and (b) the highest concentration of hydroxyl free radicals that can be developed in aqueous solution is on the order of 10^{-12} Molar. Therefore, the Manufacturers of some AOP systems may choose to conduct microbial seeding or challenge testing to show the level of inactivation that can be achieved for a specific process. Manufacturers of some ozone systems may also choose to conduct microbial inactivation studies for equipment verification.

Labatiuk, Belosevic, and Finch (1994) recommended that ozone disinfection processes should maintain a stable ozone residual for disinfection prior to the addition of hydrogen peroxide for oxidation of other compounds. If water treatment equipment employing an AOP concept provides for detention time in which water can be in contact with dissolved ozone for a significant time before the application of hydrogen peroxide or ultraviolet radiation, evaluation of CT values attained prior to conversion of ozone to hydroxyl radicals may be possible. In this situation, AOP systems could be tested to develop CT information, but the manufacturer's statement of performance regarding disinfection capability would have to be limited to the portion of the treatment process in which a dissolved ozone residual is maintained.

3.0 GENERAL APPROACH

Testing of equipment covered by this ETV plan will be performed by an NSF-qualified Field Testing Organization (FTO) that is selected by the equipment Manufacturer. Water quality and microbiological analytical work to be carried out as part of this ETV plan will be contracted with a state-certified or third party- or EPA-accredited analytical laboratory.

4.0 OVERVIEW OF TASKS

4.1 Initial Operations: Overview

The purpose of these tasks is to provide preliminary information, which will facilitate final test design and data interpretation. Initial Operations Tasks A and B are not mandatory but they are recommended as an aid to successful completion of Verification Testing. Furthermore, if the verification entity conducts a site visit for quality assurance (QA) purposes, the Task B would need to be performed.

4.1.1 Task A: Characterization of Feed Water

The objective of this Initial Operations task is to obtain a chemical and physical characterization of the feed water for those systems using ozone or AOPs for inactivation. The biological quality of the feed water shall be determined for those plants conducting microbiological seeding or challenge testing.

A thorough description of the watershed or aquifer and any pretreatment modules that provide the feed water should also be prepared to aid interpretation of feed water characterization.

4.1.2 Task B: Initial Test Runs

During Initial Operations, the equipment Manufacturer may want to evaluate equipment operation and determine flow rates, hydraulic retention time, contact times (via tracer tests), ozone dosage, number of ozone injection points, pH range, temperature, alkalinity, sequencing or timing of UV light/hydrogen peroxide addition relative to ozonation, or other factors which provide effective treatment of feed water. This is a recommended Initial Operations task.

The equipment Manufacturer may also want to work with the FTO and analytical laboratory to perform blank or preliminary challenges and sampling routines to verify that sampling equipment can perform its required functions including microorganism survivability (if conducting microbiological challenge testing). This is also a recommended Initial Operations Task.

4.2 Verification Operations: Overview

The verification testing objective is to operate the treatment equipment provided by the equipment Manufacturer and to assess its ability to meet stated water quality goals and any other performance characteristics specified by the Manufacturer. Equipment shall be operated for a minimum of one test period to collect data on equipment performance and water quality for purposes of performance verification. The test period(s) selected should represent the worst-case for concentrations of ozone demanding contaminants (e.g., iron, manganese, organics, hydrogen sulfide, pesticides, or turbidity).

4.2.1 Task 1: Verification Testing Runs and Routine Equipment Operation

To characterize the technology in terms of efficiency and reliability, water treatment equipment that includes ozone (or AOPs) shall be operated for Verification Testing purposes with the operational parameters based on the results of the Initial Operations testing (see Task B).

4.2.2 Task 2: Feed Water and Finished Water Quality

During each Verification Testing period, feed water and treated water samples shall be collected and analyzed for those parameters relevant to oxidation performance and microbial inactivation or for those parameters affecting equipment performance, as outlined in Section 10, Table 1.

4.2.3 Task 3: Documentation of Operating Conditions and Treatment Equipment Performance

During each Verification Testing run, operating conditions and performance of water treatment equipment shall be documented. This includes ozone feed gas concentration, gas and liquid pressures, gas and liquid temperatures, gas and liquid flow rates, ozone off-gas concentration, applied and transferred ozone dosage, power usage for the ozone generator, ozone transfer equipment, ozone feed-gas and off-gas monitors (if part of the ozone system) and ozone destruct unit, as well as stability of the electrical power supply (surges, brown-outs, etc.).

If ozone (or an AOP) is used following pretreatment (e.g., coagulation/settling), then a complete description of the pretreatment process shall be provided. For AOP systems, the operating conditions and parameters associated with hydrogen peroxide or UV light equipment must also be documented.

4.2.4 Task 4: Microbial Inactivation

The ability of water treatment ozone equipment to achieve microbial inactivation will be demonstrated by maintaining a level of performance criteria (CT value) for ozone systems. Microbial seeding studies to verify microbial inactivation will be allowed in lieu of the performance criteria (CT value) requirement. To evaluate microbial inactivation by hydroxyl radicals in AOP systems (i.e. after addition of hydrogen peroxide or after use of UV light), microbial seeding studies are required.

4.2.5 Task 5: Data Management

The objective of this task is to establish an effective field protocol for data management at the field operations site and for data transmission between the FTO and NSF for data obtained during the Verification Testing. Prior to the beginning of field testing, the database design must be developed by the FTO and reviewed and approved by NSF. This will ensure that the required data will be collected during the testing, and that it can be effectively transmitted to NSF for review.

4.2.6 Task 6: Quality Assurance/Quality Control (QA/QC)

An important aspect of Verification Testing is the protocol developed for quality assurance and quality control. The objective of this task is to assure accurate measurement of operating and water quality parameters during ozone equipment

Verification Testing. Prior to the beginning of field testing, a QA/QC plan must be developed which addresses all aspects of the testing process. Each water quality parameter and operational parameter must have appropriate QA/QC measures in place and documented. For example, the protocol for ozone measurement using a spectrophotometer should describe how the instrument is calibrated, what adjustments are made, and provide a permanent record of all calibrations and maintenance for that instrument.

5.0 TESTING PERIODS

A minimum of one verification testing period shall be performed. Additional verification testing periods may be necessary to verify the manufacturer's performance objectives, such as in the treatment of surface water where additional testing during each season may assist in verifying an objective. For systems treating solely groundwater or surface waters of consistent quality due to pre-treatment, one verification testing period may be sufficient. If one verification testing period is selected, the feed water should represent the worst-case concentrations of contaminants which can verify the manufacturer's performance objectives. Although one testing period satisfies the minimum requirement of the ETV program, manufacturers are encouraged to use additional testing periods to cover a wider range of water quality conditions.

The required tasks in the Verification Testing Plan (Tasks 1 through 6) are designed to be carried out during each testing period. Each testing period shall provide for at least 200 hours of ozone equipment operation. During this time, the performance and reliability of the equipment shall be documented.

Some systems may operate for less than 24 hours per day. Interruptions in ozone production are allowed but the reason and duration of all interruptions shall be fully described in the Verification Testing report. Any testing conducted at intervals less than 200 hours is considered a test *run*, whereas the entire 200 hours (either continuous or as the sum of individual test runs) of ozone equipment operation is considered the Verification Test *period*. If ozone production is interrupted during a verification test run, that test run shall be considered to have been concluded at the time of interruption of the ozone feed. After restart, all data collected are to be part of a new verification test run.

6.0 DEFINITION OF OPERATIONAL PARAMETERS

Definitions that apply to ozone and AOP processes are given below. Refer to Appendix A of *Ozone in Water Treatment, Application and Engineering*, by the American Water Works Association Research Foundation and Compagnie Générale des Eaux, Lewis Publishers, 1991 for a more detailed description of terms.

6.1 Feed Gas or Ozone Production Concentration (% weight or g/m³ NTP)

The feed gas or ozone production concentration (Y_1) is the ozone concentration (in gaseous form) being applied to the water being treated. It is expressed in units of g/m³ normal temperature and pressure (NTP) or as percent by weight. The temperature and pressure values associated with NTP are 0°C and one atmosphere (i.e., 14.696 psi, 760 mm Hg, or 101.325 kPa), respectively.

6.2 Off Gas Concentration (% weight or g/m³ NTP)

The off gas concentration (Y_2) is the ozone concentration (in gaseous form) of the gas which is being released (i.e., off gas) from the water being treated. This off gas contains ozone, which was not transferred into a dissolved form during treatment. It is expressed in units of g/m³ NTP or as percent by weight.

6.3 Applied Ozone Dosage (mg/L)

The amount of ozone added to the water being treated is the applied ozone dosage. The equation for calculating the applied ozone dosage is as follows:

$$D = P / (8.34 \text{ L})$$

where:

D =	applied ozone dosage (mg/L)
P =	ozone production (lb/day)
L =	water flow rate (MGD, million U.S. gallons per day)

6.4 Transfer Efficiency (percent)

The transfer efficiency is defined as the percentage of ozone that becomes dissolved into the water being treated. The equation for calculating the transfer efficiency is as follows:

$$TE = [(Y_1 - Y_2) / Y_1] * 100$$

where:

TE =	transfer efficiency (percent)
Y_1 =	ozone production concentration (g/m ³ NTP or percent by weight)
Y_2 =	off gas ozone concentration (g/m ³ NTP or percent by weight)

This calculation assumes that the flow of the feed gas is equal to the flow of the off gas. The transfer efficiency calculation can be refined by measuring both gas flow rates or by monitoring the dissolved gas concentration in the liquid phase if the Manufacturer desires.

6.5 Transferred Ozone Dosage (mg/L)

The transferred ozone dosage is the concentration of ozone that becomes dissolved into the water being treated. The equation for calculating the transferred ozone dosage is as follows:

$$T = (D * TE)/100$$

where: T = transferred ozone dosage (mg/L)
 D = applied ozone dosage (mg/L)
 TE = transfer efficiency (percent, i.e., 95.0 and not 0.95)

6.6 Dissolved Ozone Concentration (mg/L)

The concentration of ozone in solution is the dissolved ozone concentration. It is measured using an indigo bleaching technique (e.g., HACH AccuVac or *Standard Method 4500-O₃ B*) or by inserting a dissolved ozone probe into the process stream. The procedure for calibration of ozone probes is described in Section 14.4.7. The dissolved ozone concentration is used to calculate CT values.

6.7 CT (mg-minute/L)

The product of the dissolved ozone concentration 'C' in mg/L and the contact time 'T' in minutes is referred to as the CT value. CT is the number produced by multiplying these two values together. Thus, equivalent CT values can be produced by a small C multiplied by a large T or a large C for a small T. For example, if the dissolved ozone concentration after 10 minutes of contact time is 0.5 mg/L, the CT value is $10 * 0.5 = 5$ mg-minute/L.

The CT value is used as a surrogate measure of disinfection effectiveness for certain microorganisms by assuming that adequate inactivation has occurred when water is exposed to a given disinfectant concentration for a given contact time. The CT value required for achieving a specific level of disinfection by ozone depends on the temperature and pH of the water being treated.

If an ozone system uses side stream injection for ozone application, none of the sample ports used for collecting samples that will be analyzed for ozone concentration may be located at the ozone side stream. All sample ports used for collecting samples needed for determining CT values shall be located in the main ozone contactor where the bulk flow of water is being disinfected.

The USEPA has outlined a recommended method for calculating CT values for conventional ozone contactors in Appendix O of the *Guidance Manual for the Surface Water Treatment Rule*. Two methods of calculating the total CT of a contactor can be used during Verification Testing: conservative and log integration.

6.7.1 Conservative Method of Determining CT Values

For contactors with multiple sampling ports, the CT value for each sample port (calculated using the measured dissolved ozone concentration and the appropriate contact time represented by the individual sample port) can be summed to calculate the overall CT value for the contactor. The T_{10}/T_{theory} factor (which shall be determined during the hydrodynamic tracer tests described in Chapter 1, Protocol for Equipment Verification

Testing of Microbiological Contaminant Inactivation) is then applied to the summed CT values to account for any short circuiting within the contactor. This method of determining CT value is referred to as the "conservative" approach.

The T_{10} value represents the minimum length of time for which 90 percent of the water will be exposed to the disinfectant within the contactor (as determined using tracer testing) while T_{theory} represents hydraulic detention time of the contactor (calculated by dividing the total volume of the contactor by the water flow rate).

An example using the conservative approach follows: if there are three sample ports, located along the ozone contactor at 2, 4, and 6 minutes of hydraulic detention time, and the dissolved ozone concentrations are 1.0, 0.7, and 0.5 mg/L at each sample port, respectively, the summed CT value for a contactor having a T_{10}/T_{theory} of 0.8 would be calculated as follows:

$$CT = (T_{10}/T_{\text{theory}}) * [(C_{\text{port 1}} * T_{\text{port 1}}) + (C_{\text{port 2}} * T_{\text{port 2-port 1}}) + (C_{\text{port 3}} * T_{\text{port 3-port 2}})]$$

$$CT = (0.8) * [(1.0 \text{ mg/L} * 2 \text{ min.}) + (0.7 \text{ mg/L} * 2 \text{ min.}) + (0.5 \text{ mg/L} * 2 \text{ min.})]$$

$$CT = 3.52 \text{ mg-minute/L}$$

6.7.2 Log Integration Method of Determining CT Value

From the equation for the conservative method of determining CT values, it can be concluded that the addition of more sampling points would result in a more accurate determination of the actual disinfection environment in the ozone contactor. Since it may be impractical to add more sampling ports to an ozone contactor, a log integration approach may be used during Verification Testing.

If the rate of ozone decay follows first order reaction kinetics, the ozone residual at any point in the contactor can be calculated (Coffey and Gramith, 1994). By measuring the ozone residual at two points (the upstream location, which may be the ozone application point, and the downstream location) in the contactor where the detention time between those two points is known, the ozone decay rate, k , can be calculated. With a constant decay rate and a known initial ozone residual, the log integration method can be used to calculate the CT value. The equation used to calculate CT values based on the log integration method is as follows:

$$CT = (T_{10}/T_{\text{theory}}) * (C_o) * (e^{(kt)} - 1)/k$$

where: T_{10}/T_{theory} = Short-circuiting factor determined during tracer tests (< 1.0)
 C_o = Initial concentration of dissolved ozone at the upstream sampling point, mg/L
 k = Decay rate, 1/minute
 t = Contact time at the downstream location, minutes

The decay rate, k , is determined using the following equation:

$$k = -[\ln C - \ln C_o]/t$$

where: C = Dissolved ozone concentration at downstream location, mg/L

Note that the C_o concentration is the measured dissolved ozone concentration at the upstream sampling location and C_o is not the applied ozone dosage.

The log integration method provides a higher, more accurate CT value than the conservative method. The following example illustrates how to calculate the CT values using the log integration method.

If there are two sample ports, located along the ozone contactor at 0 and 6 minutes of hydraulic detention time, and the dissolved ozone concentrations are 1.4 and 0.5 mg/L at each sample port, respectively, the log integrated CT value for a contactor having a T_{10}/T_{theory} of 0.8 would be calculated as follows:

First, calculate the decay rate, k :

$$k = -[\ln C - \ln C_o]/t$$

$$k = -[\ln (0.5) - \ln (1.4)]/6 \text{ min}$$

$$k = -[(-0.693) - (0.336)]/6$$

$$k = 0.172/\text{min}$$

Next, calculate the CT value:

$$CT = (T_{10}/T_{\text{theory}}) * (C_o) * (e^{(kt)} - 1)/k$$

$$CT = (0.8) * (1.4) * (e^{(0.172 * 6)} - 1)/0.172$$

$$CT = 11.8 \text{ mg-minutes/L}$$

This comparison shows that the log integration method can give higher CT values than the conservative method.

7.0 TASK A: CHARACTERIZATION OF FEED WATER

7.1 Introduction

This Initial Operations task is performed to determine if the chemical, biological, and physical characteristics of the feed water are appropriate for the water treatment equipment to be tested.

Initial Operations Tasks A and B are not mandatory but they are recommended as an aid to successful completion of Verification Testing.

7.2 Objectives

The objective of this task is to obtain a complete chemical and physical characterization of the source water, or the feed water after pre-treatment that will be entering the treatment system being tested.

7.3 Work Plan

During this Initial Operations task, the following water quality characteristics of the feed water to the ozone system should be measured and recorded for both ground and surface waters: ozone demand, turbidity, temperature, pH, alkalinity, calcium, total hardness, total sulfides, total organic carbon, dissolved organic carbon, ultraviolet absorbance (at 254 nm), color, bromide, iron, and manganese.

Sufficient information shall be obtained to illustrate the variations expected to occur in these parameters that will be measured during the Verification Testing for a typical annual cycle for the water source. This information will be compiled and shared with NSF so NSF and the FTO can determine the adequacy of the data for use as the basis to make decisions on the testing schedule.

A brief description of the watershed or aquifer source shall be provided, to aid in interpretation of feed water characterization. The watershed description should include a statement of the approximate size of the watershed, a description of the topography (i.e., flat, gently rolling, hilly, mountainous) and a description of the kinds of human activity that take place (i.e., mining, manufacturing, cities or towns, farming, wastewater treatment plants) with special attention to potential sources of pollution that might influence feed water quality. The presence of livestock as well as the existence of other wildlife (e.g., beavers) in the watershed shall be reported. The nature of the water source, such as stream, river, lake or man-made reservoir, should be described as well. Aquifer description should include (if available) the above characterization relative to the recharge zone, a description of the hydrogeology of the water bearing stratum(a), well boring data, and any Microscopic Particulate Analysis data indicating whether the groundwater is under the influence of surface waters. Any information pertaining to the nature of the well and aquifer (e.g., shallow well or vulnerable well) should also be included.

Any pretreatment, including oxidation, coagulation, or pH adjustment, of the water upstream of the ozone equipment shall be completely documented and characterized. Any coagulant or other chemical addition shall be identified and the chemical form and dosage shall be fully described.

7.4 Analytical Schedule

There is no recommended analytical schedule for characterization of the feed water. Any existing water quality data should be reviewed to assess the character of the feed or source water

as well as the range of water quality that can be expected during each season. Water quality sampling can be performed if there are data gaps in the existing information.

7.5 Evaluation Criteria

Feed water quality will be evaluated in the context of the Manufacturer's statement of the equipment performance objectives but should not be beyond the range of water quality suitable for treatment for the equipment in question. The device shall be tested using water of the quality for which the equipment was designed.

8.0 TASK B: INITIAL TEST RUNS

8.1 Introduction

During the Initial Operations, a Manufacturer may choose to evaluate equipment operations and determine flow rates, hydraulic residence time, ozone production, CT results, and power supply requirements, or other factors applicable to the technology and related to effective treatment of the feed water. The Manufacturer may also choose to work with the FTO and the analytical laboratory to perform blank or preliminary challenges (if necessary) and sampling routines to verify that sampling equipment can perform the required functions under normal operating conditions. This information may also indicate operating conditions under which the Manufacturer's stated performance objectives are not met, or whether any CT values cannot be achieved. This is a recommended Initial Operations task. An NSF field inspection of equipment operations and sampling and field analysis procedures may be carried out during the initial test runs, and if this occurs, the Initial Operations Task B must be performed.

The "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies" (Chapter 1) under which this test plan is formulated requires hydraulic tracer testing to demonstrate flow conditions and residence times (i.e., T_{10} times) in the ozone equipment. The equipment Manufacturer may want to conduct such tests during these initial runs.

The hydrodynamic tracer testing may be done at the ETV field test site, or at another location, including the manufacturer's plant. Testing at a location other than the field test site may be advantageous in terms of using dye tracers, sampling and analysis, etc. The tracer testing must be conducted by the FTO, regardless of the site chosen for this testing. Performing hydrodynamic tracer tests at a location other than the ETV field test site is an option only if the treatment equipment has an ozone contact chamber produced by the manufacturer and if this contact chamber is the standard chamber provided with the treatment equipment.

Additional tracer tests are required if flow rates or hydraulics differ from those demonstrated previously (i.e., other Verification Testing). Procedures for developing a tracer test methodology are described in the Protocol.

8.2 Objectives

The objective of these test runs is to bracket the proper operating parameters for treatment of feed water during Verification Testing. The disinfection ability of an ozone system will vary depending on the quality of the feed water being treated and the season. Therefore, conducting initial test runs is strongly recommended.

8.3 Work Plan

Because Initial Operations test runs are not a requirement of this ETV plan, the Manufacturer and FTO can decide the duration of Initial Operations. Enough time should be available to establish optimal operating conditions and to ensure that the system will be able to meet any performance objectives.

8.4 Analytical Schedule

Because these runs are being conducted to define future operating conditions for Verification Testing, a strictly defined schedule for sampling and analysis does not need to be followed. Adhering to the schedule for sampling and analysis to be followed during Verification Testing is recommended, however, so the operator can gain familiarity with the time requirements that will be applicable during Verification Testing. Also during the Initial Operations phase, NSF may conduct an initial on-site inspection of field operations, sampling activities, and on-site analyses. The sampling and analysis schedule to be used during Verification Testing shall be followed during the on-site inspection.

8.5 Evaluation Criteria

The Manufacturer should evaluate the data produced during the Initial Operations to determine if the water treatment equipment performed in a manner, which will meet or exceed the statement of performance objectives. If performance is not as good as claimed in the statement of performance objectives, the Manufacturer may conduct additional Initial Operations or cancel the remainder of the testing program.

9.0 TASK 1: VERIFICATION TESTING RUNS AND ROUTINE EQUIPMENT OPERATION

9.1 Introduction

Water treatment equipment that includes ozone or AOPs shall be operated for verification testing purposes with the operational parameters appropriate for the manufacturer's statement of performance objectives.

9.2 Experimental Objectives

The objective of this task is to operate the ozone or AOP equipment and characterize the effectiveness and reliability of the equipment.

9.3 Work Plan

9.3.1 Verification Testing Runs

The Verification Testing Runs in this task consist of an evaluation of the treatment system, using the most successful treatment parameters defined during Initial Operations. Performance and reliability of the equipment shall be tested during one or more Verification Testing periods consisting of at least 200 hours of ozone production at the test site. If only one testing period is used, the time selected should represent the worst-case for concentrations of ozone-demanding contaminants. During each testing period, Tasks 1 through 6 shall be conducted simultaneously.

Operation to treat a range of feed water quality is recommended for equipment treating surface waters because of the differences in water quality that can occur on a seasonal basis, although pre-treatment modules, when present, may dampen these variations. Factors that can influence microbial inactivation include:

- The presence of ozone-demanding substances that may be present in the form of particulate matter, dissolved organic matter, or dissolved inorganic matter; often occurring in the spring, or during reservoir or lake turn-over events, or also encountered in rivers carrying a high sediment load or in surface waters during periods of high runoff resulting from heavy rains or snow melt. Algae also exert an ozone demand, as do iron, manganese, and cyanide. The presence of ozone-demanding substances will affect the CT value achieved by the system.
- pH: which can vary seasonally, will affect the decay rate of ozone in natural waters, and may also affect the CT values achieved by the system.
- Temperature: the required CT values for *Giardia* and viruses are higher for colder water.
- Other ozone-demanding substances.

9.3.2 Routine Equipment Operation

If the water treatment equipment is being used for production of potable water during the time intervals between verification runs, routine operation of the equipment will occur. In this situation, the operating and water quality data collected and furnished to the Safe Drinking Water Act (SDWA) primacy agency shall be supplied to the NSF-qualified FTO for use in evaluating conditions during verification testing.

For equipment that is being used to treat water for distribution to customers, it is assumed that the State has already issued a permit (if one is necessary) for installation and operation. If verification testing is being conducted to establish the inactivation capabilities of the existing equipment, permission by the State may be required if the system were taken off-line for Verification Testing.

9.4 Schedule

During Verification Testing, water treatment equipment shall be operated for a minimum of 200 hours. The reason and duration of any interruptions in ozone production during Verification Testing shall be fully documented.

9.5 Evaluation Criteria

The goal of this task is to operate the equipment for 200 hours during each Verification Testing period. Data shall be provided to substantiate that 200 hours of operation have been completed.

10.0 TASK 2: FEED WATER AND TREATED WATER QUALITY

10.1 Introduction

Water quality data shall be collected during Verification Testing for the feed water and treated water as shown in Table 1. The Field Test Organization, on behalf of the equipment Manufacturer, shall assure the sampling or measuring of the water quality parameters in Table 1. The FTO may use local personnel to assist in collection of samples or measurement of test parameters, but is responsible for their training to assure proper techniques are used at all times.

10.2 Experimental Objectives

The objective of this task is to identify the presence and concentration of water quality characteristics, which might affect the ability of ozone to inactivate microorganisms. This task also may be conducted to provide data on the effect of ozone use on the formation of disinfection by-products such as trihalomethanes (THMs) and haloacetic acids (HAAs) in the test water.

10.3 Work Plan

The Manufacturer or FTO will be responsible for establishing the testing operating parameters, on the basis of the Initial Operations testing. Many of the water quality parameters described in this task will be measured on-site by the NSF-qualified FTO or by local community personnel properly trained by the FTO. Analysis of the remaining water quality parameters will be performed by a state-certified or third party- or EPA-accredited analytical laboratory. The methods to be used for measurements of water quality parameters in the field are listed in the Analytical Methods section in Table 2. The analytical methods utilized in this study for on-site monitoring of feed water and treated water qualities are described in Task 6, Quality Assurance/Quality Control (QA/QC). Where appropriate, the *Standard Methods* reference

numbers for water quality parameters are provided for both the field and laboratory analytical procedures. EPA Methods for analysis of the parameters listed in Table 2 also may be used.

Any disinfectant added upstream of the ozone addition point will affect the ozone demand; therefore, an agreement between NSF, the manufacturer, and the FTO must be made to determine whether or not to allow pre-disinfection prior to ozonation during the Verification Testing Period. If a pre-disinfectant is used, testing shall be conducted to verify that no disinfectant residual exists at the influent of the ozone contactor, or if a disinfectant residual does exist, a quenching solution (e.g., sodium bisulfite or hydrogen peroxide) shall be used. The latter option (quenching) is less desirable because the concentration of the quenching agent will have to be carefully monitored during testing to minimize over-feeding of the quenching agent (which would result in an ozone demand).

10.4 Analytical Schedule

Water quality data shall be collected at the intervals specified in Table 1. Additional sampling and data collection may be performed at the discretion of the Manufacturer. Sample collection protocol shall be defined by the FTO in the PSTP. Algae sampling is not required for systems using groundwater sources.

For water quality samples that will be shipped to a state-certified or third party- or EPA-accredited laboratory for analysis, the samples shall be collected in appropriate containers (containing preservatives as needed) prepared by the laboratory. These samples shall be preserved, stored, shipped, and analyzed in accordance with appropriate procedures and holding times, as specified by the laboratory. Original field sheets and chain-of-custody forms shall accompany all samples shipped to the laboratory. Copies of field sheets and chain-of custody forms for all samples shall be provided to NSF.

10.5 Evaluation Criteria

Evaluation of water quality in this task is related to the manufacturer's statement of performance objectives for plants that employ ozone or AOPs in the treatment process.

11.0 TASK 3: DOCUMENTATION OF OPERATING CONDITIONS AND TREATMENT EQUIPMENT PERFORMANCE

11.1 Introduction

Throughout the Verification Testing period, operating conditions shall be documented. This shall include descriptions of pretreatment chemistry and filtration performance for the system processes, if used, and their operating conditions. The performance of the ozone equipment (including ozone generator(s), air preparation system(s), off-gas destruct unit(s), injection equipment, ozone monitor(s), and contactor(s)) as well as UV light and hydrogen peroxide equipment shall be documented. The total volume of water treated and the total power usage for all equipment associated with the ozone or AOP system shall also be recorded.

11.2 Objectives

The objective of this task is to accurately and fully document the operating conditions during treatment, and the performance of the equipment. This task is intended to collect data that describe operation of the equipment and information that can be used to develop cost estimates for operation of the equipment.

11.3 Work Plan

During Verification Testing, treatment equipment operating parameters for both pretreatment and ozonation shall be monitored and recorded on a routine basis by the NSF-qualified FTO or by local community personnel properly trained by the FTO.

Table 3 outlines some of the operating parameters that shall be monitored throughout Verification Testing. Operating parameters, in addition to those listed in Table 3, may be needed to adequately assess the operating conditions of the ozone or AOP equipment. These additional parameters shall be identified by the Manufacturer and the FTO and agreed upon by the Manufacturer and NSF.

Examples of operational parameters that shall be monitored are:

- water flow rates
- gas flow rates
- water pressures
- gas pressures
- water temperatures
- gas temperatures
- ozone operating voltage
- ozone production power consumption
- air preparation power consumption or other consumables for air preparation
- oxygen feed rate (if applicable) and other pertinent operation information
- performance of oxygen generation or oxygen feed equipment
- ozone electrical frequency, if variable
- amperage of ozone equipment.

On a daily basis, the operator shall note and record whether any visual effects of ozonation are apparent in the treated water or on piping or vessels that convey or hold treated water. This may include surface scum, precipitation of metals, color changes, etc. At the end of the test period, if an ozone contact chamber is provided with the equipment and if it is accessible, the contact chamber shall be inspected for deposits of scum, precipitation of metals, or color changes, and this information shall be noted in the Verification Testing report.

11.4 Schedule

Table 3 presents the schedule and recording data required for ozone and AOP systems. The length of time (hours) of operation (during Verification Testing) shall be recorded for all of the ozone and AOP equipment.

11.5 Evaluation Criteria

Where applicable, the data developed from this task will be compared to statements of performance objectives. If no relevant statement of performance objectives exists, results of operating and performance data will be tabulated for inclusion in the Verification Report.

12.0 TASK 4: DOCUMENTATION OF EQUIPMENT PERFORMANCE: CALCULATION OF CT AND (OPTIONAL) INACTIVATION OF MICROORGANISMS

12.1 Introduction

Inactivation of microorganisms is one of the primary purposes of ozone in drinking water treatment modules. The ability of ozone and AOP equipment to inactivate certain microorganisms can be assessed by determining the CT values that can be attained by the equipment under carefully defined water quality and operating conditions and/or measuring the inactivation of microorganisms by conducting challenge testing.

The ability of ozone to inactivate virus and *Giardia* is well documented and the USEPA, in its guidance manual to the states, has adopted a CT approach for determining inactivation of these microorganisms by disinfection. The USEPA has not yet adopted CT values for *Cryptosporidium*, because researchers are still carrying out studies on this (March 1999).

Microbial seeding studies can also be performed to determine the inactivation ability of the ozone equipment being tested. This will be necessary for AOPs, the performance of which cannot be estimated by using CT calculations. The measurement of inactivation is a comparison of the percent of viable organisms in the feed stream with the percent of viable organisms in the effluent.

12.2 Experimental Objectives

The objective of this task is to determine the CT capabilities of the equipment (based on data from Tasks 2 and 3), and if microbial challenge testing is performed, to determine the logs of inactivation achieved during these tests.

12.3 Work Plan

The manufacturer shall conduct water quality sampling and calculate CT values attained by the equipment. In some instances, microbial challenge testing will be used to determine the level of log inactivation that can be achieved by the ozone or AOP equipment.

12.3.1 CT Criteria

The CT concept of assessing disinfection is described in detail in Section 6.6. The data that are needed to calculate CT values include: dissolved ozone concentration at

appropriate monitoring points, pH, temperature, and water flow rate and T_{10} contacting time. The CT values necessary to achieve inactivation of viruses, *Giardia*, and *Cryptosporidium* are different from one another and are described in the next two sections.

12.3.1.1 Required CT for Virus and *Giardia*. The EPA-published CT values associated with inactivation of viruses and *Giardia* cysts are shown in Tables 4 and 5, respectively. If the Manufacturer's statement of performance is presented in terms of logs of inactivation of viruses or *Giardia* cysts, the calculated CT values for an ozone system or for an AOP system that provides for dissolved ozone contact in the water being treated before introduction of hydrogen peroxide or UV radiation must exceed the relevant EPA-published CT values shown in Tables 4 and 5. Because CT values for viruses and *Giardia* cysts are temperature dependent, testing should be scheduled to include the extreme range in water temperatures expected to occur during different seasons of the year. The range in water temperatures being treated shall be determined and agreed upon by the FTO and the Manufacturer during the Initial Test Runs conducted prior to Verification Testing.

If a Manufacturer's statement of performance presents log inactivation values that exceed those shown in Tables 4 and 5, or presents log inactivation values for water quality conditions not included in Tables 4 and 5, microbial challenge or seeding studies shall be required to verify the levels of inactivation achieved by the equipment.

If the pH of the feed water to the ozone or AOP system is less than 6 or greater than 9, microbial challenge studies are required for Verification Testing.

12.3.1.2 CT Calculations for *Cryptosporidium*. The USEPA has not developed CT values for estimating the log inactivation of *Cryptosporidium* by disinfection, and as of March 1999 regulatory requirements for *Cryptosporidium* have not been promulgated. During verification testing, the CT value achieved by the equipment shall be determined, regardless of the level of *Cryptosporidium* inactivation that has occurred. However, if a Manufacturer states that the equipment can achieve a certain level of *Cryptosporidium* inactivation, microbial challenge testing must be performed.

12.3.2 Microbial Challenge Tests

Microbial challenge tests, if undertaken, shall be conducted at full scale with commercially available equipment and not with pilot or prototype equipment. The FTO shall conduct the challenge studies in the field, and the FTO shall submit the resulting samples to a state-certified or third party- or EPA-accredited laboratory. Water produced during challenge testing shall not be distributed to the public. Challenge organisms to be tested will be selected by the equipment Manufacturer. Microbial challenge tests shall be performed three times per Verification Test period.

As a QA/QC measure, one additional process control microbial seeding test shall be performed while the ozone equipment is not operating. This seeding test shall be

performed after the three microbial challenge tests have been completed, and the system has been flushed with at least three volumes of water (with ozone equipment in use) to ensure that all seeded organisms have exited the system.

If the Manufacturer's Statement of Performance Objectives is based on microbial inactivation, the FTO shall identify the microbiological contaminant inactivation capabilities in the Statement of Performance Objectives provided in the PSTP. In the Statement of Performance Objectives, the Manufacturer shall identify the specific microbiological contaminants to be monitored during equipment testing and the specific operational conditions under which inactivation testing shall be performed. The Statement of Performance Objectives prepared by the FTO on behalf of the Manufacturer shall also indicate the range of water quality under which the equipment can be challenged while successfully treating the feed water. Examples of satisfactory Statements of Performance Objectives based on microbial inactivation were provided below.

For Microbial Inactivation:

"This system is capable of achieving 3-log₁₀ inactivation of Giardia lamblia at a generation system output of 80% for a feed water flow of 100 gpm for a feed water with pH of 8.5 or less, turbidity of 20 NTU or less, organic carbon concentrations between 2.0 and 4.0 mg/L and alkalinity less than 150 mg/L as CaCO₃."

Microbial Inactivation (Comparative):

"This system is capable of achieving 3-log₁₀ inactivation of Giardia lamblia at CTs 20% lower than EPA's published chlorine CTs. This level of Giardia lamblia inactivation will be achieved by the equipment at a generation system output of 80% for a feed water flow of 100 gpm for a feed water with pH of 8.5 or less, turbidity of 20 NTU or less, organic carbon concentrations between 2.0 and 4.0 mg/L and alkalinity less than 150 mg/L as CaCO₃."

12.3.2.1 Organisms Employed for Challenge Experiments. Microorganisms that may be used for inactivation studies are listed below. These species represent microorganisms of particular interest and concern to the drinking water industry, and represent a range of resistance to inactivation methods. The specific batches of microorganisms used in inactivation testing must be shown to be initially viable by the laboratory involved in the analytical aspects of the testing.

Protozoan cysts and oocysts: *Giardia muris*, *Giardia lamblia*, *Cryptosporidium parvum*
 Bacteria: *Bacillus subtilis*, *Pseudomonas* spp., *Clostridium perfringens*,
 Virus: MS2 bacteriophage (surrogate)

12.3.2.2 Spiking Protocols. The total number of organisms required to provide steady-state microbiological populations will depend on the overall volume of the disinfection contactor, the flow rate through the contactor, the detection limits of the analytical methods, the number of surviving microorganisms at the end of the test, and the duration

of the experiments. For viruses, a steady-state final concentration large enough to show 4-log inactivation in the effluent is necessary. For all organisms, the laboratory (ies) supplying the organisms and performing the viability studies shall be experienced in challenge testing and be able to predict initial dosages required to overcome any inherent experimental losses. Microbial challenges shall be conducted either by batch seeding or by feed stream injection.

12.3.2.3 Batch Seeding. A batch feed tank with sufficient volume to provide the required test volume shall be used. The discharge from this tank shall be located so that 100% of the contents can be delivered to the system. The tank shall be filled with feed water that shall be dechlorinated, if necessary. The feed water shall be stirred during dechlorination. Verification of dechlorination shall be performed prior to the introduction of the seed organisms. The feed tank shall be continuously stirred during seeding and throughout the testing period. Prior to microbial seeding of the tank, agitation of the bulk seed container received from the supplier (by vortexing or sonication) shall be employed to assure organisms are not clumped together. A secondary source of feed water (dechlorinated, if necessary) sufficient to provide 3 retention time equivalents (as determined by tracer tests or as defined by system functions) shall be available to add to the tank when the initial contents have been consumed. The purpose of this feed water will be to continue flushing seeded organisms through the ozone contactor to the effluent sample ports.

12.3.2.4 In-line Injection. The microorganism feed suspension will be plumbed into the test unit with a check-valve equipped injection port followed by a mixing chamber. A one liter carboy equipped with a bottom dispensing port will feed this injection port by means of a metering pump (diaphragm or peristaltic or equivalent) via siliconized or Teflon tubing. The pump shall be capable of fluid injection into the pressurized system feed line for the duration of the test, at a measurable and verifiable rate such that the one-liter carboy is depleted coincident with the end of the test.

The carboy with the spiked suspension will contain a magnetic stir bar, will be filled with one liter of system water (dechlorinated if necessary), and will be placed on a stirplate. The stock suspension of microorganisms shall be agitated by methods such as vortexing or sonication prior to being added to the carboy. After the appropriate flow rate has been established through the ozone contactor, the contactor is operating properly, and sample collection systems are readied, the injection pump can be started. During the course of the test run, monitoring of the flow rate through the ozone contactor and the spike injection rate shall be performed at regular intervals. Adjustments to these flow rates will be made to maintain test conditions.

12.3.3 Test Operation and Sample Collection

12.3.3.1 Test Stream Sampling. Sample ports shall be provided for the feed water stream (spiked with concentrations of microbiological contaminants) and the ozone-treated water stream at the contactor effluent. The FTO shall specify the specific ways in which sample collection is performed according to the organisms that will be used for the

proposed microbiological inactivation experiments. Examples of potential sample collection methods for bacterial, viral and protozoan organisms are provided below. The methods described, or any other peer-reviewed method may be used for verification testing. The FTO shall propose in the PSTP the specific methods that are to be used for viability assessment of the selected microorganisms (See Section 12.3.5 below).

For bacterial and/or viral seeding experiments, methods for organism spiking and sample collection shall be consistent with a selected peer-reviewed method. The frequency and number of samples collected for each sampling point will be determined by the length of the test run and shall be specified by the FTO in the PSTP. The volume of each ozone-treated water sample from the disinfection contactor effluent will depend on the concentrations of test organisms spiked, and the requirements of the analytical laboratory.

For protozoan spiking experiments, EPA Method 1622 or any other method that has been evaluated through the peer-reviewed process (e.g., Nieminski and Ongerth, 1995) may be followed for sample collection from the spiked water streams. The sample collection system shall be plumbed to allow installation of housings and filters for capture of sufficient flow for microbiological analysis. The FTO shall provide an indication of the recovery efficiency achievable under the sample collection method selected for use during protozoa seeding studies. The specific capture filter recovery system shall be fully described in the PSTP by the FTO. In addition, the PSTP shall include a plan of study for verification testing with a minimum of three standard recovery efficiency tests from the microbiological laboratory.

The sample tap(s) shall be sanitized with 95% ethanol one minute prior to initiating any bacteria or virus sample collection. Taps shall be flowing at the appropriate sample rate for at least one minute prior to sample collection.

12.3.3.2 Chlorine Residual Analysis. The chlorine concentration of the dilution water used for preparing microorganism spiking solutions shall be measured to ensure that no chlorine residual is present.

12.3.3.3 Post-Test Sample Handling. At completion of the test run, the FTO shall disconnect the capture filter holders from the sample taps. Filters shall then be handled and prepared for delivery to the analytical laboratory as directed by that laboratory. The FTO shall then take steps to contain and/or sanitize any organisms remaining in the system. Depending on the unit (design and materials), sanitization may be done using steam or hot water (80°C for 10 minutes). The QA/QC plan should address how this sanitization procedure is to be done to ensure inactivation of live organisms and subsequent removal of inactivated organisms from the unit. The plan should also address biosafety concerns for both humans and the environment.

12.3.4 Experimental Quality Control

Two QA/QC samples shall be included in the microbial challenge tests: 1) process control; and, 2) trip control. The requirements associated with these QA/QC samples are discussed in Task 6, Section 14.5.

12.3.5 Viability Analysis

Methods for assessing the viability of the selected bacteria and viruses shall be specified by a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the USEPA for the appropriate microbial analyses. Selected viability methods shall be specified by the FTO in the PSTP.

Methods for assessing the viability of cysts and oocysts are non-standard but may be used in verifying objectives that an ozone treatment system inactivates protozoan cysts and oocysts if the method has undergone peer review. A summary and comparison of viability methods is presented in research completed by the following researchers: Korich et al. (1993), Nieminski and Ongerth (1995), Slifko et al. (1997) and others (see Section 16.0 References in this Test Plan). Interim, non-standard methods for assessing the viability of cyst and oocyst (e.g., excystation, DAPI/PI) may be used for verification of inactivation after exposure to disinfectants. However, any interim organism viability method is subject to review by experts of cyst and oocyst viability and subsequent method change. Any non-standard method for assessing cyst and oocyst viability shall be correlated to animal infectivity. Microbial viability analyses are further discussed in Section 4.4 of the "Protocol For Equipment Verification Testing of Microbiological Contaminant Inactivation."

Prior to microbial challenge testing, an adequate method of determining viability should be selected to provide meaningful results for the study. For example, the experimental set-up for viability analyses should be able to adequately show the range of log inactivation capabilities of the ozone system being tested.

12.4 Analytical Schedule

For CT value determinations, during the 200 hours of ozone production for Verification Testing, the dissolved ozone residual shall be measured at specified sampling locations and at regular intervals. These intervals shall be three times per day (3/d) if ozone production is continuous over the 200 hour testing period or three times per staffed shift (3/shift) if ozone production is to be periodically interrupted or terminated during Verification Testing such that the periods of ozone production are less than 24 hours. For example, if a system operates for only 8 hours each day, Verification Testing will be conducted over a total of 25 days. Each day, dissolved ozone measurements shall be collected at three different times. The pH, temperature, and water flow rate also need to be measured concurrently with the dissolved ozone concentration so the CT values can be calculated accurately.

Microbial challenge testing shall be performed three times during the Verification Test period. The operating conditions shall be the same for each of the three required challenge tests. These challenge tests shall be conducted during the 200 hours of Verification Testing. A recommended schedule for microbial testing would be to begin the challenge testing at 50, 100, and 150 hours of continuous operation. If additional time is needed beyond the 200 hours for Verification Testing, the schedule of testing for all water quality parameters and operational conditions of Tasks 1, 2, and 3 shall be continued until the microbial challenge tests are completed.

12.5 Evaluation Criteria

The CT values measured in this task will be compared to the Manufacturer's statement of performance for the ozone or AOP equipment. These field-measured CT values will be compared to the EPA-published CT values for the level of inactivation of virus and *Giardia* (Tables 4 and 5) achieved by the ozone or AOP system. If microbial challenge testing is performed, the measured log inactivations of microorganisms will be compared to the ozone CT/inactivation relationships established by the USEPA.

The total CT values for the ozone or AOP system will be calculated for each individual sampling time (i.e., three sampling events per day or per shift), therefore each Verification Test period will produce a minimum of 25 individual CT values. The minimum, maximum, and average CT value for each Verification Test shall also be reported.

13.0 TASK 5: DATA MANAGEMENT

13.1 Introduction

The data management system used in the Verification Testing program shall involve the use of computer spreadsheet software and manual recording of the operational parameters for the water treatment equipment on a daily basis.

13.2 Experimental Objectives

The objectives of this task are: 1) to establish a viable structure for the recording and transmission of field testing data so the FTO will provide sufficient and reliable operational data for verification purposes, and 2) to provide the information needed for a statistical analysis of the data, as described in "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies."

13.3 Work Plan

The following protocol has been developed for data handling and data verification by the FTO. Where possible, a Supervisory Control and Data Acquisition (SCADA) system should be used for automatic entry of testing data into computer databases. Specific parcels of computer databases for operational and water quality parameters should then be downloaded by manual importation into Excel (or similar spreadsheet software) as a comma delimited file. These

specific database parcels will be identified based upon discrete time spans and monitoring parameters. In spreadsheet form the data will be manipulated into a convenient framework to allow analysis of water treatment equipment operation. Backup of the computer databases to diskette should be performed on a monthly basis at a minimum. When SCADA systems are not available, direct instrument feed to data loggers and laptop computers shall be used when appropriate.

For parameters for which electronic data acquisition is not possible, field testing operators will record data and calculations by hand in laboratory notebooks (daily measurements will be recorded on specially-prepared data log sheets as appropriate). Each notebook must be permanently bound with consecutively numbered pages. Each notebook must indicate the starting and ending dates that apply to entries in the logbook. All pages will have appropriate headings to avoid entry omissions. All logbook entries must be made in black water insoluble ink. All corrections in any notebook shall be made by placing one line through the erroneous information. Products such as "correction fluids" are never to be utilized for making corrections to notebook entries. Operating logs shall include a description of the water treatment equipment (description of test runs, names of visitors, description of any problems or issues, etc.); such descriptions shall be provided in addition to experimental calculations and other items. The original notebooks will be stored on-site; photocopies will be forwarded to the project engineer of the FTO at an agreed upon schedule. This protocol will not only ease referencing the original data, but will also offer protection of the original record of results.

The database for the project will be set up in custom-designed spreadsheets. The spreadsheets will be capable of storing and manipulating each of the monitored water quality and operational parameters from each task, each sampling location, and each sampling time. All data from the laboratory notebooks and data log sheets will be entered into the appropriate spreadsheets. Data entry will be conducted on-site by the designated field testing operators. All recorded calculations will also be checked at this time. Following data entry, the spreadsheet will be printed out and the print-out will be checked against the handwritten data sheet. Any corrections will be noted on the hard-copies and corrected on the screen, and then a corrected version of the spreadsheet will be printed out. Each step of the verification process will be initiated by the field testing operator or engineer performing the entry or verification step.

Each experiment (e.g. each challenge test run or verification run) will be assigned a run number which will then be tied to the data from that experiment through each step of data entry and analysis. As samples are collected and sent to state-certified or third party- or EPA-accredited laboratories, the data will be tracked by use of the same system of run numbers. Data from the outside laboratories will be received and reviewed by the field testing operator. These data will be entered into the data spreadsheets, corrected, and verified in the same manner as the field data.

13.4 Statistical Analysis

Water quality developed from grab samples collected during test runs according to the Analytical Schedule in Task 2 of this Test Plan shall be analyzed for statistical uncertainty. The FTO shall calculate 95% confidence intervals for grab sample data obtained during Verification Testing as

described in "Protocol for Equipment Verification Testing of Microbiological Contaminant Inactivation" (Chapter 1). Statistical analysis could be carried out for a large variety of testing conditions.

The statistics developed will be helpful in demonstrating the degree of reliability with which water treatment equipment can attain quality goals. Information on the differences in feed water quality variations for entire test runs versus the quality produced during the optimized portions of the runs would be useful in evaluating appropriate operating procedures.

14.0 TASK 6: QUALITY ASSURANCE/QUALITY CONTROL

14.1 Introduction

Quality assurance and quality control (QA/QC) of the operation of the water treatment equipment and the measured water quality parameters shall be maintained during the Verification Testing program.

14.2 Experimental Objectives

The objective of this task is to maintain strict QA/QC methods and procedures during testing. When specific items of equipment or instruments are used, the objective is to maintain the operation of the equipment or instructions within the ranges specified by the Manufacturer or by *Standard Methods*. Maintenance of strict QA/QC procedures is important in that if a question arises when analyzing or interpreting data collected for a given experiment, it will be possible to verify exact conditions at the time of testing.

14.3 Work Plan

Equipment flow rates and associated signals shall be documented and recorded on a routine basis. Daily routine walk-throughs during testing shall be used to verify that each piece of equipment or instrumentation is operating properly. In-line monitoring equipment, such as flow meters, will be checked to verify that the readout matches with the actual measurement (i.e., flow rate) and that the signal being recorded is correct. The items listed below are in addition to any specified checks outlined in the analytical methods.

14.3.1 Daily QA/QC Verifications

These verifications shall be conducted daily:

- In-line turbidimeter flow rates (verified volumetrically over a specific time period)
- In-line turbidimeter readings checked against a properly calibrated bench-top model

14.3.2 QA/QC Verifications Performed Every Two Weeks

These verifications shall be conducted every two weeks:

- In-line flow meters/rotameters (clean equipment to remove any debris or biological buildup and verify flow volumetrically to avoid erroneous readings).
- In-line turbidimeters, if any, (clean out reservoirs and re-calibrate, if employed)

14.3.3 QA/QC Verifications For Each Testing Period

This verification shall be conducted before testing begins:

- Tubing: Verify that all tubing and connections are in good condition and replace if necessary. For surface water systems, microbial growth could occur between verification test runs, so replacement of tubing prior to each verification test may be necessary.

14.4 On-Site Analytical Methods

The analytical methods utilized in this study for on-site monitoring of raw water and disinfected water quality are described in the following section. Use of either bench-top or in-line field analytical equipment will be acceptable for the verification testing; however, in-line equipment is recommended for ease of operation. Use of in-line equipment is also preferable because it reduces the introduction of error and the variability to analytical results generated by inconsistent sampling techniques.

14.4.1 pH

Analysis for pH will be performed according to *Standard Method* 4500-H⁺ or EPA Method 150.1/150.2. A three-point calibration of any pH meter used in this study shall be performed once per day when the instrument is in use. Certified pH buffers in the expected range shall be used. The pH probe shall be stored in the appropriate solution defined in the instrument manual. Transport of carbon dioxide across the air-water interface can confound pH measurement in poorly buffered waters. If this is a problem, measurement of pH in a confined vessel is recommended to minimize the effects of carbon dioxide loss to the atmosphere.

14.4.2 Temperature

Readings for temperature shall be conducted in accordance with *Standard Methods* 2550. Raw water temperatures shall be obtained at least once daily. The thermometer shall have a scale marked for every 0.1°C, as a minimum, and should be calibrated weekly against a precision thermometer certified by the National Institute of Standards and Technology (NIST). (A thermometer having a range of -1°C to +51°C, subdivided in 0.1° increments, would be appropriate for this work.)

14.4.3 True Color

True color shall be measured with a spectrophotometer at 455 nm, using an adaptation of the *Standard Methods* 2120 procedure. Samples shall be collected in clean plastic or glass bottles and analyzed as soon after collection as possible. If samples cannot be

analyzed immediately they shall be stored at 4°C for up to 24 hours, and then warmed to room temperature before analysis. The filtration system described in *Standard Methods* 2120 C shall be used, and results should be expressed in terms of PtCo color units.

14.4.4 Dissolved Oxygen

Analysis for dissolved oxygen shall be performed according to *Standard Method* 4500-O using an iodometric method or the membrane electrode method. The techniques described for sample collection must be followed very carefully to avoid causing changes in dissolved oxygen during the sampling event. Sampling for dissolved oxygen does not need to be coordinated with sampling for other water quality parameters, so dissolved oxygen samples should be taken at times when immediate analysis is going to be possible. This will eliminate problems that may be associated with holding samples for a period of time before the determination is made.

If the sampling probe is not mounted such that the probe is continuously exposed to the process stream, then care must be taken when measuring the dissolved oxygen concentration. For best results, collect the dissolved oxygen sample with minimal agitation and measure the dissolved oxygen concentration immediately. If possible, measure the dissolved oxygen under a continuous stream of sample by placing the tip of the probe in the sample container, allowing the sample to overflow the container while the probe reaches equilibrium (usually less than 5 minutes).

14.4.5 Total Sulfides

Total sulfide samples should also be collected with minimal agitation and analyzed immediately after sample collection. If possible, the sample container should be filled using a piece of flexible Tygon tubing attached to the sampling port. The end of the tubing should be placed at the bottom of the sampling container, and the container filled to overflowing before removing the tubing and tightly capping the container.

14.4.6 Turbidity Analysis (Optional)

Turbidity analyses shall be performed according to *Standard Methods* 2130 or EPA Method 180.1 with either a bench-top or in-line turbidimeter. In-line turbidimeters shall be used for measurement of turbidity in the filtrate waters, and either an in-line or bench-top turbidimeter may be used for measurement of the feedwater.

During each verification testing period, the bench-top and in-line turbidimeters will be left on continuously. Once each turbidity measurement is complete, the unit will be switched back to its lowest setting. All glassware used for turbidity measurements will be cleaned and handled using lint-free tissues to prevent scratching. Sample vials will be stored inverted to prevent deposits from forming on the bottom surface of the cell.

The Field Testing Organization shall be required to document any problems experienced with the monitoring turbidity instruments, and shall also be required to document any subsequent modifications or enhancements made to monitoring instruments.

14.4.6.1 Bench-top Turbidimeters. Grab samples shall be analyzed using a bench-top turbidimeter. Readings from this instrument will serve as reference measurements throughout the study. The bench-top turbidimeter shall be calibrated within the expected range of sample measurements at the beginning of equipment operation and on a weekly basis using primary turbidity standards of 0.1, 0.5, and 3.0 NTU. Secondary turbidity standards shall be obtained and checked against the primary standards. Secondary standards shall be used on a daily basis to verify calibration of the turbidimeter and to recalibrate when more than one turbidity range is used.

The method for collecting grab samples will consist of running a slow, steady stream from the sample tap, triple-rinsing a dedicated sample beaker in this stream, allowing the sample to flow down the side of the beaker to minimize bubble entrainment, double-rinsing the sample vial with the sample, carefully pouring from the beaker down the side of the sample vial, wiping the sample vial clean, inserting the sample vial into the turbidimeter, and recording the measured turbidity.

For the case of cold water samples that cause the vial to fog preventing accurate readings, the vial must be allowed to warm up by partial submersion into a warm water bath for approximately 30 seconds.

14.4.6.2 In-line Turbidimeters. In-line turbidimeters are required for filtered water monitoring during verification testing and must be calibrated and maintained as specified in the manufacturer's operation and maintenance manual. It will be necessary to verify the in-line readings using a bench-top turbidimeter at least daily; although the mechanism of analysis is not identical between the two instruments the readings should be comparable. Should these readings suggest inaccurate readings then all in-line turbidimeters should be recalibrated. In addition to calibration, periodic cleaning of the lens should be conducted, using lint-free paper, to prevent any particle or microbiological build-up that could produce inaccurate readings. Periodic verification of the sample flow rate should also be performed using a volumetric measurement. Instrument bulbs should be replaced on an as-needed basis. It should also be verified that the LED readout matches the data recorded on the data acquisition system, if the latter is employed.

14.4.7 Dissolved Ozone

The dissolved ozone concentration can be measured using an indigo bleaching technique, such as *Standard Method* 4500-O₃ B or the HACH Indigo AccuVac method. When sampling for dissolved ozone, it is important to minimize sample agitation and transfer from one container to another. One good sampling technique is to collect the sample directly from the sample tap. If HACH AccuVac vials are used, the tip of the AccuVac can be placed directly into the tap opening where the water is flowing. Apply pressure and snap the tip while it is inside the sample tap opening. The vacuum in the AccuVac

vial will draw the water sample into the AccuVac. Once the AccuVac is filled, remove the AccuVac from the sample tap and analyze according the HACH instructions. If necessary, a short piece (i.e., less than 2 feet) of Tygon tubing can be attached to the sample tap for dissolved ozone sampling. If HACH AccuVac vials are not used, use of tubing attached to the sample port for sample collection is recommended to minimize sample agitation and mixing. This tubing should be Tygon and should be no longer than 2 feet in length.

Another method for measuring dissolved ozone is a dissolved ozone probe. These probes can be placed in the process stream to provide continuous measurements of ozone residuals. Check the probe tip daily to ensure that the membrane has been installed properly and that there are no air bubbles underneath the membrane. Also, check that the pressure and flow rate within the contactor are within the appropriate range for the probe being used. The performance of the probe shall be verified on a daily basis by measuring the dissolved ozone concentration with one of the indigo bleaching methods to ensure that the probe is functioning properly.

A third method for measuring dissolved ozone concentrations is an on-line analyzer which uses UV spectrophotometry to measure the gas-phase concentration of ozone which has been stripped from a liquid sample. These analyzers then correlate the gas-phase ozone concentration to the dissolved ozone concentration. These analyzers are calibrated at the factory.

14.4.8 Gas Phase Ozone

Gas phase ozone concentrations can be measured using either UV absorbance ozone monitors or a wet-chemistry test. Ozone monitors are calibrated at the factory and provide a continuous measure of the ozone concentration in gas phase. The wet-chemistry test method of measuring the ozone concentration of a gas stream involves bubbling ozone through a potassium iodide solution, acidification with sulfuric acid, and titration with sodium thiosulfate. This method is described in detail in Rakness *et al.* (1996). During each Verification Test, a wet-chemistry measurement of the ozone feed gas shall be conducted to independently check that the ozone monitor is functioning properly. If ozone monitors are not available, wet-chemistry tests shall be performed three times per day or three times per shift to measure the ozone concentration in the feed gas and off gas.

14.4.9 Hydrogen Peroxide

The concentration of hydrogen peroxide can be measured using one of two spectrophotometric methods: 1) cobalt-bicarbonate and 2) peroxidase. The cobalt-bicarbonate method, described in Masschelein *et al.* (1977), can be used to measure up to 2 mg/L hydrogen peroxide at 260 nm, whereas the peroxidase method, described in Bader *et al.* (1988), can be used to measure up to 1.7 mg/L hydrogen peroxide at 551 nm.

At low pH, ozone and peroxide can be in solution at the same time, because the reaction rate is slow. The presence of ozone interferes with any hydrogen peroxide analysis; therefore, to measure the amount of hydrogen peroxide in the AOP system, ozone production shall be temporarily terminated while hydrogen peroxide samples are being collected and analyzed.

To ensure the proper feed rate of hydrogen peroxide to the AOP system, use a stopwatch to measure the time required to collect a specified volume of hydrogen peroxide stock solution from the feed system. This requires that the hydrogen peroxide feed line to the contactor be temporarily disconnected so that the pumping rate of the stock hydrogen peroxide solution can be measured. Typically, a graduated cylinder is used to collect the pumped hydrogen peroxide sample and the size of the graduated cylinder is such that the length of collection time exceeds 10 seconds.

The strength of the peroxide feed solution can also be determined from the peroxide supplier's shipping information, as long as the peroxide being used for testing has not been: 1) diluted by the user; 2) exposed to contamination (which would affect its strength); 3) stored for longer than one year; or, 4) stored at temperatures greater than 77 °F.

14.5 Chemical and Biological Samples Shipped Off-Site for Analyses

The analytical methods that shall be used during testing for chemical and biological samples that are shipped off-site for analyses are described in this section.

14.5.1 Organic Samples

Samples for analysis of total organic carbon (TOC), dissolved organic carbon (DOC), and UV₂₅₄ absorbance shall be collected in glass bottles supplied by the state-certified or third party- or EPA-accredited laboratory and shipped at 4°C to the analytical laboratory. These samples shall be preserved, held and shipped in accordance with *Standard Method* 5010 B. Storage time before analysis shall be minimized, according to *Standard Methods*.

Assimilable organic carbon (AOC) samples shall be collected in sampling containers supplied by the state-certified or third party- or EPA-accredited laboratory. Sample collection, preservation, and storage requirements are outlined in *Standard Methods* 9060A and 9060B.

14.5.2 Microbial Parameters: Viruses, Bacteria, Protozoa, and Algae

Samples for analysis of any microbial parameter shall be collected in bottles supplied by the analytical laboratory. Microbial samples shall be refrigerated at approximately 2 to 8°C immediately upon collection. Such samples shall be shipped in a cooler and maintained at a temperature of approximately 2 to 8°C during shipment. Samples shall be processed for analysis by a state-certified or third party- or EPA-accredited laboratory

within 24 hours of collection. The laboratory shall keep the samples at approximately 2 to 8°C until initiation of processing. TC densities shall be reported as most probable number per 100 ml (MPN/100 mL) and HPC densities shall be reported as colony forming units per mL (cfu/mL).

Methods for assessing the viability of the selected bacteria and viruses shall be specified by the laboratory(ies) performing the analysis and shall be specified in the PSTP. The FTO may select a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the USEPA for analysis of microbial contaminants in water samples.

Methods for assessing the viability of cysts and oocysts are non-standard but may be used in verifying objectives that an ozone system inactivates protozoan cysts and oocysts if the method has undergone peer review. A summary and comparison of viability methods is presented in research completed by the following researchers: Korich et al. (1993), Nieminski and Ongerth (1995), and Slifko et al. (1997). Any non-standard method for assessing cyst and oocyst viability shall be correlated to animal infectivity.

Algae samples shall be preserved with Lugol's solution after collection, stored and shipped in a cooler at a temperature of approximately 2 to 8°C, and held at that temperature range until counted.

14.5.3 Inorganic Samples

Inorganic chemical samples, including alkalinity, shall be collected and preserved in accordance with *Standard Method* 3010B, paying particular attention to the sources of contamination as outlined in *Standard Methods* 3010C. The samples shall be refrigerated at approximately 4°C immediately upon collection, shipped in a cooler, and maintained at a temperature of approximately 4°C during shipment. Samples shall be processed for analysis by a state-certified or third party- or EPA-accredited laboratory within 24 hours of collection. The laboratory shall keep the samples at approximately 4°C until initiation of analysis.

14.5.4 Bromate

Samples for the analysis of bromate samples shall be collected in sampling containers supplied by the state-certified or third party- or EPA-accredited laboratory. Sample collection and storage requirements are outlined in EPA Method 300.1 or shall be provided by the laboratory conducting the analysis.

14.6 Microbial Challenge Testing

The quality control requirement for microbiological testing was specified in Task 4, Section 12.3.4.

14.6.1 Process Control

A second round of testing shall be carried out using procedures described in Section 12.3, Task 4, but without operating the ozone equipment. The purpose of this testing is to evaluate any cumulative effects produced by the equipment, the spiking and sampling procedures, and the sample handling procedures on organism viability. This testing shall not occur until sanitizing agents and inactivated target organisms, whose presence could affect subsequent tests of the unit (*Giardia* and *Cryptosporidium*), have been eliminated from the contactor. The process control samples should show minimal inactivation of the target organism(s) relative to the trip control sample. Significant inactivation of the organisms in the process control sample indicates that some aspect of the process other than ozone disinfection contributes to inactivation of the test organism(s). Repeat testing is required when this is shown to occur.

14.6.2 Trip Control

For tests utilizing spike challenges, a replicate or subsample of the spiking suspension shall accompany the actual spiking suspension from the analytical laboratory. This replicate sample shall undergo all of the processes used on the actual suspension including dose preparation pre-enumeration, shipping, preparation for spiking, and return to the laboratory for enumeration and viability baseline assessment. The trip control samples should show minimal inactivation of the target organism(s). Significant inactivation of the trip control sample indicates that some step in handling the suspension contributed to inactivation of the test organism(s). The seeding tests must be repeated when significant inactivation of the trip control sample is observed.

15.0 OPERATION AND MAINTENANCE

The following are recommendations for criteria for Operation and Maintenance (O&M) Manuals for drinking water treatment equipment employing ozone treatment.

15.1 Maintenance

The Manufacturer shall provide readily understood information on the recommended or required maintenance schedule for each piece of operating equipment including, but not limited to, the following, where applicable:

- ozone generator (dielectric replacement)
- ozone diffusers or injection port, control valves
- ozone destruct unit (catalyst replacement)
- gas phase ozone monitors (for feed gas and off gas)
- dissolved ozone monitoring equipment
- cooling water equipment
- air preparation unit or oxygen feed system for ozone generation
- gas and liquid rotameters

- UV lamps and other relevant equipment
- peroxide feed equipment
- other equipment such as pumps and valves

The Manufacturer shall also provide readily understood information on the recommended or required maintenance for non-mechanical or non-electrical equipment, including but not limited to, the following, where applicable:

- piping
- contactor chamber

15.2 Operation

The Manufacturer shall provide readily understood recommendations for procedures related to proper operation of all equipment. Among the operating aspects that should be addressed in the O&M manual are:

Ozone Generator

- air preparation or oxygen feed requirements (moisture content, filtration requirements, flow rate)
- cooling water requirements (flow)
- range of variable voltage for adjusting ozone output
- proper sequence of operation for start-up and shut-down
- proper sequence of operation for initial start-up or for re-start after maintenance

Ozone Monitors (Gas Phase)

- temperature and pressure compensation
- zeroing and calibration procedures
- proper sequence of operation for start-up and shut-down

Ozone Destruct Units

- heater and/or blower requirements
- catalyst requirements
- proper sequence of operation for start-up and shut-down

Air Preparation or Oxygen Feed Systems

- desiccant requirements and replacement procedures
- filters (maintenance and replacement schedule)
- proper sequence of operation for start-up and shut-down
- supplemental gas (air or nitrogen) flow rate, pressure, and temperature.

Cooling Water System

- maintenance of proper temperature
- monitoring cooling water flow
- pump maintenance

- proper sequence of operation for start-up and shut-down
- maintenance of recirculation equipment, if cooling water is recirculated

Ozone Contactor Systems

- maintenance schedule and procedures
- replacement procedures

UV lamps

- hours of operation (verification procedures)
- UV irradiance (calibration and verification procedures)
- maintenance schedule and procedures
- replacement procedures
- proper sequence of operation for start-up and shut-down

Hydrogen Peroxide Feed System

- procedures for variable speed adjustments to pump
- information about proper tubing type and size
- anticipated schedule for tubing replacement
- storage information (i.e., safety, container type, container material, temperature, length of storage time) for stock hydrogen peroxide solutions
- proper sequence of operation for start-up and shut-down

Control Valves

- open/close indication
- sequence of operations

The Manufacturer shall provide a troubleshooting guide; a simple checklist of what to do for a variety of problems, including but not limited to:

- no flow to unit
- sudden change in flow to unit
- no electric power
- automatic operation (if provided) not functioning
- valve stuck or will not operate

16.0 REFERENCES

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Table 1. Water Quality Sampling and Measurement Schedule

Parameter	Sampling Location	Mandatory (M) or Optional (O)	Frequency*	
			Surface Water Systems	Ground Water Systems
Temperature (°C)	Feed Water Treated Water	M	3/d or 3/shift	3/d or 3/shift
Dissolved Ozone Residual (mg/L)	Treated Water†	M	3/d or 3/shift	3/d or 3/shift
pH	Feed Water	M	3/d or 3/shift	3/d or 3/shift
Total Alkalinity (mg/L as CaCO ₃)	Feed Water	O	1/d	1/d
Total Organic Carbon (mg/L)	Feed Water	O	1/d	1/50 hours of ozone production
Dissolved Organic Carbon (mg/L)	Feed Water	O	1/d	1/50 hours of ozone production
UV absorbance at 254 nm (1/m)	Feed Water Treated Water	O	1/d	1/50 hours of ozone production
Color (Pt-Co)	Feed Water Treated Water	O	1/d	1/50 hours of ozone production
Turbidity (NTU)	Feed Water Treated Water	O	3/d or 3/shift	3/d or 3/shift
Bromide (mg/L)	Feed Water Treated Water	O	1/50 hours of ozone production	1/50 hours of ozone production
Bromate (µg/L)	Feed Water Treated Water	O	1/50 hours of ozone production	1/50 hours of ozone production

Table 1. Water Quality Sampling and Measurement Schedule, continued

Parameter	Sampling Location	Mandatory (M) or Optional (O)	Frequency*	
			Surface Water Systems	Ground Water Systems
Bacteria and Viruses	Feed Water Treated Water	M**	A minimum of three triplicate samples per Verification Testing period.	A minimum of three triplicate samples per Verification Testing period.
Protozoa	Feed Water Treated Water	M**	A minimum of three samples per Verification Testing period.	A minimum of three samples per Verification Testing period.
AOC (ug acetate/L)	Treated Water	M	1 per 200 hours	1 per 200 hours
Quenching Solution (mg/L) (e.g., hydrogen peroxide)	Feed Water	M	1/d	1/d
Hydrogen Peroxide (mg/L)	Stock Solution Treated Water	M††	1 per 50 hours 1 per Verification test period	1 per 50 hours 1 per Verification test period.
Total THMs (µg/L) (chloroform, bromoform, bromodichloromethane, dibromochloromethane)	Treated Water	O	1/50 hours of ozone production	1/50 hours of ozone production
HAAs (µg/L) (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, dibromoacetic acid)	Treated Water	O	1/50 hours of ozone production	1/50 hours of ozone production

Table 1. Water Quality Sampling and Measurement Schedule, continued

Parameter	Sampling Location	Mandatory (M) or Optional (O)	Frequency*	
			Surface Water Systems	Ground Water Systems
Iron ($\mu\text{g/L}$)	Feed Water	O	1/50 hours of ozone production	1/50 hours of ozone production
Total Manganese ($\mu\text{g/L}$)	Feed Water Treated Water	O	1/50 hours of ozone production	1/50 hours of ozone production
Dissolved Manganese ($\mu\text{g/L}$) (Manganese concentration passing through 0.2 μm filter)	Feed Water Treated Water	O	1/50 hours of ozone production	1/50 hours of ozone production
Total Sulfides	Feed Water	O	1/d	1/d
Dissolved Oxygen	Feed Water Treated Water	O	1/50 hours of ozone production	1/50 hours of ozone production
Algal enumeration and speciation	Feed Water	O	1 per Verification Test Period	Not Required
Calcium (mg/L as CaCO_3)	Feed Water	O	1/50 hours of ozone production	1/50 hours of ozone production
Total Hardness (mg/L as CaCO_3)	Feed Water	O	1/50 hours of ozone production	1/50 hours of ozone production

* 3/d or 3/shift means that the water quality parameter shall be measured either 3 times per day if ozone production is continuous over the 200 hours of Verification Testing, or 3 times per staffed shift if ozone production is periodically terminated or interrupted, and the length of time of ozone production is less than 24 hours. 1/50 hours of ozone production means that the water quality parameter shall be measured once per each 50 hours of ozone production, regardless of interruptions in ozone production.

† The dissolved ozone concentration should be measured at sampling ports within the ozone contactor or immediately at the outlet of the ozone contactor. Multiple sampling ports may need to be sampled to calculate CT values.

** Mandatory if microbial challenge testing is being conducted. If CT calculations are used, these methods are not required.

†† The peroxide concentration of the stock solution shall be checked at the prescribed frequency. The peroxide concentration within the contactor shall be checked once during or immediately prior to the verification testing period, while the ozone equipment is not operating. Peroxide monitoring within the contactor will require that samples be withdrawn at appropriate sampling ports at the end or outlet of the contactor.

Table 2. Analytical Methods

Parameter	Facility	<i>Standard Methods</i> ¹ number or Other Method Reference	EPA Method ²
Temperature	On-Site	2550 B	
pH	On-Site	4500-H ⁺ B	150.1 / 150.2
Total alkalinity	Lab	2320 B	
Total Hardness	Lab	2340 C	
Total organic carbon	Lab	5310 C	
Turbidity	On-Site	2130 B / Method 2	180.1
Dissolved Ozone Residual	On-Site	4500 O ₃ B; HACH Indigo Blue Method*	
Iron	Lab	3111 D / 3113 B / 3120 B	200.7 / 200.8 / 200.9
Manganese	Lab	3111 D / 3113 B / 3120 B	200.7 / 200.8 / 200.9
UV ₂₅₄ absorbance	Lab	5910 B	
Calcium Hardness	Lab	3500-Ca D	
Dissolved Manganese (manganese passing through 0.2 µm filter)	Lab	3500-Mn	200.0 / 243.2 / 243.3
Bromide	Lab	4500-Br ⁻	300.0
Total THMs	Lab	6232B	502.2, 524.2, 551
Haloacetic Acids (HAAs)	Lab	6251 B	552.1
Dissolved Organic Carbon	Lab	5310 C	
Color (Pt-Co)	Lab	2120 C	110.2
Total Sulfides	Lab or On-Site	4500-S ²⁻ D, E	
Dissolved Oxygen	Lab or On-Site	4500-O	
AOC	Lab	9217	
Bromate	Lab		300.1
Hydrogen Peroxide (mg/L)	Lab or On-site	HACH Method HYP-1 or Masschelein, W., <i>et al.</i> , (1977) or Bader <i>et al.</i> (1988)	
Algal enumeration and speciation	Lab	Part 10000, Biological Examination†	

* Dissolved ozone residual measurements can also be from a properly calibrated and installed dissolved ozone monitor.

† *Standard Methods* does not contain a method for enumeration and speciation of algae. It does, however, contain methods for laboratory techniques, which may need to be performed for proper enumeration and speciation of the algae. Only an experienced and qualified laboratory analyst shall conduct algal enumeration and speciation.

Table 3. Equipment Operating Data

Operational Parameter		Frequency
Water Flow (gpm)	Feed Water	3/d or 3/shift
	Side Stream (if applicable)	3/d or 3/shift
	Cooling Water	3/d or 3/shift
Water Pressure (psig)	Inlet to Ozone System	3/d or 3/shift
	Outlet of Ozone System	3/d or 3/shift
	Side Stream (if applicable)	3/d or 3/shift
	Cooling Water	3/d or 3/shift
Water Temperature (°C)	Inlet to Ozone System	3/d or 3/shift
	Outlet to Ozone System	3/d or 3/shift
	Side Stream (if applicable)	3/d or 3/shift
Gas Phase Ozone Concentration (% wt)	Feed Gas	3/d or 3/shift
	Off Gas	3/d or 3/shift
Power Usage (kw/hr)	Ozone Generator	3/d or 3/shift
	Air Preparation System or Oxygen System	3/d or 3/shift
	Gas Phase Ozone Feed and Off Gas Monitors	3/d or 3/shift
	Cooling Water System	3/d or 3/shift
	Destruct Units	3/d or 3/shift
	Other pumps or motors	3/d or 3/shift
Ozone Feed Gas Temperature (°C)		3/d or 3/shift
Ozone Feed Gas Pressure (psig)		3/d or 3/shift
Ozone Feed Gas Flow (scfm)		3/d or 3/shift
Atmospheric Pressure (psia)		1/d or 1/shift
Dew Point (if using air feed system)		1/d or 1/shift
Ozone Production (lb/d)		1/d or 1/shift
If applicable: Purity of oxygen supply (%) Supplemental nitrogen flow rate (scfm), pressure (psig), and temperature (°C) Supplemental air flow rate (scfm), pressure (psig), and temperature (°C)		1/d or 1/shift 1/d or 1/shift 1/d or 1/shift
If applicable: Peroxide feed concentration (mg/L) Peroxide feed rate (mL/min) Peroxide to Ozone ratio (by weight)		1/d or 1/shift
If applicable: Operating parameters for UV-light systems (see ETV Testing Plan for Microorganism Contaminant Inactivation by Ultraviolet Based Technology – Chapter 4)		3/d or 3/shift

Table 4. CT Values for Inactivation of *Giardia* Cysts by Ozone at pH 6 to 9

Inactivation	Temperature (°C)					
	0.5	5	10	15	20	25
0.5 log	0.48	0.32	0.23	0.16	0.12	0.08
1.0 log	0.97	0.63	0.48	0.32	0.24	0.16
1.5 logs	1.5	0.95	0.72	0.48	0.36	0.24
2.0 logs	1.9	1.3	0.95	0.63	0.48	0.32
2.5 logs	2.4	1.6	1.2	0.79	0.60	0.40
3.0 logs	2.9	1.9	1.4	0.95	0.72	0.48

Source: Appendix O to the Guidance Manual For Compliance With the Filtration and Disinfection Requirements For Public Water Systems Using Surface Water Sources.

Table 5. CT Values for Inactivation of Viruses by Ozone

Inactivation	Temperature (°C)					
	0.5	5	10	15	20	25
2.0 logs	0.9	0.6	0.5	0.3	0.25	0.15
3.0 logs	1.4	0.9	0.8	0.5	0.4	0.25
4.0 logs	1.8	1.2	1.0	0.6	0.5	0.3

Source: Appendix O to the Guidance Manual For Compliance With the Filtration and Disinfection Requirements For Public Water Systems Using Surface Water Sources.

CHAPTER 3

EPA/NSF ETV

EQUIPMENT VERIFICATION TESTING PLAN FOR

ON-SITE GENERATION OF HALOGEN DISINFECTANTS FOR

INACTIVATION OF MICROBIOLOGICAL CONTAMINANTS

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1.0 APPLICATION OF THIS VERIFICATION TESTING PLAN

This document is the ETV Testing Plan for evaluation of water treatment equipment utilizing on-site generation of halogen disinfectants used in drinking water treatment systems for small public or private water supplies. This Testing Plan is to be used as a guide in the development of the Product-Specific Test Plan (PSTP) for testing of microbiological inactivation equipment using on-site generation of halogen disinfectants, within the structure provided by the Protocol entitled "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies".

Various types of treatment equipment employ on-site generation of halogen disinfectants to meet water treatment objectives such as microbiological inactivation and oxidation. This Equipment Verification Testing Plan is applicable only to treatment systems that rely on equipment for on-site generation of halogen disinfectants to effectively inactivate microorganisms in drinking water treatment systems. Systems may incorporate innovative techniques for generation of halogen disinfectants, such as the electrolysis of brine to produce chlorine and multiple oxidants.

In order to participate in this equipment verification process for microbiological inactivation via on-site generation of halogen disinfectants, the equipment Manufacturer shall employ the procedures and methods described in this test plan and in the referenced ETV Protocol as guidelines for the development of the PSTP. The Field Testing Organization (FTO) shall clearly specify in its PSTP the methods that shall be used for spiking of microorganisms, sampling of water streams and determination of microorganism viability, as well as any methods to be used for measurement of disinfectant concentrations in treated water streams. Methods for assessing the viability of cysts and oocysts are non-standard but may be used in verifying objectives that an on-site halogen generation system inactivates protozoan cysts and oocysts if the method has undergone peer review. Any non-standard method for assessing cyst and oocyst viability shall be correlated to animal infectivity.

2.0 INTRODUCTION

This ETV Testing Plan is applicable to any system that is used for on-site generation of halogen disinfectants for drinking water treatment applications, such as primary disinfection, residual disinfection, and process chemistry enhancement. This Testing Plan is also applicable to treatment systems that used in response to emergency scenarios. Typical systems in this category for on-site generation of halogen disinfectants may include but are not limited to: salt brine electrolysis generators, mixed oxidant systems, systems that include on-site generation of chlorine dioxide, systems providing iodination technologies, and other systems employing on-site generation of halogens. Based upon the goals of the Verification Testing Program, there are four primary aspects to the equipment evaluation process: 1) demonstration of equipment operation and generation capabilities; 2) measurement of halogen concentration and speciation; 3) inactivation of microbiological contaminants in feed waters to the system; and 4) measurement of the formation of disinfection by-products (DBPs) and other water quality parameters in treated waters.

To be applicable for this verification program, the on-site halogen generation systems must have the primary goal of halogen production for use in drinking water treatment applications. Additional goals of the on-site halogen generation systems may be to inactivate microbial

contaminants (primary disinfection), to provide a residual disinfectant in the distribution system (residual disinfection), to reduce formation of disinfection by-products (DBPs), or to provide oxidation of dissolved and particulate matter (organic or inorganic) in the source water.

On-site halogen generation systems that reduce the reliance on chlorine for disinfection hold promise for small utilities. Small on-site generators may be easier to operate than chlorine gas systems, and may provide effective oxidation of dissolved water constituents. In addition, the use of on-site generation systems such as salt brine electrolysis generators, mixed oxidant systems and chlorine dioxide generators may also allow for reduced formation of disinfection by-products. Further, on-site systems, such as iodine generators, may have applications in emergency situations.

3.0 GENERAL APPROACH

Testing of equipment covered by this Verification Testing Plan will be conducted by a NSF-qualified FTO that is selected by the equipment Manufacturer. The analytical work will be contracted with a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the U.S. Environmental Protection Agency (EPA) for the appropriate water quality or microbiological parameters.

For this Verification Testing, the Manufacturer shall identify in a Statement of Performance Objectives the specific performance criteria to be verified and the specific operational conditions under which the verification testing shall be performed. There are several types of Statements of Performance Objectives that may be verified in this testing. Examples of Statements of Performance Objectives are included in Table 1.

Table 1.
Types of Statements of Performance Objectives for On-Site Halogen Generation Systems

Type of Statement of Performance Objectives	Example of Statement of Performance Objectives
Halogen Production	<i>"This system is capable of producing a halogen concentration of 1,000 mg/L (0.1%) as ClO₂ in the concentrated halogen stream at a generation system output of 80%."</i>
CT	<i>"This system is capable of producing a chlorine concentration of 10 mg/L for a 10-minute contact time that will meet or exceed EPA published CTs for 1.0 log₁₀ inactivation of Giardia at a generation system output of 80% for a feed water flow of 100 gpm for a feed water with pH of 8.0 or less, turbidity of 20 NTU or less, organic carbon concentrations between 2.0 and 4.0 mg/L, alkalinity less than 150 mg/L as CaCO₃ and water temperatures greater than 5°C."</i>
CT (Comparative)	<i>"This system is capable of producing halogen concentrations that will meet EPA published CTs for 4-log₁₀ inactivation of virus and 3- log₁₀ inactivation of Giardia at a generation system output of 80% for a feed water flow of 100 gpm for a feed water with pH of 8.5 or less, turbidity of 20 NTU or less, organic carbon concentrations between 2.0 and 4.0 mg/L and alkalinity less than 150 mg/L as CaCO₃, while producing DBP concentrations 75% less than those produced by free chlorine at identical CTs."</i>
Microbial Inactivation	<i>"This system is capable of achieving 3-log₁₀ inactivation of Giardia lamblia at a generation system output of 80% for a feed water flow of 100 gpm for a feed water with pH of 8.5 or less, turbidity of 20 NTU or less, organic carbon concentrations between 2.0 and 4.0 mg/L and alkalinity less than 150 mg/L as CaCO₃."</i>
Microbial Inactivation (Comparative)	<i>"This system is capable of achieving 3-log₁₀ inactivation of Giardia lamblia at CTs 20% lower than EPA's published chlorine CTs. This level of Giardia lamblia inactivation will be achieved by the equipment at a generation system output of 80% for a feed water flow of 100 gpm for a feed water with pH of 8.5 or less, turbidity of 20 NTU or less, organic carbon concentrations between 2.0 and 4.0 mg/L and alkalinity less than 150 mg/L as CaCO₃."</i>

The tasks required to complete the Verification Testing depend on the type of Statement of Performance Objectives made by the Manufacturer. The following tasks are included in this Verification Testing program:

- Task 1: Equipment Operation and Disinfectant Production Capabilities
- Task 2: Microbiological Contaminant Inactivation (Optional)
- Task 3: Treated Water Quality
- Task 4: Data Management
- Task 5: Quality Assurance/Quality Control (QA/QC)

For each of the above-mentioned tasks and Statements of Performance Objectives, there are a number of different operational and system characteristics that would require evaluation during Verification Testing. Table 2 provides an overview of the equipment operational characteristics to be evaluated in tasks 1 through 3 of the Verification Testing Plan. Tasks 4 and 5 shall be performed for all Statements of Performance Objectives.

Table 2.
Summary of Equipment Operational Characteristics
To be Evaluated in Each Verification Testing Task

Type of Statement of Performance Objectives (See Table 1)	Equipment Operational Characteristic to be Evaluated	Task*
Halogen Production	1. Range of feed water flow rates	1
	2. Range of halogen concentrations produced under a variable range of percent generator output	1
	3. Speciation of halogens produced	1
	4. DBP formation	3
	5. Power consumption	1
	6. Characteristics and costs of initial constituent materials for halogen generation	1
	7. Waste stream characterization and range of waste stream flow rates	1
CT	Characteristics 1 through 7, and:	
	8. Hydraulic tracer testing 9. Range of hydraulic residence times of feed waters (disinfectant contact times) through the system	1 1
Microbial Inactivation	Characteristics 1 through 9, and: 10. Microbial inactivation	2

*Note: Tasks 4 and 5 shall be performed for all Statements of Performance Objectives

4.0 OVERVIEW OF TASKS

The following section provides a brief overview of the recommended tasks that may be components of the Verification Testing Plan and PSTP for on-site generation of halogen disinfectants used in drinking water treatment systems for small public or private water supplies.

4.1 Task 1: Equipment Operation and Disinfectant Production Capabilities

The objective of this task is to operate the treatment equipment provided by the Manufacturer and to assess its ability to produce on-site generation of halogen disinfectants for microbial contaminant inactivation. The system performance shall be evaluated relative to the stated water quality goals and any other performance characteristics specified by the Manufacturer. For Verification Testing purposes, the equipment shall be operated for a minimum of one, one-month testing period for each operational condition for which verification is desired. It is recommended that Verification Testing be performed under the poorest conditions of feed water quality for which the Manufacturer wishes to make a Statement of Performance Objectives. The FTO must provide statements in the PSTP as to what would constitute the worst-case feed water quality for the specific on-site halogen generation system. Examples of such worst-case feed water quality may include cold temperatures and/or high concentrations of suspended solids, organic carbon or oxidizable materials. Additional one-month testing periods shall be performed for other feed

water qualities or other operating conditions for which the Manufacturer wishes to make a Statement of Performance Objectives.

For all types of Statements of Performance Objectives, the FTO shall evaluate the following operational parameters: range of flow rates for which system is designed, concentration of disinfectants generated by the system (under a range of operational conditions and a range of percent disinfectant output), the speciation of the disinfectants produced by the on-site generation system, and production of DBPs. For Statements of Performance Objectives based on CT or inactivation, the FTO shall also determine hydraulic retention times. For Statements of Performance Objectives based on inactivation, the FTO shall determine contact times between the disinfectant and microbiological contaminants. Inactivation of microbiological contaminants will be addressed in Task 2. Formation of DBPs and other water quality impacts in treated waters will be addressed in Task 3.

4.2 Task 2: Microbiological Contaminant Inactivation (Optional)

This task shall be performed if the Statement of Performance Objectives is based on inactivation. This task may be waived if the Statement of Performance Objectives is based only on halogen production or CT. The objective of this task is to measure the performance of the on-site halogen generation drinking water treatment equipment for inactivation of selected bacterial, viral or protozoan contaminants that may include: *Clostridium perfringens*, *Klebsiella*, *Pseudomonas aeruginosa* (if there high HPC counts are present in feed waters), MS2 bacteriophage, *Giardia lamblia*, and/or *Cryptosporidium parvum*.

4.3 Task 3: Treated Water Quality

The objective of this task is to evaluate the quality of treated water. Multiple water quality parameters will be monitored during each testing period. The mandatory water quality monitoring parameters for all testing periods shall include: pH, temperature, turbidity, disinfectant residual, hydrogen sulfide, alkalinity, total dissolved solids (TDS), ammonia nitrogen, total organic carbon (TOC), UV absorbance at 254 nm (UVA), true color, iron, manganese, chloride, bromide, sodium, total coliforms, and heterotrophic plate count (HPC) bacteria. Monitoring of free available chlorine (FAC) and total available chlorine (TAC) shall be required for all Verification Testing of on-site halogen generation systems, whether or not chlorine is considered the primary agent of inactivation. Formation of instantaneous and/or DBP formation testing of organic DBPs in the treated water shall also be monitored by the FTO, as applicable. Inorganic by-products of treatment with the on-site halogen generation system shall be monitored as applicable, including but not limited to chlorite, chlorate and bromate. Water quality produced shall be evaluated in relation to feed water quality and operational conditions.

4.4 Task 4: Data Management

The objective of this task is to establish an effective field protocol for data management at the field operations site and for data transmission between the FTO and NSF for data obtained during the Verification Testing. Prior to the beginning of field testing, the database design must be developed by the FTO and reviewed and approved by NSF. This will insure that the required data will be collected during the testing, and that it can be effectively transmitted to NSF for review.

4.5 Task 5: Quality Assurance/Quality Control (QA/QC)

An important aspect of Verification Testing is the protocol developed for quality assurance and quality control. The objective of this task is to assure accurate measurement of operational and water quality parameters during Verification Testing of the on-site halogen generation equipment. Prior to the beginning of field testing, a QA/QC plan must be developed which addresses all aspects of the testing process. Each water quality parameter and operational parameter must have appropriate QA and QC measures in place and documented. For example, the protocol for pH measurement should describe how the pH meter is calibrated (frequency, pH values), what adjustments are made, and provide a permanent record of all calibrations and maintenance for that instrument.

5.0 TESTING PERIODS

For Verification Testing purposes, the equipment shall be operated for a minimum of one, one-month testing period at each set of operational conditions and/or feed water qualities for which verification is desired (i.e., conditions of testing that will support the Statement of Performance Objectives). For example, separate one-month testing periods shall be performed for different operating conditions of the halogen generation equipment, such as different output levels of the halogen generator (e.g., separate one-month testing periods for 80%, 50% and 20% generator output). Examples of some of the different operational conditions that might be included as separate testing periods in the Verification Testing program are listed in Table 3.

Table 3.
Examples of Potential Operating Conditions for Verification Testing

Potential Operating Conditions	Required Testing Period	Required Tasks per Testing Period	Optional Tasks per Testing Period
80% generator output	one month	1, 3, 4, 5	2
50% generator output	one month	1, 3, 4, 5	2
20% generator output	one month	1, 3, 4, 5	2

It is recommended that one-month of Verification Testing shall be performed under the poorest feed water quality for which the Manufacturer wishes to verify the Statement of Performance Objectives. The FTO must provide statements in the PSTP as to what would constitute the worst-case feed water quality for the specific on-site halogen generation system. Examples of some of the different water quality conditions that might be included as separate testing periods in the Verification Testing program are listed in Table 4.

Table 4.**Examples of Potential Feed water Types for Evaluation in Distinct Testing Periods**

Potential Testing Conditions	Required Testing Period	Required Tasks per Testing Period	Optional Task in Testing Period
Poor Water Quality	one-month	1, 3, 4, 5	2
Spring Run-Off Event	one-month	1, 3, 4, 5	2
Summer Algae Bloom	one-month	1, 3, 4, 5	2
Cold Temperature	one-month	1, 3, 4, 5	2
Untreated Surface Water	one-month	1, 3, 4, 5	2
Treated Surface Water	one-month	1, 3, 4, 5	2
Groundwater	one-month	1, 3, 4, 5	2
Groundwater Under the Influence	one-month	1, 3, 4, 5	2

Examples of poor feed water quality may include high concentrations of suspended solids, organic carbon or other materials that can exert an oxidant demand. These worst-case feed water quality characteristics may not occur simultaneously. For example, the Manufacturer may wish to conduct an additional one-month testing period during a spring run-off event in order to demonstrate equipment performance on a water quality characterized by elevated turbidity and organic material. The Manufacturer may wish to conduct testing in another one-month testing period during a summer algae bloom for demonstration of performance under conditions of elevated levels of organic material. Additionally, the Manufacturer may wish to conduct testing in a third one-month testing period during the coldest water temperatures of the winter.

The Manufacturer may also wish to demonstrate the Statement of Performance Objectives using water supplies from both surface water sources (treated and untreated) and groundwater sources (e.g., untreated and/or under the influence of surface water). In this case, the FTO must provide statements in the PSTP as to what constitutes the worst-case feed water quality for each supply and schedule the testing periods accordingly.

Prior to the initiation of Verification Testing, sufficient information shall be provided to illustrate the variations expected to occur in feed water quality for a typical annual cycle for the water source. Any pretreatment chemical additions that may impact the feed water to the on-site halogen generation system shall be fully described by the FTO in the PSTP. For example, any coagulant or other chemical additions shall be identified. Predicted effects on feed water turbidity, suspended solids and total organic carbon concentration shall also be discussed in the PSTP prepared by the FTO. Failure to adequately characterize the feed water could result in testing at a site later deemed inappropriate, so the initial characterization will be important to the success of the testing program.

The required tasks (Task 1 and Tasks 3 through 5) and optional task (Task 2) in the Verification Testing Plan are designed to be completed during each one-month testing period performed for the Verification Testing. One month is the minimum duration of each testing period; longer testing periods may be employed at the discretion of the Manufacturer or as necessary to complete the required (and optional, if applicable) tasks. The required one-month duration of each testing period does not include the time required for mobilization or start-up, nor does it include the time required to achieve steady-state operation.

6.0 TASK 1: EQUIPMENT OPERATION AND DISINFECTANT PRODUCTION CAPABILITIES

6.1 Introduction

During Task 1, the FTO shall evaluate equipment operations and determine the rates of feed water flow and halogen production concentration for which the on-site generation system is designed. The on-site halogen generation equipment shall be operated for Verification Testing purposes within the operational range presented in the Manufacturer's Statement of Performance Objectives, as described above in Section 3.0. Monitoring in Task 1 shall be focused on determination of the operational characteristics summarized above in Table 2, depending on the type of Statement of Performance Objectives made in the PSTP, or other factors applicable to the technology that provide effective treatment of the feed water. The FTO shall establish the testing conditions to be evaluated for Task 1 in the PSTP.

Before the initiation of Verification Testing in Task 1, the FTO on behalf of the Manufacturer shall make known the limitations of the equipment and any existing equipment incompatibilities with treatment processes or chemical additions. To this end, a listing shall be provided by the Manufacturer describing the potentially incompatible treatment processes or chemical additions (i.e., oxidants, coagulants, anti-scalants, chemicals for pH adjustment) that would adversely impact the equipment materials or the treatment process. In addition, the FTO shall report any incompatibilities between equipment and treatment processes or chemical additions that are observed during the course of the Verification Testing Program.

The FTO (with input from the equipment Manufacturer) may want to conduct preliminary studies in Task 1 to determine the range of operational capabilities during initial runs with the on-site halogen generation equipment. For Statements of Performance Objectives based on CT or microbial inactivation, the FTO shall describe in the PSTP the type of disinfectant contacting system that will be employed during Verification Testing of the on-site halogen generation system. The FTO shall also propose and fully describe in the PSTP the method of hydraulic tracer testing that will be performed to demonstrate flow conditions and residence duration (exposure time). Procedures for developing a tracer test methodology are described in the General Requirements section of the Protocol for Equipment Verification Testing of Microbiological Contaminant Inactivation.

This testing plan applies to halogen generation systems that are designed for either continuous flow or for intermittent flow through the generation equipment. If the Statement of Performance Objectives applies to intermittent flow applications, this should be specifically stated in the Statement of Performance Objectives and the work plan should include a designated shutdown period each day in which the on-site halogen generation equipment is turned off.

6.2 Objectives

The objectives of Task 1 are to determine the appropriate range for equipment operation and to determine the range of disinfectant concentrations (as well as speciation) generated under different conditions of percent system generation output. The performance of on-site halogen generation systems may be different for feed waters from different test sites or for the feed water from the same site during different seasonal water quality episodes. Therefore, it will be necessary to fully document the feed water conditions under which Verification Testing is

performed. Complete chemical, biological and physical characterization of the feed waters and treated waters produced by the system will be performed as part of Task 3. This task is intended to result in data that describe the operation of the equipment and data that can be used to develop cost estimates for operation of the equipment.

6.3 Work Plan

Mobilization and start-up of equipment shall be performed prior to the initiation of Task 1 testing. Furthermore, the on-site halogen generation system shall have achieved a condition of steady-state operation before the start of Task 1 testing. The FTO shall clearly describe in the PSTP the protocol for start-up of the on-site halogen generation system, as well as operations and maintenance issues that may arise during mobilization and start-up.

During each day of Verification Testing in Task 1 (minimum one-month testing period at one set of operational conditions and/or one set of water quality characteristics), treatment equipment operating parameters for the on-site halogen generation will be monitored and operating data will be recorded. Operating parameters for monitoring shall include: rate of feed water and treated water flow; generated halogen concentration and speciation (dilution of concentrated halogen stream may be required); rate and quality of feed stock (i.e., salt) consumption, and other equipment characteristics as specified for measurement by the FTO in the PSTP. In addition, the aggregate horsepower of all motors and mechanical efficiencies of all motors/devices supplied with the equipment shall be determined and used to develop an estimate of the maximum power requirements and routine power consumption during operation. A summary of the operational parameters to be recorded during Task 1 and the minimum frequency of monitoring is presented in Table 5. The FTO shall provide the necessary methods information for monitoring of the operational parameters presented in Table 5. Additional monitoring of feed water chemistry shall be performed during Verification Testing, as described below in Task 3 (Section 8.0).

If any waste streams are generated by the on-site halogen generation system, these streams must be fully characterized during Task 1 testing. The FTO shall fully describe and provide general characterization of the waste streams that are generated by the on-site halogen generation system in the PSTP, including pH, total dissolved solids (TDS), alkalinity, disinfectant residual, and temperature. In the case that water softening of the feedwater is required prior to halogenation, the characteristics of the waste streams produced by the water softener shall also be described. The FTO shall also discuss the applicable potential waste stream disposal issues in the PSTP, including disposal to the sewer or receiving water.

Table 5.
Task 1 - Required Minimum Operating Data for On-Site Halogen Generation Systems

Operational Parameter	Action, Monitoring Frequency
Feed water flow rate	Check and record twice daily. Adjust when 10% above or below target. Record both before and after adjustment.
Rate of feed stock consumption	Check and record consumption twice daily. Adjust when 10% above or below target. (Quality of feed stock required by equipment shall also be recorded.)
Halogen concentration and speciation (at each set of operational conditions)	Sample the following and record twice daily: 1. Concentrated halogen stream (generator product) 2. Halogen-treated water at disinfection contactor influent (if applicable) 3. Halogen-treated water at disinfection contactor effluent (if applicable)
Horsepower and efficiency of motors, and consumed amperage for on-site generation (at each set of operational conditions)	Provide record of current draw to motors on cumulative basis. Provide information on start-up amperage and horsepower requirements.
Waste stream composition (Testing recommended for each batch of constituent chemicals)	Sample once each one-month testing period for: pH, NaOH, TDS, heavy metal scan (only those technologies producing definable waste). Water softeners may require monitoring of additional parameters.
Waste stream flow rate	Check and record waste flow streams (if applicable) twice daily.
For Statements of Performance Objectives based on CT or microbial inactivation: Hydraulic detention time in disinfectant contacting system (at selected flow rate)	Provide correlation to measured value on daily basis.

6.4 Schedule

During Verification Testing, water treatment equipment shall be operated continuously for a minimum of one month at one set of operational conditions (e.g., percent generator output – Table 3) and/or one feed water quality (examples given Table 4). Interruptions in operation may be allowed during the one-month testing period as needed for system maintenance. Necessary details of the system shutdown procedure shall be specified by the FTO in the PSTP.

6.5 Evaluation Criteria

- General operational performance
 - ⇒ Temporal profile of feed water flow rate over each one-month testing period. One temporal profile graph (at daily resolution) shall be provided for each set of operational conditions and/or water qualities evaluated during Verification Testing.

- ⇒ Temporal profile of waste stream flow rate measured during each one-month testing period.
- ⇒ Table of disinfectant concentrations generated for each disinfectant species in the halogenated water and treated water streams during each one-month testing period.
- Rate of consumption of feed material for halogen generation and for feedwater conditioning. Quality of feedstock material required for halogen generation shall also be reported.
- Power consumption
 - ⇒ Table of horsepower requirements, motor efficiency and consumed amperage for the testing period(s), as measured for each set of operational conditions.
- Waste stream characterization
 - ⇒ Table of waste stream quality parameters measured during each one-month testing period.
- Contact time (only for Statements of Performance Objectives based on CT or microbial inactivation)
 - ⇒ Table of calculated or estimated hydraulic detention time in disinfectant contacting system for each set of operational conditions evaluated during the testing period(s).

7.0 TASK 2: MICROBIOLOGICAL CONTAMINANT INACTIVATION (OPTIONAL)

7.1 Introduction

If the Statement of Performance Objectives is based on microbial inactivation, the effectiveness of the on-site generation equipment for inactivation of microorganisms such as bacteria, viruses, or protozoa (or a combination thereof) introduced in the feed water to the system will be evaluated in this task. The measurement of inactivation for this study will be based upon a comparison of the percent of viable organisms in the feed water stream and the percent of viable organisms in the halogen-treated water stream at the disinfection contactor effluent. In the case that the FTO can demonstrate that the feed waters contain a naturally occurring and consistent concentration of microorganisms approved by this inactivation test plan that is sufficient to demonstrate the manufacturer's Statement of Performance Objectives, no spiking of organisms will be necessary for the inactivation experiments.

7.2 Objectives

The objective of this task is to characterize the on-site halogen generation technology in terms of efficacy for inactivation of selected microbiological contaminants. Microorganisms for inactivation testing will be selected by the FTO and specifically identified in the PSTP.

7.3 Work Plan

If the Manufacturer's Statement of Performance Objectives is based on microbial inactivation, the FTO shall identify the microbiological contaminant inactivation capabilities in the Statement of Performance Objectives provided in the PSTP. In the Statement of Performance Objectives, the Manufacturer shall identify the specific microbiological contaminants to be monitored during equipment testing and the specific operational conditions under which inactivation testing shall be performed. The Statement of Performance Objectives prepared by the FTO on behalf of the Manufacturer shall also indicate the range of water quality under which the equipment can be

of the disinfection contactor, the detection limits of the sampling and analytical methods and the duration of experiments. For all organisms, the laboratory(ies) supplying the organisms and performing the viability studies shall be experienced in challenge testing and be able to predict initial dosages required to overcome any inherent experimental losses. The FTO shall fully describe in the PSTP the spiking methodology to be employed during the microbiological inactivation testing. An example of a spiking protocol for microbiological inactivation studies is provided below.

The feed water stream to the on-site halogen generation test unit will be plumbed with a check-valve to prevent back-flow of waters spiked with concentrations of microbiological contaminants. Consistent dosing of the spiking stock suspension will be controlled by means of a metering pump (diaphragm or peristaltic or equivalent) via siliconized or Teflon tubing. The pump shall be capable of fluid injection into the pressurized system feed line for the duration of the test, at a measurable and verifiable rate such that the dosing of the spiking stock suspension is consistent throughout the duration of the test run. Once appropriate flow has been initiated through the test system, the test unit must be demonstrated to operate in a steady-state condition. The spiking shall continue for a period of time that allows a minimum of three retention time-equivalents through the on-site generation and contacting system (as determined by tracer tests or as defined by system functions) prior to sample collection. During the course of the experiment, monitoring of the system flow rate and spike injection rate shall be performed and adjustments made to maintain test design.

7.4.2 Sample Collection

7.4.2.1 Test Stream Sampling. Sample ports shall be provided for the feed water stream (spiked with concentrations of microbiological contaminants) and the halogen-treated water stream at the contactor effluent. The FTO shall specify the specific ways in which sample collection is performed according to the organisms that will be used for the proposed microbiological inactivation experiments. Examples of potential sample collection methods for bacterial, viral and protozoan organisms are provided below. The methods described, or any other peer-reviewed method may be used for verification testing. The FTO shall propose in the PSTP the specific methods that are to be used for viability assessment of the selected microorganisms (See Section 7.5 below).

For bacterial and/or viral seeding experiments, methods for organism spiking and sample collection shall be consistent with a selected peer-reviewed method. The frequency and number of samples collected for each sampling point will be determined by the length of the test run and shall be specified by the FTO in the PSTP. The volume of each halogen-treated water sample from the disinfection contactor effluent will depend on the concentrations of test organisms spiked, and the requirements of the analytical laboratory.

For protozoan spiking experiments, EPA Method 1622 or any other method that has been evaluated through the peer-reviewed process (e.g., Nieminski and Ongerth, 1995) may be followed for sample collection from the spiked water streams. The sample collection system shall be plumbed to allow installation of housings and filters for capture of sufficient flow for microbiological analysis. The FTO shall provide an indication of the recovery efficiency achievable under the sample collection method selected for use during protozoa seeding studies. The specific capture filter recovery system shall be fully

challenged while successfully treating the feed water. Examples of satisfactory Statements of Performance Objectives based on microbial inactivation were provided in Table 1.

7.3.1 Organisms Employed for Inactivation Experiments

The FTO on behalf of the Manufacturer shall specify which organisms shall be employed in Verification Testing for demonstration of the inactivation efficacy of the on-site halogen generation system. Examples of organisms for potential use in this task are listed below in Table 6. These species represent microorganisms of particular interest and concern to the drinking water industry, and represent a range of resistance to inactivation methods. The specific batches of microorganisms used must be shown to be viable by the laboratory involved in the analytical aspects of the testing. The FTO shall specify in their PSTP, which of the approved organisms will be employed for Verification Testing. The FTO shall also specify the specific methods that shall be used for analysis of the count and the viability of the test organisms.

Table 6.
Example Microorganisms for Task 2 Inactivation Experiments

Type of Spiking Organism	Example Microorganisms for Inactivation Experiments
Bacteria	<i>Clostridium perfringens</i> <i>Klebsiella</i> <i>Pseudomonas aeruginosa</i> (if high HPC counts are present) Total Coliform Bacteria
Virus	MS2 Bacteriophage Enteric virus species
Protozoan (oo)cysts	<i>Giardia lamblia</i> <i>Cryptosporidium parvum</i>

Microbial inactivation experiments with the on-site generation system shall be performed as three replicate studies done consecutively at one set of selected operational conditions and/or a range of influent water qualities, as required in Task 1. Microbiological inactivation experiments may be conducted during the minimum one-month Verification Testing period that is required for a single set of operating conditions and/or influent water quality in Task 1. Only one process control test shall be performed in which the on-site halogen generation system is turned off. The FTO shall fully describe the spiking and sampling methods to be used during the microbial inactivation testing in Task 2. A description of some possible spiking and sampling methods is provided below in the Analytical Methods portion of this Section 7.0.

7.4 Analytical Methods

7.4.1 Spiking Protocols

The total number of each type of test organism required for spiking will depend on the reactor volume, the water flow rate, and the desired steady-state concentration of microbiological contaminants in the reactor. The total number of organisms required to provide these steady-state microbiological populations will depend on the overall volume

described in the PSTP by the FTO. In addition, the PSTP shall include a plan of study for verification testing with a minimum of three standard recovery efficiency tests from the microbiological laboratory.

7.4.2.2 Post-Test Sample Handling. The FTO shall take steps to sanitize the system following microbial spiking experiments to inactivate any organisms remaining in the system. Depending on the unit (design and materials), sanitization may be done using steam or hot water (80°C for 10 min) or other acceptable disinfectant. The FTO shall specify in the QA/QC plan of the PSTP how this sanitization procedure is to be done to ensure inactivation of live organisms and subsequent removal of inactivated organisms from the unit. Biosafety concerns for humans and the environment that are associated with the disinfection of live organisms shall be outlined in the Safety Plan that is developed as part of the QA/QC plan in the PSTP. (Refer to section 10.5 of this test plan for more detail on the Health and Safety Measures to be detailed in the QA/QC Safety Plan.)

7.4.2.3 Process Control. A control round of testing shall also be carried out identical to the procedure identified by the FTO in the PSTP, with the on-site halogen generation system turned off. The purpose of this testing is to evaluate any cumulative effects of the equipment stream, spiking and sampling processes, and sample handling on organism viability. This testing shall not occur until elimination of sanitizing agents and inactivated target organisms, whose presence could affect the inactivation capabilities of the unit. The process control samples should show minimal inactivation of the target organism(s) relative to the trip control sample. If significant inactivation of the process control sample is measured in control testing, some aspect of the process other than on-site halogen generation system may have contributed to inactivation of the test organisms. Under such a scenario, re-testing of the on-site halogen generation system for microbiological inactivation would be required.

7.4.2.4 Trip Control. For tests utilizing spike challenges, a replicate or sub-sample of the spike dose shall accompany the actual spike dose from the analytical laboratory, including all preliminary processes of dose preparation pre-enumeration, shipping, and preparation for spiking, through return to the laboratory for enumeration and viability baseline assessment. The trip control samples should show minimal inactivation of the target organism(s). Significant inactivation of the trip control sample would indicate that some aspect of the handling, from preparation to testing, contributed to inactivation of the test organism(s). Evidence of greater than 90% inactivation of trip control samples will require re-testing.

7.4.2.5 Comparison Control. If the Statement of Performance Objectives involves comparison of microbial inactivation by the on-site halogen generation system to microbial inactivation by another disinfectant (i.e., chlorine), then a control experiment shall be conducted using the comparison disinfectant. In this experiment, all spiking, contacting, sampling and analysis must be identical to that employed for the inactivation testing with the on-site halogen generation system, with the exception that free chlorine shall be used to meet CT rather than the halogens generated on site.

7.5 Microbiological Viability Analysis

Methods for assessing the viability of the selected bacteria and viruses (see Table 6) shall be specified by a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the EPA for the appropriate microbial analyses. Selected viability methods shall be specified by the FTO in the PSTP.

Methods for assessing the viability of cysts and oocysts are non-standard but may be used in verifying objectives that an on-site halogen generation system inactivates protozoan cysts and oocysts if the method has undergone peer review. A summary and comparison of viability methods is presented in research completed by the following researchers: Korich et al. (1993), Nieminski and Ongerth (1995), Slifko et al. (1997) and others (see Section 12.0 References in this Test Plan). Interim, non-standard methods for assessing the viability of cyst and oocyst (e.g., excystation, DAPI/PI) may be used for verification of inactivation after exposure to halogen disinfectants. However, any interim organism viability method is subject to review by experts of cyst and oocyst viability and subsequent method change. Any non-standard method for assessing cyst and oocyst viability shall be correlated to animal infectivity.

7.6 Evaluation Criteria and Minimum Reporting Requirements

- Concentrations of microbiological contaminants in the feed water and halogen-treated water at the disinfection contactor effluent
 - ⇒ Table of feed water and treated water concentrations of the NSF-approved spiked microorganisms (Table 6) for challenge experiments (three replicate runs), process control experiment, and comparison control experiment (if applicable)
 - ⇒ Trip control results
 - ⇒ Bar graph of $\log_{10}$ inactivation results for three replicate test runs and all control test runs
 - ⇒ The variability of the results from microbial inactivation tests should be presented with the bar graphs as 95% confidence intervals.

8.0 TASK 3: TREATED WATER QUALITY

8.1 Introduction

Water quality data shall be collected for the feed water and halogen-treated water as shown in the sampling schedule in Table 7. These data shall be collected during the equipment operation test runs of Task 1 and the microbiological contaminant inactivation test runs of Task 2 (if applicable). No additional test runs need to be performed for Task 3, other than those performed for Tasks 1 and 2.

8.2 Experimental Objectives

The objective of this task is to assess the impact on water quality of treatment with the on-site halogen generation system. Specific water quality analyses and sampling frequencies are detailed in Table 7.

8.3 Work Plan

A list of the minimum number of water quality parameters is provided in Table 7 for monitoring of the feed water, concentrated halogen stream, and halogen-treated water at the disinfection contactor influent and effluent during Equipment Verification Testing. The actual water quality parameters selected for testing and monitoring shall be stipulated by the FTO in the PSTP.

Table 7.
Water Quality Sampling Schedule (Minimum Required for Each Testing Period)

Parameter	Sampling Frequency	Test Stream to be Sampled	Standard Method	EPA Method
<i>On-Site Analyses</i>				
pH	1/Day	Feed, Treated ¹ , Waste	4500 H+	150.1/ 150.2
Temperature	1/Day	Feed, Treated, Waste	2550 B	
Turbidity	1/Day	Feed, Treated	2130 B	180.1
Disinfectant Residual: Chlorine (FAC, TAC) Iodine Chlorine Dioxide Bromine	2/Day	Feed ² , Concentrated Halogen Stream ³ , Halogen-Treated Water at Contactor Influent ⁴ and Effluent ¹ , Waste	4500-Cl F ⁵ 4500-I B ⁵ 4500-ClO ₂ D ⁵	300.0 300.0
Hydrogen sulfide	1/Day	Feed	4500-S ²⁻	
<i>Laboratory Analyses</i>				
Alkalinity	1/Week	Feed, Treated, Waste	2320 B	
TDS	1/Testing Period	Feed, Treated, Waste	2540 C	
Ammonia Nitrogen	1/Week	Feed, Treated	4500-NH ₃ G	
TOC	1/Testing Period	Feed, Treated	5310 C	
UVA	1/Week	Feed, Treated	5910 B	
True Color	1/Week	Feed, Treated	2120 B	
Iron	1/Testing Period	Feed, Treated	3500-Fe C	200.7/ 200.8/ 200.9
Manganese	1/Testing Period	Feed, Treated	3500-Mn C	200.7/ 200.8/ 200.9
Chloride	1/Testing Period	Feed, Treated	4500-Cl F	300.0
Bromide	1/Testing Period	Feed, Treated	4500-Br C	300.0
Sodium	1/Testing Period	Feed, Treated	3500-Na B	200.7
Total Coliform Bacteria	5/Week	Feed, Treated	9221 / 9222 / 9223	
HPC Bacteria	5/Week	Feed, Treated	9215 B	
TTHMs	1/Testing Period	Feed ² , Treated		524.2
HAAs	1/Testing Period	Feed ² , Treated		552.1

Table 7. (continued)
Water Quality Sampling Schedule (Minimum Required for Each Testing Period)

Parameter	Sampling Frequency	Test Stream to be Sampled	Standard Method	EPA Method
Optional DBPs ⁶ :				
Halooacetoneitriles	1/Testing Period	Feed ² , Treated		551
(HANs)	1/Testing Period	Feed ² , Treated		551
Chloropicrin	1/Testing Period	Feed ² , Treated		551
Chloral Hydrate	1/Testing Period	Feed ² , Treated		524.2
Cyanogen Chloride				
Chlorite, Chlorate (if applicable)	1/Testing Period	Feed ² , Treated		300.0 B
Bromate (if applicable)	1/Testing Period	Feed ² , Treated		300.0 B
DBP Formation Testing⁷				
TTHMs	1/Testing Period	Treated		524.2
HAAs	1/Testing Period	Treated		552.1
Optional DBPs ⁶ :				
HANs	1/Testing Period	Treated		551
Chloropicrin	1/Testing Period	Treated		551
Chloral Hydrate	1/Testing Period	Treated		551
Cyanogen Chloride	1/Testing Period	Treated		524.2
Bromate (if applicable)	1/Testing Period	Treated		300.0 B
Chlorite, Chlorate (if applicable)	1/Testing Period	Treated		300.0 B

¹ For purposes of Table 7, "treated" water indicates the halogen-treated water at the disinfection contactor effluent. If the equipment being tested does not include a disinfection contactor (i.e., includes only feed water and concentrated halogen stream sampling points), then only the feed water sample shall be collected.

² Feed water sampling for these parameters shall be performed once during the Verification Testing to verify that no addition of disinfectants or oxidants and no formation of DBPs occurs upstream of the feed water sampling point.

³ The "concentrated halogen stream" is the generator product stream.

⁴ The "halogen-treated water at contactor influent" indicates the feed water to the equipment immediately after dosing with the concentrated halogen stream.

⁵ The stated Standard Method shall be used if the halogen generator produces only one of the listed disinfectants (e.g., chlorine) and no other disinfectant. If the halogen generator produces more than one of the listed disinfectants, or if the halogen generator produces bromine, then the method described in White (1992) and Palin (1974) shall be used for disinfectant residual measurement.

⁶ Optional DBPs shall be measured if applicable.

⁷ DBP formation testing shall be conducted if on-site halogen generation equipment is used to provide both primary disinfection and residual disinfection. Conditions for DBP formation testing preparation shall follow the UFC proposed in the Information Collection Rule (see section 8.4.4 of this test plan).

If the on-site halogen generation system is used only for primary disinfection, with residual disinfection provided by another process, then sampling for organic (Total Trihalomethanes (TTHMs), haloacetic acids (HAAs) and optional DBPs) and inorganic (bromate, chlorite, chlorate) DBPs shall be performed on an instantaneous basis after the specified disinfection contact time. Both instantaneous sampling and simulated distribution system testing for organic and inorganic DBPs shall be performed if the on-site halogen generation system is used for both primary disinfection and residual disinfection. Water samples collected for DBP analysis should be collected simultaneously with samples collected for other analyses such as pH, alkalinity, TOC, UVA, turbidity, ammonia, and other pertinent water quality parameters.

Many of the water quality parameters described in this task shall be measured on-site by the FTO. Analysis of the remaining water quality parameters shall be performed by a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the EPA for the appropriate water quality parameters. The methods to be used for measurement of all water quality parameters in the field and in the off-site analytical laboratory are specified in Table 7 and are described in detail in Task 5, Quality Assurance/Quality Control (QA/QC). Where appropriate, the Standard Methods reference numbers and EPA method numbers for water quality parameters are provided in Table 7 for both the field and laboratory analytical procedures.

For the case of off-site shipment, the samples shall be collected in appropriate containers (containing preservatives as applicable) prepared by the off-site analytical laboratory. These samples shall be preserved, stored, shipped and analyzed in accordance with appropriate procedures and holding times, as specified by the analytical laboratory. Samples shall be shipped to a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the EPA. Original field sheets and chain-of-custody forms shall accompany all samples shipped to the off-site analytical laboratory. Copies of field sheets and chain-of-custody forms for all samples shall be provided to NSF.

8.4 Analytical Schedule

8.4.1 Characterization of Feed Water, Concentrated Halogen Stream and Halogen-Treated Water at the Disinfection Contactor Influent and Effluent.

The water quality characteristics of the feed water, the concentrated halogen stream and the halogen-treated waters at the influent and effluent to the disinfection contactor shall be characterized by measurement of the parameters listed in Table 7. Sampling shall be performed during steady-state operation of the on-site halogen generation equipment in Task 1 and Task 2 (if applicable).

8.4.2 Water Quality Sample Collection

Water quality data for Task 3 will be collected at regular intervals during test runs conducted for Tasks 1 and 2, as indicated by the sampling frequency in Table 7. No additional test runs shall be required for Task 3 other than those already described in Tasks 1 and 2. The minimum monitoring frequency for the required water quality parameters is provided in Table 7. At the discretion of the Manufacturer and the designated FTO, the water quality sampling program may be expanded to include a

greater number of water quality parameters and to require more frequent sampling. Sample collection frequency and protocol shall be defined by the FTO in the PSTP.

8.4.3 Feed Water Quality Limitations

The characteristics of feed water encountered during each testing period shall be explicitly stated in reporting the data from Tasks 1 and 2. Accurate reporting of such feed water characteristics as turbidity, temperature, pH, ammonia nitrogen and total organic carbon is critical for the Verification Testing, as these parameters can substantially influence the disinfection performance of the on-site halogen generation equipment.

8.4.4 Disinfection By-Product Formation Testing

DBP formation testing shall be performed if the on-site halogen generation equipment is used for residual disinfection in addition to primary disinfection. DBP formation testing shall be performed on the treated water once each testing period (at a minimum) during steady-state operation of the on-site halogen generation equipment for Task 1 or Task 2. DBP formation testing will be used to estimate by-product formation in the distribution system, including TTHMs, the six measured HAA compounds, and (if applicable) HANs, chloropicrin, chloral hydrate, cyanogen chloride, bromate, chlorite and chlorate.

If no additional dosing of halogens is used for residual disinfection subsequent to primary disinfection, the DBP formation testing method shall be performed by collecting a sample of the halogen-treated water at the disinfection contactor effluent and holding the sample in the dark at the uniform formation conditions (UFC) specified in the Information Collection Rule (ICR) Manual for Bench- and Pilot-Scale Treatment Studies. If additional dosing of the halogens is used for residual disinfection subsequent to primary disinfection, the DBP formation testing method shall be performed by collecting a sample of the halogen-treated water at the disinfection contactor effluent, spiking it with an additional dose of disinfectant, and holding the sample in the dark at the UFC. (Refer to the DBP formation testing protocol in Task 5, QA/QC, of this Verification Testing Plan for further details.)

The following UFC will be used for DBP formation testing:

- Incubation period of 24 ± 1 hours
- Incubation temperature of $20 \pm 1.0^{\circ}\text{C}$
- Buffered pH of 8.0 ± 0.2
- 24-hour chlorine residual of 1.0 ± 0.4 mg/L.

8.4.5 Comparison DBP Testing

If the Statement of Performance Objectives involves comparison of DBP formation by the on-site halogen generation system to DBP formation by another disinfectant (i.e., chlorine), then comparison DBP testing (and DBP formation testing, if applicable) shall be conducted using the comparison disinfectant. For these comparisons, identical procedures for sampling, testing and analysis shall be performed for the DBP sampling with the on-site halogen generation system and alternative disinfectants.

8.5 Evaluation Criteria and Minimum Reporting Requirements

In the items below, “treated water” refers to the halogen-treated water sampled at the disinfection contactor effluent.

- General water quality
 - ⇒ Table of daily feed water and treated water levels of pH, temperature and turbidity during each testing period
 - ⇒ Table of weekly feed water and treated water levels of alkalinity and ammonia nitrogen during each testing period
 - ⇒ Table of feed water and treated water levels of TDS, iron, manganese, chloride, bromide and sodium during each testing period
 - ⇒ Table of twice daily disinfectant residuals during each testing period
- Organic water quality
 - ⇒ Table of weekly feed water and treated water levels of UVA and true color during each testing period
 - ⇒ Table of feed water and treated water levels of TOC during each testing period
- DBPs
 - ⇒ Table of instantaneous, and DBP formation testing if applicable (for treated water only), feed water (one sample) and treated water concentrations of TTHMs and HAAs monitored during each testing period, and other optional DBPs, such as HANs, chloropicrin, chloral hydrate and cyanogen chloride (if applicable)
 - ⇒ Table of instantaneous, and DBP formation testing if applicable (for treated water only), feed water (one sample) and treated water concentrations of bromate, chlorite and chlorate (if applicable) during each testing period
 - ⇒ If applicable, table comparing instantaneous (and DBP formation testing, if applicable) DBP concentrations of TTHMs and HAAs, and if applicable, other DBPs (e.g., HANs, chloropicrin, chloral hydrate and cyanogen chloride) produced in the treated water by the on-site halogen generation system and a comparison disinfectant (i.e., chlorine)
- Indigenous bacteria (Total Coliform and HPC)
 - ⇒ Table of feed water and treated water levels of Total Coliform bacteria (TC) and HPC bacteria during each testing period
 - ⇒ Table of TC and HPC $\log_{10}$ inactivation during each testing period

9.0 TASK 4: DATA MANAGEMENT

9.1 Introduction

The data management system used in the Verification Testing shall involve the use of computer spreadsheet software and manual (or on-line) recording of operational parameters for the on-site halogen generation equipment on a daily basis.

9.2 Experimental Objectives

The objectives of this task are: 1) to establish a viable structure for the recording and transmission of field testing data such that the FTO provides sufficient and reliable data for

verification purposes, and 2) to develop a statistical analysis of the data, as described in the "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies".

9.3 Work Plan

The following protocol has been developed for data handling and data verification by the FTO. Where possible, a Supervisory Control and Data Acquisition (SCADA) system should be used for automatic entry of testing data into computer databases. Specific parcels of the computer databases for operational and water quality parameters should then be downloaded by manual importation into Excel (or similar spreadsheet software) as a comma-delimited file. These specific database parcels shall be identified based upon discrete time spans and monitoring parameters. In spreadsheet form, the data shall be manipulated into a convenient framework to allow analysis of water treatment equipment operation. Back-up of the computer databases to diskette should be performed following each testing period at a minimum. When SCADA systems are not available, direct instrument feed to data loggers and laptop computers shall be used when appropriate.

For parameters for which electronic data acquisition is not possible, field testing operators shall record data and calculations by hand in laboratory notebooks. Daily measurements shall be recorded on specially-prepared data log sheets as appropriate. Each notebook must be permanently bound with consecutively numbered pages. Each notebook must indicate the starting and ending dates that apply to entries in the logbook. All pages shall have appropriate headings to avoid entry omissions. All logbook entries must be made in black water-insoluble ink. All corrections in any notebook shall be made by placing one line through the erroneous information. Products such as "correction fluids" are never to be utilized for making corrections to notebook entries. Operating logs shall include a description of the water treatment equipment (description of test runs, names of visitors, description of any problems or issues, etc.); such descriptions shall be provided in addition to experimental calculations and other items. The original notebooks shall be stored on site. This protocol will not only ease referencing the original data, but offer protection of the original record of results.

The database for the project shall be set up in the form of custom-designed spreadsheets. The spreadsheets shall be capable of storing and manipulating each monitored water quality and operational parameter from each task, each sampling location, and each sampling time. All data from the laboratory notebooks and data log sheets shall be entered into the appropriate spreadsheets. Data entry shall be conducted on site by the designated field testing operators. All recorded calculations shall also be checked at this time. Following data entry, the spreadsheet shall be printed out and the print-out shall be checked against the handwritten data sheet. Any corrections shall be noted on the hard-copies and corrected on the screen, and then a corrected version of the spreadsheet shall be printed out. Each step of the verification process shall be initialed by the field testing operator or engineer performing the entry or verification step.

Each experiment (e.g., each test run) shall be assigned a run number that shall then be tied to the data from that experiment through each step of data entry and analysis. As samples are collected and sent to the chosen laboratory(ies), the data shall be tracked by use of the same system of run numbers. The FTO may send samples to a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the EPA for analysis of water quality parameters. Data from the outside laboratories shall be received and reviewed by the field

testing operator. These data shall be entered into the data spreadsheets, corrected, and verified in the same manner as the field data.

9.4 Statistical Analysis

Water quality developed from grab samples collected during test runs according to the Water Quality Sampling Schedule (Table 7) in Task 3 shall be analyzed for statistical uncertainty. For example, the FTO shall calculate the mean values, standard deviations and 95% confidence intervals for grab sample data obtained during the Verification Testing as described in the "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies" (Chapter 1). The mean values with 95% confidence intervals can then be used to compare the water quality results from tests conducted under different conditions of equipment operation or feed water quality. For comparisons between data from more than two testing periods, construction of an analysis of variance (ANOVA) table may be helpful in determining the statistical significance of differences between operational, microbial inactivation and treated water quality results. Statistical analysis such as that described above could be carried out for water quality data obtained under a large variety of testing conditions. The statistics developed will be helpful in demonstrating the degree of reliability with which water treatment equipment can attain quality goals.

10.0 TASK 5: QUALITY ASSURANCE/QUALITY CONTROL

10.1 Introduction

Quality assurance and quality control (QA/QC) of the operation of the on-site halogen generation equipment and the measured water quality parameters shall be maintained during the Verification Testing program.

10.2 Experimental Objectives

The objective of this task is to maintain strict QA/QC methods and procedures during testing. When specific items of equipment or instruments are used, the objective is to maintain the operation of the equipment or instructions within the ranges specified by the Manufacturer or by *Standard Methods*. Maintenance of strict QA/QC procedures is important in that if a question arises when analyzing or interpreting data collected for a given experiment, it will be possible to verify exact conditions at the time of testing.

10.3 Work Plan

Equipment flow rates and associated signals shall be documented and recorded on a routine basis. A routine daily walk-through during testing shall be established to verify that each piece of equipment or instrumentation is operating properly. In-line monitoring equipment such as flow meters shall be checked to verify that the read-out matches with the actual measurement (i.e., flow rate) and that the signal being recorded is correct. The items listed below are in addition to any specified checks outlined in the analytical methods.

10.3.1 Daily QA/QC Verifications

These QA/QC verifications shall be conducted daily during testing:

- Chemical feed pump flow rates (verified volumetrically over a specific time period)
- Flow rates to in-line analytical equipment (e.g., pH meter, turbidimeter), if any (verified volumetrically over a specific time period)
- In-line turbidimeter readings checked against a properly calibrated bench-top model.

10.3.2 QA/QC Verifications Performed Every Two Weeks

These verifications shall be conducted every two weeks:

- In-line flow meters/rotameters (clean equipment to remove any debris or biological buildup and verify flow volumetrically to avoid erroneous readings).
- In-line turbidimeters, if any, (clean out reservoirs and re-calibrate, if employed)

10.3.3 QA/QC Verifications To Be Performed For Each Testing Period

This verification shall be conducted before each testing period begins:

- Tubing (verify good condition of all tubing and connections; replace if necessary)

10.4 Analytical Methods and Sample Collection

The analytical methods utilized in this study for on-site monitoring, sample collection and testing of the quality of the feed water, concentrated halogen stream and halogen-treated water at the disinfection contactor influent and effluent are described below. Use of either bench-top or in-line analytical equipment will be acceptable for the verification testing; however, in-line equipment is recommended for ease of operation. Use of in-line equipment is also preferable because it reduces the introduction of error and the variability to analytical results generated by inconsistent sampling techniques.

10.4.1 pH

Analyses for pH shall be performed according to *Standard Method* 4500-H+ or EPA Method 150.1/150.2. A three-point calibration of the pH meter used in this study shall be performed once a day when the instrument is in use. Certified pH buffers in the expected range shall be used. The pH probe shall be stored in the appropriate solution, as defined in the instrument manual. Transport of carbon dioxide across the air-water interface can confound pH measurement in poorly buffered waters. If this is a problem, measurement of pH in a confined vessel is recommended to minimize the effects of carbon dioxide loss to the atmosphere.

10.4.2 Temperature

Readings for temperature shall be conducted in accordance with *Standard Methods* 2550. Raw water temperatures shall be obtained at least once daily. The thermometer shall have a scale marked for every 0.1°C, as a minimum, and should be calibrated weekly against a precision thermometer certified by the National Institute of Standards and Technology (NIST). (A thermometer having a range of -1°C to +51°C, subdivided in 0.1° increments, would be appropriate for this work.)

10.4.3 True Color

True color shall be measured with a spectrophotometer at 455 nm, using an adaptation of the *Standard Methods* 2120 procedure. Samples shall be collected in clean plastic or glass bottles and analyzed as soon after collection as possible. If samples cannot be analyzed immediately they shall be stored at 4°C for up to 24 hours, and then warmed to room temperature before analysis. The filtration system described in *Standard Methods* 2120 C shall be used, and results should be expressed in terms of PtCo color units.

10.4.4 Turbidity Analysis

Turbidity analyses shall be performed according to *Standard Methods* 2130 or EPA Method 180.1 with either a bench-top or in-line turbidimeter. In-line turbidimeters shall be used for measurement of turbidity in the filtrate waters, and either an in-line or bench-top turbidimeter may be used for measurement of the feedwater.

During each verification testing period, the bench-top and in-line turbidimeters will be left on continuously. Once each turbidity measurement is complete, the unit will be switched back to its lowest setting. All glassware used for turbidity measurements will be cleaned and handled using lint-free tissues to prevent scratching. Sample vials will be stored inverted to prevent deposits from forming on the bottom surface of the cell.

The Field Testing Organization shall be required to document any problems experienced with the monitoring turbidity instruments, and shall also be required to document any subsequent modifications or enhancements made to monitoring instruments.

10.4.4.1 Bench-top Turbidimeters. Grab samples shall be analyzed using a bench-top turbidimeter. Readings from this instrument will serve as reference measurements throughout the study. The bench-top turbidimeter shall be calibrated within the expected range of sample measurements at the beginning of equipment operation and on a weekly basis using primary turbidity standards of 0.1, 0.5, and 3.0 NTU. Secondary turbidity standards shall be obtained and checked against the primary standards. Secondary standards shall be used on a daily basis to verify calibration of the turbidimeter and to recalibrate when more than one turbidity range is used.

The method for collecting grab samples will consist of running a slow, steady stream from the sample tap, triple-rinsing a dedicated sample beaker in this stream, allowing the sample to flow down the side of the beaker to minimize bubble entrainment, double-rinsing the sample vial with the sample, carefully pouring from the beaker down the side of the sample vial, wiping the sample vial clean, inserting the sample vial into the turbidimeter, and recording the measured turbidity.

For the case of cold water samples that cause the vial to fog preventing accurate readings, the vial shall be allowed to warm up by partial submersion into a warm water bath for approximately 30 seconds.

10.4.4.2 In-line Turbidimeters. In-line turbidimeters are required for treated water monitoring during verification testing and must be calibrated and maintained as specified in the manufacturer's operation and maintenance manual. It will be necessary to verify the in-line readings using a bench-top turbidimeter at least daily; although the mechanism of analysis is not identical between the two instruments the readings should be comparable. Should these readings suggest inaccurate readings then all in-line turbidimeters should be recalibrated. In addition to calibration, periodic cleaning of the lens should be conducted, using lint-free paper, to prevent any particle or microbiological build-up that could produce inaccurate readings. Periodic verification of the sample flow rate should also be performed using a volumetric measurement. Instrument bulbs should be replaced on an as-needed basis. It should also be verified that the LED readout matches the data recorded on the data acquisition system, if the latter is employed.

10.4.5 Chlorine Residual

Because free chlorine in aqueous solutions is unstable, the free chlorine concentration in treated water samples will decrease rapidly. Exposure to sunlight or other strong light, or agitation, will accelerate free chlorine loss. Therefore, analysis of free and total chlorine samples shall begin immediately after sampling, and excessive light and agitation shall be avoided. Samples to be analyzed for free or total chlorine shall not be stored prior to analysis.

Glassware to be used for chlorine analyses shall be chlorine demand free. Chlorine demand free glassware will be prepared by soaking glassware in a 50 mg/L chlorine bath for a period of 24 hours. At the end of this time, all glassware will be rinsed three times with organic-free water that has a TOC concentration of less than 0.2 mg/L. Glassware will then be dried at room temperature for a period of 24 hours. During the drying process, bottle openings will be covered with aluminum foil to prevent contamination.

The method for collecting samples for chlorine analyses shall consist of the following procedure: running a slow, steady stream from the sample tap, triple-rinsing a chlorine demand free sample beaker in this stream, allowing the sample to flow down the side of the beaker to minimize agitation, performing the free and total chlorine analyses, and recording the measured chlorine concentrations.

10.4.6 Iodine Residual

Because iodine provides a more stable residual than chlorine and is less affected by environmental factors, glassware used for sampling is not required to be iodine demand free. Analysis of iodine samples shall begin as soon as possible after sampling. Samples to be analyzed for iodine shall not be stored prior to analysis. The method for collecting samples for iodine analysis shall be the same as that described above for chlorine residual, with the exceptions noted herein.

10.4.7 Chlorine Dioxide Residual

Similar to chlorine, chlorine dioxide in aqueous solutions is unstable. Exposure to sunlight or other strong light, or agitation, will accelerate chlorine dioxide loss. Therefore, analysis of chlorine dioxide samples shall begin immediately after sampling,

and excessive light and agitation shall be avoided. Samples to be analyzed for chlorine dioxide shall not be stored prior to analysis. Glassware for chlorine dioxide analyses shall be chlorine demand free, as described above in Section 10.4.5. The method for collecting samples for chlorine dioxide residual shall be identical to that described above for chlorine residual.

10.4.8 Bromine Residual

Bromine in aqueous solutions is even more unstable than chlorine. Exposure to sunlight or other strong light, or agitation, will accelerate bromine loss. Therefore, analysis of bromine samples shall begin immediately after sampling, and excessive light and agitation shall be avoided. Samples to be analyzed for bromine shall not be stored prior to analysis. Glassware for bromine analyses shall be chlorine demand free, as described above in Section 10.4.5. The method for collecting samples for bromine residual shall be identical to that described above for chlorine residual.

10.5 Chemical and Biological Samples Shipped Off-Site for Analyses

The analytical methods that shall be used during testing for chemical and biological samples that are shipped off-site for analyses are described in this section.

10.5.1 Organic Samples

Samples for analysis of total organic carbon (TOC) and UV₂₅₄ absorbance shall be collected in glass bottles supplied by the state-certified or third party- or EPA-accredited laboratory and shipped at 4°C to the analytical laboratory. These samples shall be preserved, held and shipped in accordance with *Standard Method* 5010 B. Storage time before analysis shall be minimized, according to *Standard Methods*.

10.5.2 Microbial Samples: TC and HPC Bacteria, Other Bacteria, Viruses and Protozoa

Samples for analysis of any microbial parameter shall be collected in bottles supplied by the analytical laboratory. Microbiological samples shall be refrigerated at approximately 2 to 8°C immediately upon collection. Such samples shall be shipped in a cooler and maintained at a temperature of approximately 2°C to 8°C during shipment. Samples shall be processed for analysis by the selected laboratory within 24 hours of collection. The laboratory shall keep the samples at approximately 2°C to 8°C until initiation of processing. TC densities shall be reported as most probable number per 100 mL (MPN/100 mL) and HPC densities shall be reported as colony forming units per mL (cfu/mL).

Methods for assessing the viability of the selected bacteria and viruses (see Table 6) shall be specified by the laboratory(ies) performing the analysis and shall be specified in the PSTP. The FTO may select a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the USEPA for analysis of microbial contaminants in water samples.

Methods for assessing the viability of cysts and oocysts are non-standard but may be used in verifying objectives that an on-site halogen generation system inactivates protozoan cysts and oocysts if the method has undergone peer review. A summary and comparison of viability methods is presented in research completed by the following researchers: Korich et al. (1993), Nieminski and Ongerth (1995), Slifko et al. (1997) and others (see Section 12.0 References in this Test Plan). Any non-standard method for assessing cyst and oocyst viability shall be correlated to animal infectivity.

10.5.3 Inorganic Samples

Inorganic chemical samples, including alkalinity, iron, sodium, and manganese, shall be collected and preserved in accordance with *Standard Method* 3010B, paying particular attention to the sources of contamination as outlined in *Standard Methods* 3010C. The samples shall be refrigerated at approximately 4°C immediately upon collection, shipped in a cooler, and maintained at a temperature of approximately 4°C during shipment. Samples shall be processed for analysis by a state-certified or third party- or EPA-accredited laboratory within 24 hours of collection. The laboratory shall keep the samples at approximately 4°C until initiation of analysis.

10.5.4 Bromate

Samples for the analysis of bromate shall be collected in sampling containers supplied by the state-certified or third party- or EPA-accredited laboratory. Sample collection and storage requirements are outlined in EPA Method 300.1 or shall be provided by the laboratory conducting the analysis.

10.6 DBP Formation Test Protocol

The DBP formation test simulates full-scale disinfection by spiking a water sample with a disinfectant and holding the spiked sample in the dark at a designated temperature and contact time. The spiked water sample may be held at the uniform formation conditions (UFC) specified by the ICR Manual for Bench- and Pilot-Scale Treatment Studies as follows:

- Incubation period of 24 ± 1 hours
- Incubation temperature of $20 \pm 1.0^{\circ}\text{C}$
- Buffered pH of 8.0 ± 0.2
- 24-hour chlorine residual of 1.0 ± 0.4 mg/L.

For this testing, one of two approaches may be employed, whichever is applicable:

1. If no additional dosing of halogens is used for residual disinfection subsequent to primary disinfection, the DBP formation test method shall be performed by collecting a sample of the treated water and holding the sample in the dark at the UFC.
2. If additional dosing of halogens is used for residual disinfection subsequent to primary disinfection, the DBP formation test method shall be performed by collecting a treated water sample, spiking it with an additional dose of disinfectant, and holding the sample in the dark at the UFC.

For either of the above approaches, as an alternative to utilizing the UFC, the conditions selected for DBP formation testing may be those that most closely approximate the residence time,

disinfectant type and disinfectant residual found in the distribution system at the location of the Verification Testing. These conditions shall be specified in the PSTP for approval by NSF.

For each DBP formation sample, three incubation bottles shall be set up. At the end of the incubation period, each sample shall be analyzed for the final disinfectant residual and the sample with the residual closest to the 1.0 ± 0.4 mg/L range shall be used for the specified DBP analyses.

All glassware used for preparation of the samples and reagents shall be chlorine demand free, as described above in Section 10.4.3.

The preparation of reagents and measurement of samples shall proceed as follows:

Preparation of Chlorine Stock Solution: The stock solution shall be prepared by adding an estimated volume of 6% reagent-grade NaOCl into a 500-mL, chlorine demand free bottle containing an estimated amount of organic-free water. To minimize the dilution error, the chlorine stock solution shall be at least 50 times stronger than the chlorine dose required.

Preparation of Other Halogen Disinfectant Stock Solution: For a halogen disinfectant other than chlorine, stock solution preparation shall be similar to that described above for chlorine stock solution. Organic free water shall be used for dilution and the stock solution shall be at least 50 times stronger than the halogen dose required.

Preparation of Additional Chemicals: Refer to *Standard Method 4500-Cl F* for the preparation method of DPD indicator, FAS standard and buffer solution.

Sample Collection and Incubation: The samples shall be collected in one liter amber bottles with Teflon lined caps. These bottles shall be stored in a temperature-controlled incubator at the specified temperature. Samples shall be adjusted to pH 8.0 ± 0.2 using 1 M HCl or NaOH and shall then be dosed with the appropriate dosage of chlorine (or other halogen disinfectant) to yield a chlorine (or other halogen disinfectant) residual of 1.0 ± 0.4 mg/L after the specified 24-hour storage period. The samples shall be capped head-space free and stored for 24 hours in the dark at the appropriate incubation temperature.

10.7 Health and Safety Measures

The FTO shall include in the PSTP specific instructions and description of the procedures that shall be used to ensure safe start-up, operation, sanitization and cleaning of the on-site halogen generation equipment during Verification Testing. In addition, the PSTP shall include information appropriate for inclusion in a Safety Plan. For example, a safety plan addressing health and safety measures shall address required actions in the event of equipment leaks, recommended organism handling procedures, requirements for protective personal equipment and bio-hazard signs etc. In summary, the following safety concerns shall be addressed by the FTO in the QA/QC plan applicable for the on-site generation equipment and verification testing procedures:

- Storage, handling and disposal of hazardous waste stream and chemicals including acids, bases, brine solutions, and oxidizing agents
- Storage, handling and disposal of biological waste streams

- Conformance with electrical code
- Chemical hazards and biohazards
- Need for spark-proof wires and/or National Electrical Code explosion-proof wiring
- Potential presence of explosive gases
- Ventilation of equipment, trailers (as applicable), or buildings (as applicable) if gases or chemicals generated by the equipment could present a safety hazard
- Emergency response procedures in case of equipment leaks or spillage of biological materials
- Requirement for personal protective equipment and emergency safety equipment.

11.0 OPERATION AND MAINTENANCE

The field testing organization shall obtain the Manufacturer-supplied O&M manual to evaluate the instructions and procedures for their applicability during the verification testing period. The following are recommendations for criteria to be included in Operation and Maintenance (O&M) Manuals for equipment for on-site generation of halogen disinfectants for inactivation of microbiological contaminants. The FTO will report on the applicability of the manual in the development of a final report of the Verification Testing period.

11.1 Maintenance

The Manufacturer shall provide readily understood information on the recommended or required maintenance schedule for each piece of operating equipment such as:

- pumps
- valves
- pressure gauges
- flow meters
- air compressors
- gas pressure vessels
- chemical feeder systems
- mixers
- motors
- instruments, such as turbidimeters, pH meters, halogen residual monitors
- water meters, if provided

The Manufacturer should provide readily understood information on the recommended or required maintenance for non-mechanical or non-electrical equipment such as:

- tanks and basins
- in-line static mixers
- tubing and hoses

11.2 Operation

The Manufacturer should provide readily interpretable recommendations for procedures related to proper operation of the equipment. In addition, the Manufacturer shall provide a schematic diagram that indicates the flow path of raw water, wastewater and disinfectant chemicals. Among the operating aspects that should be discussed are the following issues:

Disinfectant/Halogen Generation:

- control of feed flow to the on-site halogen generation system
- measurement of halogen concentration generated at a selected percent system output
- measurement of gas pressures (where applicable) generated during halogen generation during on-site system operation
- change in feed flow and halogen generation in response to temperature changes

Disinfectant Contact Time:

- control of feed flow to disinfectant contact basin
- adjustment of hydraulic detention time (i.e., volume if appropriate) in the contact basin
- control of halogen concentration dosed to the contact basin

Chemical Feeders (in the case that chemical pretreatment is applied):

- chemical feed pumps calibration check
- settings and adjustments -- how they should be made
- proper procedures for dilution of chemicals

Intermittent Operation:

- proper procedures for system shut-down and start-up of on-site generation system
- safety checks of halogen and gas concentrations prior to system shut-down
- safety checks of potential microbiological contaminant concentrations prior to system shut-down and start-up
- proper procedures for rinsing and disinfection of system following shut-down
- proper procedures for disinfection of system following spiking of microbiological contaminants

Monitoring and Sampling Procedures:

- observation of feed water quality or pretreated water turbidity
- observation of halogen generation efficiency as a function of feed water quality, flow rates and generation system output
- proper sampling procedures for spiking of microbiological contaminants
- proper safety and disinfection procedures following spiking with microbiological contaminants

The Manufacturer should provide a troubleshooting guide; a simple check- list of what to do for a variety of problems including:

- no raw water (feed water) flow to plant
- lack of feed water flow control through equipment
- valving configuration for direct feed flow and pretreated feed flow to system
- poor filtrate quality
- failed halogen generation safety test
- low pump feed pressure
- automatic operation (if provided) not functioning
- reduced rate of halogen generation at same percent system output
- machine will not start and "Power On" indicator off
- machine will not start and "Power On" indicator on
- pump cavitation

- valve stuck or won't operate
- no electric power
- no chemical feed
- no chemical feed to halogen generation system

11.3 Operability

The following are recommendations regarding operability aspects of systems that are designed to achieve inactivation of microbiological contaminants. These aspects of plant operation should be included if possible in reviews of historical data, and should be included to the extent practical in reports of equipment testing when the testing is done under the ETV Program.

During Verification Testing and during compilation of historical equipment operating data, attention shall be given to equipment operability aspects. Among the factors that should be considered are:

- Fluctuation of flow rates, halogen generation and pressures through unit, as well as the time interval at which flow control and adjustment of halogen production is needed
 - ⇒ Does on-site generation system (and any contact tanks provided) provide for variable hydraulic detention time and contact with disinfectant?
 - ⇒ How long can feed pumps and halogen generation equipment maintain target flow and contact time values?
 - ⇒ Is rate of feed water flow to on-site generation system measured?
 - ⇒ Does plant have facilities for pretreatment of feed water in the form of the following: pH adjustment, coagulant chemical feed, other?
 - ⇒ Can pretreatment chemical dosing (if applicable) be adjusted with changes in feed water flow?
- Presence of devices to aid the operator with adjustment of flow control, halogen generation, chemical dosage selection and system safety
 - ⇒ does rate of primary chemical feed change with flow of feed water or change in feed water quality (e.g., halogen demand)?
 - ⇒ are on-line halogen concentration monitors provided with on-site generation system?
 - ⇒ does remote notification to operator occur when a failure of on-site generation system occurs?
- Provision of on-line water quality monitors for feed water, concentrated halogen stream and halogen-treated water streams at the disinfection contactor influent and effluent
 - ⇒ are on-line turbidimeters provided on feed water stream?
 - ⇒ are on-line halogen residual monitors (e.g., chlorine monitors) provided on the halogen-treated water streams?

Both the reviews of historical data and the reports on Verification Testing should address the above questions in the written reports. The issues of operability and production should be dealt with in the portion of the reports that are written in response to Task 1 of the Verification Testing Plan.

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CHAPTER 4

EPA/NSF ETV EQUIPMENT VERIFICATION TESTING PLAN FOR ULTRAVIOLET RADIATION TECHNOLOGIES FOR INACTIVATION OF MICROBIOLOGICAL CONTAMINANTS

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1.0 APPLICATION OF THIS VERIFICATION TESTING PLAN

This document is the ETV Testing Plan for evaluation of water treatment equipment utilizing ultraviolet (UV) light for inactivation of microorganisms. This Testing Plan is to be used as a guide in the development of the Product-Specific Test Plan (PSTP) for testing UV equipment, within the structure provided by the ETV Protocol entitled "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies". This Environmental Technology Verification (ETV) Testing Plan is applicable only to treatment systems that rely on UV light to effectively inactivate microorganisms. Systems may incorporate unique strategies for enhancing the effect of UV light on target organisms, such as by applying innovative lamp technologies. All UV technologies including their UV lamps. Reactors and Irradiance sensors may be tested under this plan.

In order to participate in the equipment verification process for inactivation by UV, the equipment Manufacturer shall employ the procedures and methods described in this test plan and in the referenced ETV Protocol as guidelines for the development of the Manufacturer's Product-Specific Test Plan (PSTP). Interim, non-standard methods for assessing the viability of cyst and oocyst after UV treatment may be used for verification. However, any interim method (see Appendix A) is subject to change and must have been reviewed by experts of cyst and oocyst viability.

Various types of water treatment equipment employ UV light for several water purification objectives, including removal of trace organic contaminants through advanced oxidation processes and microbiological disinfection (inactivation). This Test Plan is applicable to the testing of water treatment equipment utilizing UV light for inactivation of microorganisms in drinking water. Because particles and other dissolved UV light absorbing contaminants can interfere with UV light and reduce its disinfecting efficiency, this plan is applicable to the use of UV technology for treating high quality water (<10 Nephelometric Turbidity Units (NTU) turbidity and >70% transmittance at 1 cm are the minimum qualities recommended) sources, including

- treated surface water supplies of consistent high quality;
- groundwater supplies that are high in percent transmittance of filtered and unfiltered water or have been pre-treated to produce water of consistent high quality.

The performance of UV reactors can be impacted by several water quality parameters, such as turbidity, UV transmittance, hardness, alkalinity, iron, manganese, organics, and pH. Many of these parameters result in a loss of UV transmittance due to fouling of the quartz sleeves surrounding the lamps and therefore mainly impact long-term reactor performance and maintenance. Some of these parameters also impact UV transmittance, but there is no need to monitor the UV absorbance of individual compounds. Only the UV transmittance and turbidity of the water may directly impact inactivation performance during a microbial challenge study. Therefore, testing of the system should be performed using the worst conditions of UV transmittance and turbidity anticipated for the installation site.

2.0 INTRODUCTION

UV light currently is being used in place of chlorine for secondary wastewater disinfection in the eastern United States, and is gaining increased attention as a disinfectant for water reuse projects in California. UV technology also is used for drinking water applications in Europe for several reasons:

- It is a physical process that does not involve the addition of chemicals.
- It has been demonstrated to be a highly effective germicide.
- It employs very short contact time (seconds) in pressurized reactors making capital costs low and maintaining existing hydraulic gradients without the need for re-pumping.
- In numerous studies to date it has been shown to produce no disinfection by-products.

The typical sources of UV light are low pressure, mercury vapor arc lamps. These lamps produce approximately 90 percent of their total energy output at the germicidal wavelength of 253.7 nanometers (nm). Low pressure UV technology has been employed in wastewater treatment and some drinking water treatment applications for inactivation of certain bacteria and viruses. Conventional low pressure UV systems have not been found to be effective at killing cysts and oocysts of protozoa such as *Giardia* and *Cryptosporidium* at cost effective dosages. Other UV technologies (including medium pressure, high intensity, advanced, and pulsed) are being developed for the inactivation of more resistant microorganisms, such as protozoan cysts and oocysts. Little is known about which wavelength(s) result in the inactivation of the protozoan cysts and oocysts by high pressure, advanced and pulsed UV technologies. Nonetheless, this ETV Testing Plan is applicable to any UV technology.

3.0 GENERAL APPROACH

Testing of equipment covered by this Test Plan will be conducted by an NSF-qualified Field Testing Organization that is selected by the equipment Manufacturer. Water quality and microbiological analytical work to be carried out as a part of this Test Plan will be contracted with a laboratory certified by a state or accredited by a third party organization (i.e., NSF) or the U.S. Environmental Protection Agency (U.S. EPA) for the appropriate water quality parameters.

4.0 OVERVIEW OF TASKS

The following section provides a brief overview of the recommended tasks that may be included in Initial Operations and of the required and optional tasks to be included in any UV inactivation Test Plan.

4.1 Initial Operations: Overview

The purpose of these tasks is to provide preliminary information that will facilitate final test design and data interpretation.

4.1.1 Task A: Characterization Of Feed Water

The objective of this recommended Initial Operations task is to obtain a chemical, biological and physical characterization of the feed water. A brief description of the watershed or aquifer and any pretreatment modules that provide the feed water shall be prepared, to aid in interpretation of feed water characterization.

4.1.2 Task B: Initial Tests Runs

During Initial Operations, the equipment Manufacturer may want to evaluate equipment operation and determine flow rates, hydraulic retention time, contact times (via tracer tests when technically feasible as many advanced UV systems have theoretically short retention times of 2 to 20 seconds), number of UV lamps, the spectral distribution of wavelength from the UV lamp or other factors which provide effective treatment of high quality water. This is a recommended Initial Operations task. The equipment Manufacturer may also want to work with the Testing Organization and analytical laboratory to perform blank or preliminary challenges and sampling routines to verify that sampling equipment can perform its required functions including laboratory studies of UV irradiance and microorganism viability. This is also a recommended Initial Operations Task.

4.2 Verification Operations: Overview

The objective of this task is to operate the treatment equipment provided by the equipment Manufacturer and to assess its ability to meet stated water quality goals and any other performance characteristics specified by the Manufacturer. A minimum of one verification testing period shall be performed. Additional verification testing periods may be necessary to verify the manufacturer's objectives, such as in the treatment of surface water where additional testing during each season may assist in verifying an objective. The time period selected for testing should represent the worst-case for concentrations of contaminants e.g., dissolved solids which interfere with UV, or potentially can foul a UV lamp or sensor e.g., iron, nitrates.

4.2.1 Task 1: Verification Testing Runs and Routine Equipment Operation

To characterize the technology in terms of efficiency and reliability, water treatment equipment that includes UV lamp, reactor and sensor for measuring UV Irradiance shall be operated for Verification Testing purposes with the operational parameters based on the results of the Initial Operations testing.

4.2.2 Task 2: Feed Water and Finished Water Quality

During each day of Verification Testing, feed water and treated water samples shall be collected, and analyzed for parameters relevant to microbial enumeration or those affecting equipment performance, as outlined in Section 10.0, Table 1.

4.2.3 Task 3: Documentation of Operating Conditions and Treatment Equipment Performance

During each day of Verification Testing, operating conditions and performance of the water treatment equipment shall be documented. This includes UV Irradiance, lamp and sensor fouling and cleaning applied and frequency, water flow (rate [g.p.m.] and total flow), power usage, stability of power supply (surges, brown-outs, etc.).

4.2.4 Task 4: Microbial Inactivation

The objective of this task is to measure the performance of the UV drinking water treatment equipment that includes the UV lamp and reactor, in inactivating microbiological contaminants during Verification Testing.

4.2.5 Task 5: Data Management

The objective of this task is to establish an effective field protocol for data management at the field operations site and for data transmission between the Field Testing Organization (FTO) and the NSF for data obtained during the Verification Testing. Prior to the beginning of field testing, the database design must be developed by the Field Testing Organization and reviewed and approved by NSF. This will insure that the required data will be collected during the testing, and that it can be effectively transmitted to NSF for review.

4.2.6 Task 6: Quality Assurance/Quality Control (QA/QC)

An important aspect of Verification Testing is the protocol developed for quality assurance and quality control. The objective of this task is to assure accurate measurement of operational and water quality parameters during UV radiation equipment Verification Testing. Prior to the beginning of field testing, a QA/QC plan must be developed which addresses all aspects of the testing process. Each water quality parameter and operational parameter must have appropriate QA and QC measures in place and documented. For example, the protocol for pH measurement should describe how the pH meter is calibrated (frequency, pH values), what adjustments are made, and provide a permanent record of all calibrations and maintenance for that instrument.

5.0 TESTING PERIODS

The required tasks in the Verification Testing Plan (Tasks 1 through 6 except Task 4 when water treatment equipment is being used to deliver potable water at the test site; see section 9 Routine Equipment Operation) are designed to be carried out for a minimum of one verification testing period. Additional verification testing periods may be necessary to verify the manufacturer's objectives, such as in the treatment of surface water where additional testing during each season may assist in verifying a performance objective. For systems treating solely groundwater or surface waters of consistent quality due to pre-treatment (<10 NTU turbidity and >70% transmittance), one verification testing period may be sufficient. If one verification testing period is selected, the feed water should represent the worst-case concentrations of contaminants

which can verify the manufacturer's objectives. For example dissolved solids which interfere with UV, or potentially can foul a UV lamp or sensor (e.g., iron, nitrates). Although one testing period satisfies the minimum requirement of the ETV program, manufacturers are encouraged to use additional testing periods to cover a wider range of water quality conditions.

Verification testing periods consist of continued evaluation of the treatment system using the pertinent treatment parameters defined in Initial Operations. Performance and reliability of the equipment shall be tested during Verification Testing periods of a minimum of 320 hours (13 full days plus one 8-hour shift). Only Task 3 shall be conducted during a 27-day period. The purpose of the 27 day test period is to assess operation and maintenance items associated with the equipment, such as the build up of potential scale or other contaminants on the surface of UV lamps and UV irradiance sensors.

6.0 DEFINITION OF OPERATIONAL PARAMETERS

Definitions that apply to UV processes are given below:

6.1 UV Output

The amount of power (in the wavelength range of 200-300 nm) delivered from the lamp to the water and described in terms of watts (W) per lamp. The absolute free-standing UV power of the lamp is decreased by end losses and by transmission losses through the quartz sleeve. The UV output can be reduced because of lamp aging, water temperature, and lamp fouling (as defined in Section 6.7).

6.2 UV Irradiance

The rate at which UV energy is incident on a unit area (e.g., 1 cm²) in the water and described in terms of UV power per unit area, e.g., microwatts per square centimeter (μW/cm²) or milliwatts per square centimeter (mW/cm²).

6.3 UV Dose

The energy is quantified to a dose by multiplying the UV Irradiance by the actual exposure time:

$$\begin{aligned} \text{Dose } (\mu\text{W sec/cm}^2) &= \text{UV Irradiance } (\mu\text{W/cm}^2) \times \text{Time (seconds)} \text{ or} \\ \text{Dose (mW sec/cm}^2) &= \text{UV Irradiance (mW/cm}^2) \times \text{Time (seconds)} \text{ or} \\ \text{Dose (mJ/cm}^2) &= \text{UV Irradiance (mW/cm}^2) \times \text{Time (seconds)} \end{aligned}$$

6.4 UV Transmittance

The ability of the water to transmit UV light. Transmittance of a water sample is generally measured as the percentage (%T) of transmitted light (I) to incident light (I₀) through an operationally defined pathlength (L). Many commercially available spectrophotometers actually report the Absorbance (A) for a fixed pathlength (L) of the sample. Percent Transmittance and Absorbance can be related as: %T = 100 × 10^{-(A/L)}. Many naturally occurring organic and inorganic constituents (e.g., natural organic matter, iron, nitrate) will absorb energy in the UV

wavelengths, thus reducing the transmittance of the water. This reduced transmittance often interferes with the disinfection efficiency of a UV disinfection system.

6.5 Low Pressure Lamps

Low pressure lamps operate at a temperature between 38 and 49°C (100 and 120°F) to produce a near monochromatic radiation at 253.7 nm. These lamps typically have a linear power density of about 0.3 W/cm.

6.6 Medium Pressure Lamps

Medium pressure lamps produce a high intensity broad spectrum of UV light (extending over the 200-300 nm range of microbiological sensitivity with a maximum output at about 255 nm) with a higher Irradiance and operating at a much higher operating temperature (surface temperatures >500°C) than do low pressure Hg lamps. The linear power density is also much higher (typically 100-300 W/cm).

6.7 Lamp Fouling

If the lamps are submerged in the feedwater, lamp fouling may occur. Lamp fouling is the reduction in UV Irradiance caused by the presence of certain organic and inorganic ions in the water that can result in the accumulation of mineral deposits or biofilm on the quartz sleeves covering the lamps. Chemical or mechanical cleaning is needed to restore the UV Irradiance to design conditions.

7.0 TASK A: CHARACTERIZATION OF FEED WATER

7.1 Introduction

This Initial Operations task is needed to determine if the chemical, biological and physical characteristics of the feed water are appropriate for the water treatment equipment to be tested.

7.2 Objectives

The objective of this task is to obtain a complete chemical, biological and physical characterization of the source water or the feed water as pre-treated that will be entering the treatment system being tested.

7.3 Work Plan

The specific parameters needed to characterize the water will depend on the equipment being tested and the source water feeding the UV drinking water treatment equipment. During this Initial Operations task, the feed water to the UV drinking water treatment systems, the following characteristics should be measured and recorded:

- Water Temperature, Turbidity, UV₂₅₄ absorbance and filtered and unfiltered transmittance (and/or absorbance measurements at other wavelengths that are appropriate to the UV

disinfection system being tested), Free and Total Chlorine, Total Organic Carbon, and Color.

- Total Coliform (for a treated water source) or Heterotrophic Plate Count (HPC) (for an untreated water source)
- Aerobic spores, and Algae.
- Total Alkalinity, pH, Calcium, Hardness, Nitrate, aluminum and Iron.

Section 9 of this document provides a list of characteristics that shall be measured and recorded depending on the source of feed water to the UV equipment and should be used as a guideline for Initial Operations.

Sufficient information shall be obtained to illustrate the variations expected to occur in these parameters that will be measured during the Verification Testing for a typical annual cycle for the water source. This information will be compiled and shared with NSF so NSF and the Testing Organization can determine the adequacy of the data for use as the basis to make decisions on the testing schedule. Failure to adequately characterize the feed water (source water) could result in testing at a site later deemed inappropriate, so the initial characterization will be important to the success of the testing program.

A brief description of the watershed or aquifer source shall be provided, to aid in interpretation of feed water characterization. The watershed description should include a statement of the approximate size of the watershed, a description of the topography (i.e. flat, gently rolling, hilly, mountainous) and a description of the kinds of human activity that take place (i.e. mining, manufacturing, cities or towns, farming) with special attention to potential sources of pollution that might influence feed water quality. The nature of the water source, such as stream, river, lake or man-made reservoir, should be described as well. Aquifer description should include the above characterization relative to the recharge zone, a description of the hydrogeology of the water bearing stratum(a), well-boring data, and any Microscopic Particulate Analysis data indicating whether the groundwater is under the influence of surface waters.

Any pretreatment modules impacting the source water shall be characterized. Any coagulant or other chemical additions shall be identified. Predicted effects on turbidity and particle load by pre-filtration shall be discussed.

7.4 Evaluation Criteria

Feed water quality will be evaluated in the context of the Manufacturer's statement of the equipment performance objectives but should not be beyond the range of water quality suitable for treatment for the equipment in question. If the device is to be used for treating high quality ground waters or those surface water sources that have already received full or partial treatment, it should be tested on waters of that quality.

8.0 TASK B: INITIAL OPERATIONS

8.1 Introduction

During Initial Operations, a Manufacturer may want to evaluate equipment operations and determine the flow rates, hydraulic residence time, pulse rates, exposure times, number and/or Irradiance of UV lamps, the spectral distribution of wavelength from the UV lamp, degree of power supply/line conditioning required, or other factors applicable to the technology which provide effective treatment of the feed water. The Manufacturer may also want to work with the Testing Organization and the analytical laboratory to perform blank or preliminary challenges and sampling routines to verify that sampling equipment can perform their required functions under normal operating conditions. This information may also indicate operating conditions under which the Manufacturer's stated performance objectives are not met, or whether any threshold UV dose level can be determined. This is a recommended Initial Operations task. An NSF field inspection of equipment operations and sampling and field analysis procedures may be carried out during the initial test runs.

The "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies" (Chapter 1) under which this test plan is formulated requires hydraulic testing to demonstrate flow conditions and residence duration (exposure time). The equipment Manufacturer may want to conduct such tests during these initial runs. Additional tracer tests are required if a system is hydraulically dissimilar to that tested for the Protocol is utilized, or if testing is to proceed at flow rates and conditions other than those demonstrated previously. Procedures for developing a tracer test methodology are described in the Protocol.

8.2 Objectives

The objective of these test runs is to bracket the proper operating parameters for treatment of the feed water during Verification Testing. UV performance may be different for feed waters from different test sites or for the feed water from the same site during different seasons. Therefore, conducting initial test runs is strongly recommended.

8.3 Work Plan

Conducting UV exposure tests on small batches (cuvettes) of feed water containing test organism can be a rapid method of roughly evaluating equipment performance and of bracketing effective UV dosages. Where batch testing cannot be applied to a particular system, scaled back or full-scale initial tests may be designed. Follow-up confirmation of initial batch testing by preliminary scaled back continuous flow tests is recommended. Continuous flow testing is required during verification testing unless the manufacturer's performance objectives also specifies use during intermittent flow or use as typical for very small community systems (<500 persons). The work plan should then include a shut down period of 12 hours each day where the UV equipment is turned off.

8.4 Analytical Schedule

Because these runs are being conducted to define operating conditions for Verification Testing, a strictly defined schedule for sampling and analysis does not need to be followed. Adhering to the schedule for sampling and analysis to be followed during Verification Testing would be wise, however, so the operator can gain familiarity with the time requirements that will be applicable later on in the test program. Also, during the Initial Operations phase, the verification organization may conduct an initial on-site inspection of field operations, sampling activities and on-site analysis. The sampling and analysis schedule for Verification Testing shall be followed during the on-site inspection.

8.5 Evaluation Criteria

The Manufacturer should evaluate the data produced during the Initial Operations to determine if the water treatment equipment performed so as to meet or exceed expectations based on the statement of performance objectives. If the performance was not as good as the statement of performance objectives, the Manufacturer may wish to conduct more Initial Operations or to cancel the testing program.

9.0 TASK 1: VERIFICATION TESTING RUNS AND ROUTINE EQUIPMENT OPERATION

9.1 Introduction

Water treatment equipment that includes UV lamp, reactor and sensor for measuring the UV light Irradiance shall be operated for Verification Testing purposes with the operational parameters based on the manufacturer's statement of performance objectives.

9.2 Experimental Objectives

The objective of this task is to characterize the technology in terms of efficiency and reliability while operating under the conditions established during the Initial Operations testing. These conditions must represent the operating conditions for which the unit was designed. For example, if the unit is designed to operate at several hundred g.p.m., the testing must be done using flow rates which approximate these conditions. However, if the unit has a family of similar units that differ only in size and the Manufacturer demonstrates with tracer data, calculations, computation, fluid dynamic models, etc., that a smaller unit has the same hydraulic behavior and irradiance distribution as the larger unit, then testing may proceed with the smallest size unit. The experimental protocol must be designed so as to assess the unit adequately when operating under its design conditions.

9.3 Work Plan

9.3.1 Verification Testing Runs

The Verification Testing Runs in this task consist of continued evaluation of the treatment system, using the most successful treatment parameters defined in Initial

Operations. Performance and reliability of the equipment shall be tested during Verification Testing periods of a minimum of 320 hours (13 full days plus one 8-hour shift). Only Task 3 shall be conducted during a 27 day period. The purpose of the 27 day test period is to assess the build up of potential scale or other contaminants on the surface of UV lamps and UV Irradiance sensors. During each testing run, Tasks 1 through 5 shall be conducted simultaneously.

Seasonal testing may be required for equipment treating surface waters because of the differences in water quality that occur on a seasonal basis, although pre-treatment modules, when present, may damp these variations. For UV treatment equipment, factors that can influence treatment performance include:

- High turbidity, often occurring in spring, encountered in rivers carrying a high sediment load or in surface waters during periods of high runoff resulting from heavy rains or snow melt. Particulate load may absorb or interfere with UV radiation.
- Algae, which may exhibit bloom on a seasonal basis. Algae absorb and interfere with UV radiation.
- Natural organic matter, which may be higher in some waters in the fall. Organic matter may absorb UV radiation, and may contribute to fouling of the lamp surfaces.
- Iron, nitrate, pH, alkalinity and hardness, which may vary seasonally for some waters. These parameters may cause or contribute to fouling of the lamp surfaces or may absorb UV radiation.
- Aluminum from alum coagulation treatment of surface water, hardness from lime softening, may contribute to fouling of the lamp surfaces.

It is unlikely that all of the above problems would occur in surface water during a single season, and this may result in testing during each season of the year and possibly at different test sites. The testing should be designed to test the UV unit when the water quality to that unit changes, either because the unit is operated without pre-treatment or because the pre-treatment produces a different quality water which is presented to the UV unit.

9.3.2 Routine Equipment Operation

If the water treatment equipment is being used for production of potable water, in the time intervals between verification runs, routine operation for water production is anticipated. In this situation, the operating and water quality data collected and furnished to the Safe Drinking Water Act (SDWA) primacy agency shall be supplied to the NSF-qualified testing organization.

9.4 Schedule

During Verification Testing, water treatment equipment shall be operated continuously for a minimum of 320 hours (13 full days plus one 8-hour work shift) with interruptions in operation as needed for system maintenance.

9.5 Evaluation Criteria

The goal of this task is to operate the equipment for the 320 hour period, including time for lamp changing and other necessary operating activities, during Verification Testing. Data shall be provided to substantiate the operation for 320 hours or more.

10.0 TASK 2: TEST RUNS FOR FEED WATER AND FINISHED WATER QUALITY

10.1 Introduction

Water quality data shall be collected for the feed water and treated water as shown in Table 1 depending upon the source of feed water (see 10.1.1- 10.1.3), during each day of Verification Testing. The Field Test Organization on behalf of the equipment Manufacturer shall assure the sampling or measuring of the water quality parameters in Table 1 depending upon the source of feed water (see 10.1.1-10.1.3). A Field Testing Organization may use local personnel to assist in collection of samples or measurement of test parameters, but is responsible for their training to assure proper technique. Water quality goals and target inactivation goals for the water treatment equipment shall be recorded in the Product-Specific Test Plan in the statement of objectives.

10.1.1 Untreated Surface Water as Feed Water:

For UV drinking water treatment systems that treat raw or filtered only surface water, the parameters in Table 1 shall be measured and recorded, except free and total chlorine and aluminum as these parameters will not likely occur in raw water (they will likely occur or be added during chemical treatment).

10.1.2 Treated Surface Water as Feed Water:

For UV drinking water treatment systems that treat feed water from consistently and previously treated (lime softening, chemical coagulation etc. but not solely filtration) surface water, the parameters in Table 1 shall be measured and recorded, except algae, total coliform and endospores as previous treatment will likely have removed these contaminants.

10.1.3 Ground Water as Feed Water

For UV drinking water treatment systems that treat ground water, the parameters in Table 1 shall be measured and recorded, except color, algae and endospores as they will not likely occur in ground water, and free and total chlorine and aluminum which are not typically added during chemical treatment of ground water. HPC is also not required for a ground water source.

Table 1. Water Quality Sampling and Measurement Schedule

Parameter:	Frequency:
Temperature	Daily
pH	Daily
Total Alkalinity	Semi-weekly
Hardness	Semi-weekly
Total Organic Carbon	Semi-weekly
UV Absorbance (254 and/or other nm)	Semi-weekly
Turbidity	Daily at bench to check continuous Turbidimeters
Algae, number and species	Semi-weekly if no algae bloom. Daily if algae bloom occurs.
True Color	Semi-weekly
Nitrate	Semi-weekly
Iron, Manganese and Aluminum	Semi-weekly
Bacteria and viruses	Daily specified in objectives statement and Total Coliform or HPC or <i>Bacillus</i> spores
Free and Total Chlorine	Daily

10.2 Experimental Objectives

For verification testing of inactivation of naturally existing microorganisms this task will allow determination of mean concentrations of organisms and their variability in the feed water. A list of a minimum number of additional water quality parameters to be monitored during equipment verification testing is provided in the Analytical Schedule section below and in Table 1. The actual water quality parameters selected for testing shall be stipulated by the Manufacturer in the Product-Specific Test Plan and shall include all those necessary to permit verification of the statement of performance objectives.

10.3 Work Plan

The manufacturer will be responsible for establishing the plant testing operating parameters, on the basis of the Initial Operations testing. Many of the water quality parameters described in this task will be measured on-site by the NSF-qualified Field Testing Organization or by local community personnel properly trained by the Field Testing Organization (refer to Table 2). Analysis of the remaining water quality parameters will be performed by a laboratory that is certified, accredited or approved by a State, a third-party organization (i.e., NSF), or the U.S. EPA. The methods to be used for measurement of water quality parameters in the field are listed in the Analytical Methods section below in Table 2. The analytical methods utilized in this study for on-site monitoring of feed water and filtered water qualities are described in Task 6, Quality

Assurance/Quality Control (QA/QC). Where appropriate, the *Standard Methods* reference numbers for water quality parameters are provided for both the field and laboratory analytical procedures.

Table 2: Analytical Methods

Parameter	Facility	Standard Methods and Other Method References	EPA Methods
Temperature	On-site	2550 B	
pH	On-site	4500 H+ B	150.1/150.2
Total Alkalinity	Lab	2320 B	
Total Hardness	Lab	2340 C	
Total Organic Carbon	Lab	5310 C	
UV Absorbance (254 and/or other nm)	Lab	5910 B	
Turbidity	On-site	2130 B	180.1
Algae, number species	Lab	10200 and 10900	
True Color	Lab or On-site	2120 B (Hach Co. modification of <i>SM</i> 2120 measured at 455 nm)	
Total Coliform	Lab	9221 / 9222 / 9223	
Heterotrophic Plate Count	Lab	9215 B	
<i>E. coli</i>	Lab	9225 or Colilert	
<i>Micrococcus luteus</i>	Lab	AWWARF Surrogate Report by CSU	
<i>Bacillus</i> spores	Lab	Rice et al. 1996	
MS2 Virus	Lab	EPA ICR Method for Coliphage Assay, 1996 or 9224 F	
Algae	Lab	AWWARF Surrogate Report by CSU	
<i>Giardia</i> and <i>Cryptosporidium</i>	Lab	EPA Draft 1622, (enumeration only)	
Iron	Lab	3120 B, 3111 B, 3113 B	200.7, 200.9
Manganese	Lab	3120 B, 3111 B, 3113 B	200.7, 200.8, 200.9
Aluminum	Lab	3120 B, 3111 D, 3113 B	200.7, 200.8, 200.9
Nitrate	Lab	4110 B, 4500- NO_3 -F, 4500- NO_3 -D, 4500- NO_3 -E	300.0, 353.2
Free and Total Chlorine	On-site	Hach modification of <i>SM</i> 4500 CL:G	

10.4 Water Quality Sample Collection

Water quality data shall be collected at regular intervals during each period of testing, as noted in this section. Additional sampling and data collection may be performed at the discretion of the Manufacturer. Sample collection frequency and protocol shall be defined by the Field Testing Organization in the Product-Specific Test Plan.

In the case of water quality samples that will be shipped to the off-site laboratory for analysis, the samples shall be collected in appropriate containers (containing preservatives as applicable) prepared by the off-site laboratory. These samples shall be preserved, stored, shipped and analyzed in accordance with appropriate procedures and holding times, as specified by the analytical laboratory. Original field sheets and chain-of-custody forms shall accompany all samples shipped to the analytical laboratory. Copies of field sheets and chain-of-custody forms for all samples shall be provided to NSF.

10.5 Analytical Schedule

During Verification Testing of UV treatment equipment, the feed water and treated water quality shall be characterized by measurement of the water quality parameters listed above in the Table with the exceptions allowed under sections 10.1.1 - 10.1.3. These parameters are listed to provide verification report readers with background data on the quality of the feed water being treated and the quality of the treated water. These data are to be collected to enhance the acceptability to the Verification Testing data to a wide range of drinking water regulatory agencies.

10.6 Evaluation Criteria

Evaluation of water quality in this task is related to general water quality capabilities indicated by the Manufacturer.

11.0 TASK 3: DOCUMENTATION OF OPERATING CONDITIONS AND TREATMENT EQUIPMENT PERFORMANCE

11.1 Introduction

Task 3 shall be conducted over a minimum 27 day period. During each day of the testing period operating conditions shall be documented. This shall include descriptions of pretreatment chemistry and filtration for the equipment processes used, if any, and their operating conditions. The performance of the UV disinfection equipment shall be documented, including total water throughput and total power usage, UV Irradiance as measured by the manufacturer's UV irradiance sensor, hours of lamp operation, lamp sensor output and its decrease in output over time, frequency of pulsing or length of cycles, if applicable, lamp fouling rates, frequency and type of mechanical cleaning and performance of automatic mechanical wipers or ultrasonic cleaners, if present. In addition, the power supply shall be tracked and spikes and brownout events shall be noted.

The measurement of true UV dose will not be measured as part of the equipment operating performance. The hydraulics and UV irradiance distribution vary greatly and would confound the UV dose calculation. UV irradiance measurements shall be measured for low pressure UV lamp equipment. For equipment using other UV technology, the operating conditions and equipment performance shall be monitored using the sensor provided with the UV system (lamp, sensor and reactor). Any change in reactor design, source of lamp or UV irradiance sensor constitutes a change in the UV system and repeat testing shall be required.

11.2 Objectives

The objective of this task is to accurately and fully document the operating conditions that applied during treatment, and the performance of the equipment. This task is intended to result in data that describe the operation of the equipment and data that can be used to develop cost estimates for operation of the equipment.

11.3 Work Plan

During each day of Verification Testing, treatment equipment operating parameters for both pretreatment and UV radiation will be monitored and recorded on a routine basis. This shall include a complete description of pretreatment chemistry; rate of flow and total flow; and UV irradiance as measured by the manufacturer's UV irradiance sensor. Calibration of lamp irradiance sensors shall be demonstrated and recorded. Electrical energy consumed by the UV treatment equipment shall be measured and recorded. In addition, the aggregate horsepower of all motors and mechanical efficiencies of all motor/devices supplied with the equipment shall be determined and used to develop an estimate of the maximum power requirements and routine power consumption during operation. A complete description of each process shall be given, with data on volume and detention time of each process stream at rated flow.

An automatic device for monitoring UV irradiance is strongly suggested with any UV system. The testing plan should include a determination of the minimum irradiance below which equipment shutoff should occur to assure adequate disinfection at all times. When the irradiance drops below this value, flow can be shut off or a signal given to the operator indicating the need for cleaning or lamp replacement.

11.4 Schedule

Table 3 presents the schedule for observing and recording UV equipment operating and performance data.

Table 3: Equipment Operating Data

OPERATIONS PARAMETER	ACTION
Flow Rate	Check and record each 2 hours. Adjust when 10% above or below target. Record both before and after adjustment.
Exposure Time*	Record retention or cycle times when applicable. If variable, record degree of variation.
UV Irradiance	Check and record each 2 hours.
UV Sensor	Record out put from in-line monitor. Record changes in lamp irradiance following each cleaning
Lamp Fouling/Cleaning system	Record frequency of sleeve cleaning, if applicable
Lamp Hours	Record Daily
Electric Power	Record meter reading daily
Lamp Cycles	Record frequency of lamp on/off cycles
* Recording of exposure time is required for systems where exposure is independent of hydraulics or UV pulse rate. For others, exposure time will have been determined in preliminary tracer testing by other means for UV systems which have short hydraulic retention times and will not vary during operation.	

11.5 Evaluation Criteria

Where applicable, the data developed from this task will be compared to statements of performance objectives. If no relevant statement of performance objectives exists, results of operating and performance data will be tabulated for inclusion in the Verification Report.

12.0 TASK 4: DOCUMENTATION OF EQUIPMENT PERFORMANCE INACTIVATION OF MICROORGANISMS

12.1 Introduction

Inactivation of microorganisms is the primary purpose of UV drinking water treatment modules. Consequently, the effectiveness of the equipment at inactivating microorganisms introduced by seeding the feed water with bacteria, viruses or protozoa or with a combination of those or other approved types of microorganisms will be evaluated in this task. When the naturally occurring concentration of the microorganism in the feed water at a test site or where an UV water treatment is delivering potable water, is sufficient to challenge the manufacturer's performance objectives, no challenge test or seeding study is necessary. The measurement of inactivation is a comparison of the percent of viable organisms in the feed stream with the percent of viable organisms in the effluent.

12.2 Experimental Objectives

The objective of this task is to operate the treatment equipment provided by the Manufacturer and to characterize the technology in terms of efficacy at inactivation of microbial organisms. Challenge organisms to be tested will be selected by the equipment Manufacturer.

12.3 Work Plan

12.3.1 Microbial Challenge Tests

Microbial challenge experiments shall be conducted at full scale and not with pilot or prototype equipment. The Field Testing Organization shall conduct the challenge studies in the field, and the Field Testing Organization shall submit the resulting samples to a laboratory that is certified, accredited or approved by a State, a third-party organization, or the U.S. EPA.

For cysts and oocysts only, the microbial challenge testing of each operating condition must be performed a minimum of three times in order to achieve a statistical measure of the precision of the performance. A minimum of three conditions are to be tested (i.e. system off – no organisms, system off – seeded organisms added, and system on at optimal setting – seeded organisms added) requiring a total of nine challenge tests corresponding to three replicate challenge experiments at each of the three test conditions. The optimal setting can be specified by the manufacturer and should be supported by the results from the Initial Operations (Section 5). A fourth condition representing a sub-optimal UV dose setting can also be performed, but it is not required. This sub-optimal UV dose condition may be achieved by increasing the flow through the reactor to decrease hydraulic retention time or decreasing the power to the UV lamp, resulting in reduced irradiance of the water.

12.3.1.1 Organisms Employed for Challenge Experiments. Microorganisms which may be used for inactivation studies are listed below. These species represent microorganisms of particular interest and concern to the drinking water industry, and represent a range of resistance to inactivation methods. The specific batch(es) used must be shown to be viable by the laboratory involved in the analytical aspects of the testing.

Bacteria	<i>Bacillus subtilis</i>	<i>Pseudomonas</i> spp.
	<i>Clostridium perfringens</i>	<i>E. coli</i>
Virus	MS2 bacteriophage (surrogate)	

12.3.1.2 Spiking Protocols. The total number of each type of test organism required for spiking will depend on the reactor volume, the water flow rate, and the desired steady-state concentration of microbiological contaminants in the reactor. For viruses, a steady-state final concentration adequate to show 4-log removal against the effluent analyses detection limit is necessary. The total number of organisms required to provide these steady-state microbiological populations will depend on the overall volume of the disinfection contractor, the detection limits of the sampling and analytical methods and the duration of experiments. For all organisms, the laboratory(ies) supplying the

organisms and performing the viability studies shall be experienced in challenge testing and be able to predict initial dosages required to overcome any inherent experimental losses. Microbial challenges shall be conducted either by batch seeding or by feed stream injection. For evaluation of inactivation of *Giardia*, bacteria species, virus, or any other organisms negatively affected by chlorine, dechlorination will be required. Any system based on synergistic effects of chlorine and UV will not require dechlorination. Evaluation of *Cryptosporidium* inactivation will not require removal of chlorine when present in concentrations typical of drinking water (<5 mg/L).

12.3.1.3 Batch Seeding. A batch feed tank with sufficient volume to provide the proposed test volume shall be used. The discharge of the tank shall be situated so that 100% of the contents can be delivered to the system. The tank shall be filled with feed water which shall be dechlorinated, if necessary. Stirring of the feed water shall accompany dechlorination. Verification of dechlorination shall precede introduction of the seed organisms. Stirring of the feed tank shall precede seeding and continue throughout testing. Prior to microbial seeding of the tank, agitation procedures of the bulk seed container (as received from the supplier) such as vortexing and sonication shall be employed to assure organisms are not clumped together. A secondary source of feed water (dechlorinated, if necessary) sufficient to provide 3 retention time-equivalents (as determined by tracer tests or as defined by system functions) shall be available to add to the tank on its depletion. The purpose of this feed water will be to continue flushing seeded organisms through the system to the effluent sample ports.

12.3.1.4 In-line Injection. The feed to the test unit will be plumbed with a check-valve equipped injection port. If the feed stream is divided to parallel treatment units, mixing chamber shall be plumbed downstream of the injection port. A one Liter carboy equipped with a bottom dispensing port will feed this injection port by means of a metering pump (diaphragm or peristaltic or equivalent) via siliconized or Teflon tubing. The pump shall be capable of fluid injection into the pressurized system feed line for the duration of the test, at a measurable and verifiable rate such that the one liter carboy is depleted coincident with the end of the test run. If dechlorination is necessary (see discussion, section 12.3.2.2), a chemical injection pump feeding a port and adequate contact mixing will be required upstream of the microorganism injection port. This pump will meter in a solution of sodium thiosulfate adequate to dechlorinate the feed water over the course of the test run.

The spike carboy will contain a magnetic stir bar and will be filled with one Liter of system water (dechlorinated if necessary) and placed on a stir plate. The prepared batch of spike organisms shall be agitated by methods such as vortexing and sonication and added to the stirring carboy. Once appropriate flow has been initiated through the test system, the test unit is operating properly, sample collection systems are readied, and complete dechlorination (<0.05 mg/L) has been verified at both the influent and effluent sample sites, the injection pump can be started. During the course of the test run, monitoring of the system flow rate and spike injection rate shall be performed and adjustments made to maintain test design.

12.3.2 Test Operation and Sample Collection

12.3.2.1 Test Stream Sampling. Sample ports shall be provided for the feed water stream (spiked with concentrations of microbiological contaminants) and the UV-treated water stream at the contactor effluent. The FTO shall specify the specific ways in which sample collection is performed according to the organisms that will be used for the proposed microbiological inactivation experiments. Examples of potential sample collection methods for bacterial, viral and protozoan organisms are provided below. The methods described, or any other peer-reviewed method may be used for verification testing. The FTO shall propose in the PSTP the specific methods that are to be used for viability assessment of the selected microorganisms (See Section 12.4 below).

For bacterial and/or viral seeding experiments, methods for organism spiking and sample collection shall be consistent with a selected peer-reviewed method. The frequency and number of samples collected for each sampling point will be determined by the length of the test run and shall be specified by the FTO in the PSTP. The volume of each UV-treated water sample from the disinfection contactor effluent will depend on the concentrations of test organisms spiked, and the requirements of the analytical laboratory.

For protozoan spiking experiments, EPA Method 1622 or any other method that has been evaluated through the peer-reviewed process (e.g., Nieminski and Ongerth, 1995) may be followed for sample collection from the spiked water streams. The sample collection system shall be plumbed to allow installation of housings and filters for capture of sufficient flow for microbiological analysis. The FTO shall provide an indication of the recovery efficiency achievable under the sample collection method selected for use during protozoa seeding studies. The specific capture filter recovery system shall be fully described in the PSTP by the FTO. In addition, the PSTP shall include a plan of study for verification testing with a minimum of three standard recovery efficiency tests from the microbiological laboratory.

The sample tap(s) shall be sanitized with 95% ethanol one minute prior to initiating any bacteria or virus sample collection. Taps shall be flowing at the appropriate sample rate for at least one minute prior to sample collection.

12.3.2.2 Chlorine Residual Analysis. When dechlorinating, residual samples of the feed water shall be collected immediately after the grab samples or at regular intervals throughout the test run. These samples shall be analyzed for chlorine residual immediately. In *Giardia*, bacteria and virus inactivation tests where chlorine would affect test organisms and synergistic UV/chlorine effects are not being evaluated, any sample showing >0.05 mg/L residual will void the entire spike test.

12.3.2.3 Post-Test Sample Handling. Filters shall then be handled and prepared for delivery to the analytical laboratory as directed by that laboratory. The Testing Organization shall then take steps to contain and/or sanitize any organisms remaining in the system. Depending on the unit (design and materials), sanitization may be done using steam or hot water (80°C for 10 min). The QA/QC plan should address how this sanitization procedure is to be done to insure inactivation of live organisms and

subsequent removal of inactivated organisms from the unit, and biosafety concerns for both humans and the environment.

12.3.3 Experimental Quality Control

12.3.3.1 Process Control. Positive control samples will be obtained by performing a second round of testing identical to the above (12.3.1-12.3.2.3), with the UV lights turned off. The purpose of this testing is to evaluate any cumulative effects of the equipment stream, spiking and sampling processes, and sample handling on organism viability. This testing shall not occur until elimination of sanitizing agents and inactivated target organisms, whose presence could affect subsequent tests of the unit, has been demonstrated (12.3.2.4). The positive process control samples should show minimal inactivation of the target organism(s) relative to the trip control sample. Significant inactivation of the process control sample indicates that some aspect of the process other than UV contributes to inactivation of the test organism(s), and re-testing is required. Negative control samples must also be obtained by performing a third round of testing identical to the above (12.3.1-12.3.2.3), without addition of microorganisms and with the UV lights turned off. The purpose of this testing is to evaluate whether there is any natural background occurrence of the test organism and that steady-state conditions have been achieved and there is insignificant carry-over from one test sample to the next.

Trip Control. For tests utilizing spike challenges, a replicate or subsample of the spike dose shall accompany the actual spike dose from the analytical laboratory, including all preliminary processes of dose preparation pre-enumeration, shipping, and preparation for spiking, through return to the laboratory for collimated beam UV dose-response assessment. The trip control samples should show minimal inactivation of the target organism(s). Significant inactivation of the trip control sample indicates that some aspect of the handling, from preparation to testing, contributed to inactivation of the test organism(s). Significant inactivation of trip control samples will require re-testing.

12.4 Microbiological Viability Analysis

Methods for assessing the viability of the selected bacteria and viruses (see Section 12.3.1.1) shall be specified by a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the USEPA for the appropriate microbial analyses. Selected viability methods shall be specified by the FTO in the PSTP.

Methods for assessing the viability of cysts and oocysts are non-standard but may be used in verifying claims that an UV system inactivates protozoan cysts and oocysts if the method has undergone peer review. A summary and comparison of viability methods is presented in research completed by the following researchers: Korich et al. (1993), Nieminski and Ongerth (1995), Slifko et al. (1997) and others (see Section 16.0 References in this Test Plan). Interim, non-standard methods for assessing the viability of cyst and oocyst (e.g., excystation, DAPI/PI) may be used for verification of inactivation after exposure to UV. However, any interim organism viability method is subject to review by experts of cyst and oocyst viability and subsequent method change. Any non-standard method for assessing cyst and oocyst viability shall be correlated to animal infectivity. Microbial viability analyses are further discussed in

Section 4.4 of the “EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation of Microbiological Contaminants: Requirements For All Studies.”

12.4.2 Assessment of Microbial Inactivation

Many different sources of variability can impact the estimation of the log inactivation achieved during microorganism challenge studies. To minimize the impact of these sources, it is imperative that all components of the challenge tests be performed on the same day with one batch of seeding organisms and that all collected samples be shipped and analyzed as a single batch. This will then eliminate the need to propagate sources of error arising from seed stock variability, changes in shift personnel, differences in shipping conditions, or assay techniques. Maintaining this type of control over microbial sources of error coupled with careful flow control during the seeding process will eliminate the need for a detailed propagation of error analysis. Instead, the average log inactivation measured for the reactor during the seeding process only needs to be adjusted for any microbial inactivation observed for the positive control or the trip blank as a simple subtraction.

Specific details of the quality control steps to take to insure the integrity of the seeding studies is described below:

(1) Verification Seed Stock Integrity:

To demonstrate that significant inactivation of the seed stock sample has not occurred during the challenge study, a t-test should be performed to compare the averages of the concentration of the stock solution retained in the laboratory with the stock solution comprising the trip blank. The assays for the two stocks should be performed as a single experiment to eliminate uncontrollable sources of experimental variability. The t-test should demonstrate no difference in the average value of the two samples at a 90% confidence level.

(2) Challenge Study Negative and Positive Controls

The negative and positive controls should be shipped and analyzed concurrently with the challenge study samples to minimize the impact of experimental variability on the calculation of log inactivation achieved by the UV reactor. The measured log inactivation obtained for the challenge studies must be adjusted by the log inactivation results obtained for the negative and positive controls in the following manner:

$$\log \left[\frac{N}{No} \right] = \log \left[\frac{N_{(m)} - N_{(NC)}}{No_{(m)} - No_{(NC)}} \right] - \log \left[\frac{N_{(PC)}}{No_{(PC)}} \right]$$

where

$N_{(m)}$ = the measured effluent concentration of organisms for the bioassay

$No_{(m)}$ = the measured influent concentration of organisms for the bioassay

$N_{(NC)}$ = the measured effluent concentration of organisms in the negative control

$N_{(NC)}$ = the measured influent concentration of organisms in the negative control

$N_{(PC)}$ = the measured effluent concentration of organisms in the positive control

$N_{(PC)}$ = the measured influent concentration of organisms in the positive control

12.6 Translating Microbial Challenge Test Data to Operational Dose

The log inactivation determined from the full-scale microbial challenge experiments of the treatment equipment must be translated to an operational dose value using bench-scale collimated beam data. The collimated beam data must be obtained using the same batch of water and seeding organisms used in the field challenge experiments. In this manner, the microbial log inactivation determined in the field can be translated to an operational dose value using the dose-response data obtained for the bench-scale collimated beam experiment.

12.6.1 Collimated Beam Apparatus

A collimated beam apparatus can be obtained directly from UV equipment manufacturers or fabricated in accordance with the minimum design criteria specified below. Additional descriptions of the collimated beam unit can be found in the "Verification Protocol for Secondary Effluent and Water Reuse Disinfection Applications," (NSF International, 2002). The collimated beam apparatus must consist of the following components:

- (a) a monochromatic low-pressure UV lamp
- (b) a suitable ballast for powering the UV lamp
- (c) appropriate lamp housing with an adequate lamp cooling/venting system
- (d) a collimating tube with a sufficient length to diameter ratio to result in a uniform irradiance across the cross-sectional plane at the bottom of the tube
- (e) a rapid shutter system (i.e. pneumatic) for the collimating tube if exposure times of less than 10 seconds will be used or a controlled means of changing the collimating tube length in order to vary the applied dose
- (f) a stable platform system that can support a suitable sample container in a fixed position immediately below the collimating tube
- (g) a suitable sample container (i.e. petri dish) that is sufficiently shallow such that the intensity at the bottom of the container is at least 25 percent of the intensity at the surface of the sample while still providing sufficient volume to support a small spin bar
- (h) a magnetic stirrer that is insulated to prevent a rise in temperature of the sample during testing and can adjusted to control the speed of the spin bar to provide adequate mixing without perturbation of the sample surface
- (i) a radiometer (IL 1700, SED 240 detector, International Light, Newburyport, Massachusetts, or equivalent)

12.6.2 Calibration of the Collimated Beam Apparatus

The intensity field delivered to the sample from the collimating tube must be measured with a calibrated radiometer. The radiometer must be factory calibrated with standards traceable to the National Institute of Standards and Technology within one month of an ETV test and every 6 months thereafter. Use of alternative calibration procedures may be

considered, but they must be described in detail in the PSTP and approved prior to their use. Replicate intensity readings taken at single sample grid locations must fall within five percent of their average for the radiometer readings to be considered valid.

A properly functioning collimated beam apparatus should generate MS2 bacteriophage dose-response data that falls within pre-established acceptance criteria for the organism. The acceptance criteria specified in the "Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse," (NWRI/AWWARF, 2000) have been revised to reflect additional data sets and have been released in the "Verification Protocol for Secondary Effluent and Water Reuse Disinfection Applications," (NSF International, 2002). The FTO must provide seeded MS2 dose-response data for their collimated beam unit prior to its approved use as part of the full-scale microbial challenge experiments.

12.6.3 Dose-Response Test with the Collimated Beam Apparatus

Running a collimated beam dose-response assay serves two purposes:

- (1) To verify the integrity of the MS2 phage stock used to seed the field reactor, and
- (2) To translate the MS2 phage inactivation observed for the field reactor test to an operational dose equivalent.

To achieve these objectives, the collimated beam dose-response must be performed with each batch of MS2 phage stock utilized and each water quality condition tested.

The FTO test plan must present the methods and materials to be used to conduct the collimated beam dose-response analyses as part of the PSTP. Each collimated beam test must consist of at least five equally spread dose conditions which cover the range of operating doses to be evaluated for the UV field test unit. Each of the five dose conditions must be tested in triplicate and each collimated beam test must also include analysis of a positive control to verify that there is no appreciable inactivation of phage in the collimated beam unit when the UV lamp is not activated. It is recommended that a monochromatic low-pressure UV lamp be used for the collimated beam tests, regardless of the UV lamp type employed in the field reactor. This will enable the operational dose performance of different reactors to be directly compared on the basis of a normalized monochromatic dose response.

The specific items to be provided in the PSTP when describing the collimated beam testing are to include the following:

- (1) A detailed schematic of the collimated beam apparatus with labeled dimensions
- (2) The organization responsible for building the unit
- (3) The lamp make, model number, and age
- (4) A description of the accuracy of the shutter controlling lamp exposure time
- (5) The dimensions of the sample container and volume and depth of the water sample within the container
- (6) The characteristics of the MS2 phage stock (host, phage growth conditions, and enumeration)

- (7) The device for measuring incident intensity and the device calibration protocol and frequency
- (8) The instrumentation used to measure the UV absorbance of the seeded sample
- (9) The algorithm and acceptance criteria used to determine the average intensity applied to the sample container

13.0 TASK 5: DATA MANAGEMENT

13.1 Introduction

The data management system used in the verification testing program shall involve the use of computer spreadsheet software and manual recording operational parameters for the water treatment equipment on a daily basis.

13.2 Experimental Objectives

The objectives of this task are 1) to establish a viable structure for the recording and transmission of field testing data such that the Field Testing Organization provides sufficient and reliable operational data for the NSF for verification purposes, and 2) to develop a statistical analysis of the data, as described in "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies".

13.3 Work Plan

The following protocol has been developed for data handling and data verification by the Field Testing Organization. Where possible, a Supervisory Control and Data Acquisition (SCADA) system should be used for automatic entry of testing data into computer databases. Specific parcels of the computer databases for operational and water quality parameters should then be downloaded by manual importation into Excel (or similar spreadsheet software) as a comma delimited file. These specific database parcels will be identified based upon discrete time spans and monitoring parameters. In spreadsheet form, the data will be manipulated into a convenient framework to allow analysis of water treatment equipment operation. Backup of the computer databases to diskette should be performed on a monthly basis at a minimum. When SCADA systems are not available, direct instrument feed to data loggers and laptop computers shall be used when appropriate.

For parameters for which electronic data acquisition is not possible, field testing operators will record data and calculations by hand in laboratory notebooks (daily measurements will be recorded on specially-prepared data log sheets as appropriate). Each notebook must be permanently bound with consecutively numbered pages. Each notebook must indicate the starting and ending dates that apply to entries in the logbook. All pages will have appropriate headings to avoid entry omissions. All logbooks entries must be made in black water insoluble ink. All corrections in any notebook shall be made by placing one line through the erroneous information. Products such as "correction fluids" are never to be utilized for making corrections to notebook entries. Operating logs shall include a description of the water treatment equipment (description of test runs, names of visitors, description of any problems or issues, etc.); such descriptions shall be provided in addition to experimental calculations and other items. The

original notebooks will be stored on-site; photocopies will be forwarded to the project engineer of the Field Testing Organization at least once per week. This protocol will not only ease referencing the original data, but offer protection of the original record of results.

The database for the project will be set up in the form of custom-designed spreadsheets. The spreadsheets will be capable of storing and manipulating each monitored water quality and operational parameter from each task, each sampling location, and each sampling time. All data from the laboratory notebooks and data log sheets will be entered into the appropriate spreadsheets. Data entry will be conducted on-site by the designated field testing operators. All recorded calculations will also be checked at this time. Following data entry, the spreadsheet will be printed out and the print-out will be checked against the handwritten data sheet. Any corrections will be noted on the hard-copies and corrected on the screen, and then a corrected version of the spreadsheet will be printed out. Each step of the verification process will be initialed by the field testing operator or engineer performing the entry or verification step.

Each experiment (e.g. each challenge test run) will be assigned a run number that will then be tied to the data from that experiment through each step of data entry and analysis. As samples are collected and sent to a laboratory that is certified, accredited or approved by a State, a third-party organization, or the EPA, the data will be tracked by use of the same system of run numbers. Data from the outside laboratories will be received and reviewed by the field testing operator. These data will be entered into the data spreadsheets, corrected, and verified in the same manner as the field data.

13.4 Statistical Analysis

Water quality developed from grab samples collected during test runs according to the Analytical Schedule in Task 4 of this Test Plan shall be analyzed for statistical uncertainty. The Field Testing Organization shall calculate 95% confidence intervals for grab sample data obtained during Verification Testing as described in "EPA/NSF ETV Protocol For Equipment Verification Testing For Inactivation Of Microbiological Contaminants: Requirements For All Studies" (Chapter 1). Statistical analysis could be carried out for a large variety of testing conditions.

The statistics developed will be helpful in demonstrating the degree of reliability with which water treatment equipment can attain quality goals. Information on the differences in feed water quality variations for entire test runs versus the quality produced during the optimized portions of the runs would be useful in evaluating appropriate operating procedures.

14.0 TASK 6: QUALITY ASSURANCE/QUALITY CONTROL

14.1 Introduction

Quality assurance and quality control (QA/QC) of the operation of the water treatment equipment and the measured water quality parameters shall be maintained during the Verification Testing program.

14.2 Experimental Objectives

The objective of this task is to maintain strict QA/QC methods and procedures during testing. When specific items of equipment or instruments are used, the objective is to maintain the operation of the equipment or instructions within the ranges specified by the Manufacturer or by *Standard Methods*. Maintenance of strict QA/QC procedures is important in that if a question arises when analyzing or interpreting data collected for a given experiment, it will be possible to verify exact conditions at the time of testing.

14.3 Work Plan

Equipment flow rates and associated signals shall be documented and recorded on a routine basis. A routine daily walk-through during testing will be established to verify that each piece of equipment or instrumentation is operating properly. In-line monitoring equipment such as flow meters shall be checked to verify that the readout matches with the actual measurement (i.e. flow rate) and that the signal being recorded is correct. The items listed below are in addition to any specified checks outlined in the analytical methods.

14.3.1 Daily QA/QC Verifications:

These verifications shall be conducted daily:

- In-line turbidimeters flow rates (verified volumetrically over a specific time period).
- In-line turbidimeter readings checked against a properly calibrated bench-top model.

14.3.2 QA/QC Verifications Performed Every Two Weeks:

These verifications shall be conducted every two weeks:

- In-line turbidimeters (clean out reservoirs and recalibrate).
- In-line flow meters/rotameters (clean equipment to remove any debris or biological buildup and verify flow volumetrically to avoid erroneous readings).

14.3.3 QA/QC Verifications for Each Testing Period:

This verification shall be conducted before each testing period begins:

- Differential pressure transmitters (verify gauge readings and electrical signal using a pressure meter).
- Tubing (verify good condition of all tubing and connections, replace if necessary).

14.4 On-Site Analytical Methods

The analytical methods utilized in this study for on-site monitoring of raw water and finished water quality are described in the section below. Use of either bench-top or in-line field analytical equipment will be acceptable for the verification testing; however, in-line equipment is recommended for ease of operation. Use of in-line equipment is also preferable because it reduces the introduction of error and the variability to analytical results generated by inconsistent sampling techniques.

14.4.1 pH

Analysis for pH shall be performed according to *Standard Methods* 4500-H⁺ or EPA Method 150.1/150.2. A three-point calibration of any pH meter used in this study shall be performed once per day when the instrument is in use. Certified pH buffers in the expected range shall be used. The pH probe shall be stored in the appropriate solution defined in the instrument manual. Transport of carbon dioxide across the air-water interface can confound pH measurement in poorly buffered waters. If this is a problem, measurement of pH in a confined vessel is recommended to minimize the effects of carbon dioxide loss to the atmosphere.

14.4.2 Temperature

Readings for temperature shall be conducted in accordance with *Standard Method* 2550. Raw water temperatures should be obtained at least once daily. The thermometer shall have a scale marked for every 0.1°C, as a minimum, and should be calibrated weekly against a precision thermometer certified by the National Institute of Standards and Technology (NIST). (A thermometer having a range of -1°C to +51°C, subdivided in 0.1° increments, would be appropriate for this work.)

14.4.3 True Color

True color shall be measured with a spectrophotometer at 455 nm, using a Hach Company adaptation of the *Standard Methods* 2120 procedure. Samples should be collected in clean plastic or glass bottles and analyzed as soon after collection as possible. If samples cannot be analyzed immediately they should be stored at 4°C for up to 24 hours, and then warmed to room temperature before analysis. The filtration system described in *Standard Methods* 2120 C should be used, and results should be expressed in terms of PtCo color units.

14.4.4 Turbidity Analysis

Turbidity analyses shall be performed according to *Standard Method* 2130 or EPA Method 180.1 with either a bench-top and in-line turbidimeter.

During each verification testing period, the bench-top and in-line turbidimeters will be left on continuously. Once each turbidity measurement is complete, the unit will be switched back to its lowest setting. All glassware used for turbidity measurements will be cleaned and handled using lint-free tissues to prevent scratching. Sample vials will be stored inverted to prevent deposits from forming on the bottom surface of the cell.

The Field Testing Organization shall be required to document any problems experienced with the monitoring turbidity instruments, and shall also be required to document any subsequent modifications or enhancements made to the monitoring instruments.

14.4.4.1 Bench-top Turbidimeters. Grab samples shall be analyzed using a bench-top turbidimeter; readings from this instrument will serve as reference measurements throughout the study. The bench-top turbidimeter shall be calibrated within the expected

range of sample measurements at the beginning of equipment operation and on a weekly basis using primary turbidity standards of 0.1, 0.5 and 3.0 NTU. Secondary turbidity standards shall be obtained and checked against the primary standards. Secondary standards shall be used on a daily basis to verify calibration of the turbidimeter and to recalibrate when more than one turbidity range is used.

The method for collecting grab samples will consist of running a slow, steady stream from the sample tap, triple-rinsing a dedicated sample beaker in this stream, allowing the sample to flow down the side of the beaker to minimize bubble entrainment, double-rinsing the sample vial with the sample, carefully pouring from the beaker down the side of the sample vial, wiping the sample vial clean, inserting the sample vial into the turbidimeter, and recording the measured turbidity.

When cold water samples cause the vial to fog and prevent accurate readings, the vial must be allowed to warm up by partial submersion into a warm water bath for approximately 30 seconds.

14.4.4.2 In-line Turbidimeters. In-line turbidimeters may be used during verification testing and must be calibrated as specified in the manufacturer's operation and maintenance manual. It will be necessary to periodically verify the in-line readings using a bench-top turbidimeter; although the mechanism of analysis is not identical between the two instruments the readings should be comparable. Should these readings suggest inaccurate readings then all in-line turbidimeters should be recalibrated. In addition to calibration, periodic cleaning of the lens should be conducted using lint-free paper, to prevent any particle or microbiological build-up that could produce inaccurate readings. Periodic verification of the sample flow should also be performed using a volumetric measurement. Instrument bulbs should be replaced on an as-needed basis. It should also be verified that the LED readout matches the data recorded on the data acquisition system, if the latter is employed.

14.5 Chemical and Biological Samples Shipped off-Site for Analyses

The analytical methods that shall be used during testing for chemical and biological samples that are shipped off-site for analyses are described in the section below.

14.5.1 Organic Parameters: Total Organic Carbon and UV₂₅₄ Absorbance

Samples for analysis of TOC and UV₂₅₄ absorbance shall be collected in glass bottles supplied by the state-certified or third party- or EPA-accredited laboratory and shipped at 4°C to the analytical laboratory. These samples shall be preserved, held, and shipped in accordance with *Standard Methods* 5010 B. Storage time before analysis shall be minimized, according to *Standard Methods*.

14.5.2 Microbial Parameters: Viruses, Bacteria, Protozoa, and Algae

Samples for analysis of any microbiological parameter shall be collected in bottles supplied by the analytical laboratory. Microbiological samples shall be refrigerated at approximately 2 to 8°C immediately upon collection. Such samples shall be shipped in a

cooler and maintained at a temperature of approximately 2 to 8°C during shipment. Samples shall be processed for analysis by a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the USEPA within 24 hours of collection. The laboratory shall keep the samples at approximately 2 to 8°C until initiation of processing. TC densities shall be reported as most probable number per 100 mL (MPN/100 mL) or as total coliform densities per 100 mL and HPC densities shall be reported as colony forming units per mL (cfu/mL). TC and HPC are optional sampling parameters.

Methods for assessing the viability of the selected bacteria and viruses shall be specified by the laboratory(ies) performing the analysis and shall be specified in the PSTP. The FTO may select a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the USEPA for analysis of microbial contaminants in water samples.

Methods for assessing the viability of cysts and oocysts are non-standard but may be used in verifying claims that an on-site halogen generation system inactivates protozoan cysts and oocysts if the method has undergone peer review. A summary and comparison of viability methods is presented in research completed by the following researchers: Korich et al. (1993), Nieminski and Ongerth (1995), Slifko et al. (1997) and others (see Section 12.0 References in this Test Plan). Any non-standard method for assessing cyst and oocyst viability shall be correlated to animal infectivity.

Algae samples shall be preserved with Lugol's solution after collection, stored and shipped in a cooler at a temperature of approximately 2 to 8°C, and held at that temperature range until counted.

14.5.3 Inorganic Samples

Inorganic chemical samples, including alkalinity, hardness, aluminum, iron, and manganese, shall be collected and preserved in accordance with *Standard Method* 3010B, paying particular attention to the sources of contamination as outlined in *Standard Method* 3010C. The samples shall be refrigerated at approximately 4°C. Samples shall be processed for analysis by a laboratory that is certified, accredited or approved by the state, a third party organization (i.e., NSF) or the USEPA within 24 hours of collection. The laboratory shall keep the samples at approximately 4°C until initiation of analysis.

15.0 OPERATION AND MAINTENANCE

The Field Testing Organization shall obtain the Manufacturer-supplied Operation and Maintenance (O&M) manual to evaluate the instructions and procedures for their applicability during the verification testing period. The following are recommendations for criteria for O&M Manuals for drinking water treatment equipment employing UV technology.

15.1 Maintenance

The Manufacturer shall provide readily understood information on the recommended or required maintenance schedule for each piece of operating equipment including, but not limited to, the following, where applicable:

- lamps
- control valves
- cooling fans
- quartz sleeves or tubes
- instruments, such as turbidimeters, UV sensors
- water meters
- electrical equipment
- mechanical wipers

The Manufacturer shall also provide readily understood information on the recommended or required maintenance for non-mechanical or non-electrical equipment, including but not limited to, the following, where applicable:

- screens
- piping
- treatment chamber

15.2 Operation

The Manufacturer shall provide readily understood recommendations for procedures related to proper operation of the equipment. Among the operating aspects that should be addressed in the O&M manual are:

UV Lamps:

- Hours of operation - how should this be checked
- UV irradiance - how check and/or calibrate
- cleaning - how and when to clean
- changing - how to determine need to change

Screens (where applicable):

- cleaning - when is it needed
- measurement of head loss during operation
- integrity - how to gauge it

Control Valves:

- open/close indication
- sequence of operations

Exposure Time:

- correlation of flowrate and exposure time
- maintenance/calibration of flow meter

Cooling Water System:

- monitoring/maintenance of proper water temperature
- monitoring cooling water flow
- recirculation pumps

The Manufacturer shall provide a troubleshooting guide; a simple checklist of what to do for a variety of problems, including but not limited to:

- no flow to unit
- sudden change in flow to unit
- no electric power
- excessive headloss across screens
- loss of cooling water flow
- filtered water turbidity too high
- sudden reduction in UV irradiance
- automatic operation (if provided) not functioning
- valve stuck or will not operate

16.0 REFERENCES

American Public Health Association, American Water Works Association and Water Environment Federation. 1999. *Standard Methods for the Examination of Water and Wastewater*. 20th Edition.

Campbell, A.T., *et al.* 1995. Inactivation of Oocysts of *Cryptosporidium parvum* by Ultraviolet Radiation. *Wat. Res.* 29(11):2583-2586.

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Karanis, P., *et al.* 1992. UV Sensitivity of Protozoan Parasites. *J Water Supply Research and Technology-Aqua.* 41(2):95-100.

Korich, D.G., *et al.* 1993. Development of a test to assess *C. parvum* oocyst viability: correlation with infectivity potential. American Water Works Association Research Foundation Report.

Nieminski, E. C. and Ongerth, J. E., 1995. Removing *Giardia* and *Cryptosporidium* by Conventional and Direct Filtration. *J. Amer Wat. Works Assoc.* 87, 96-106.

NSF International. October 2002. Verification Protocol for Secondary Effluent and Water Reuse Disinfection Applications.

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O'Brien, W.J., *et al.* 1995. Ultraviolet System Design: Past, Present, and Future. Proceedings, Am. Water Works Assoc. Water Quality Technical Conference. Part 1:271 - 305.

Slifko, T. R., Friedman, D. E., Rose, J. B., Upton, S. J. and Jakubowski, W. 1997. An In-vitro Method for Detection of Infectious *Cryptosporidium* Oocysts using Cell Culture. Appl. Environ. Microbiol., 63(9), 3669-3675.

Snicer, G.A., *et al.* 1997. Evaluation of Ultraviolet (UV) Technology for Groundwater Disinfection. Draft document, American Water Works Association Research Foundation.

SWS. 1996. Evaluation of the Safe Water Solutions, L.L.C. *Cryptosporidium* Inactivation Device for Inactivation of *Cryptosporidium parvum* Oocysts. Safe Water Solutions, Clancy Environmental Consultants. St. Albans, VT 05478. 7 p. and 7 p. attachment.

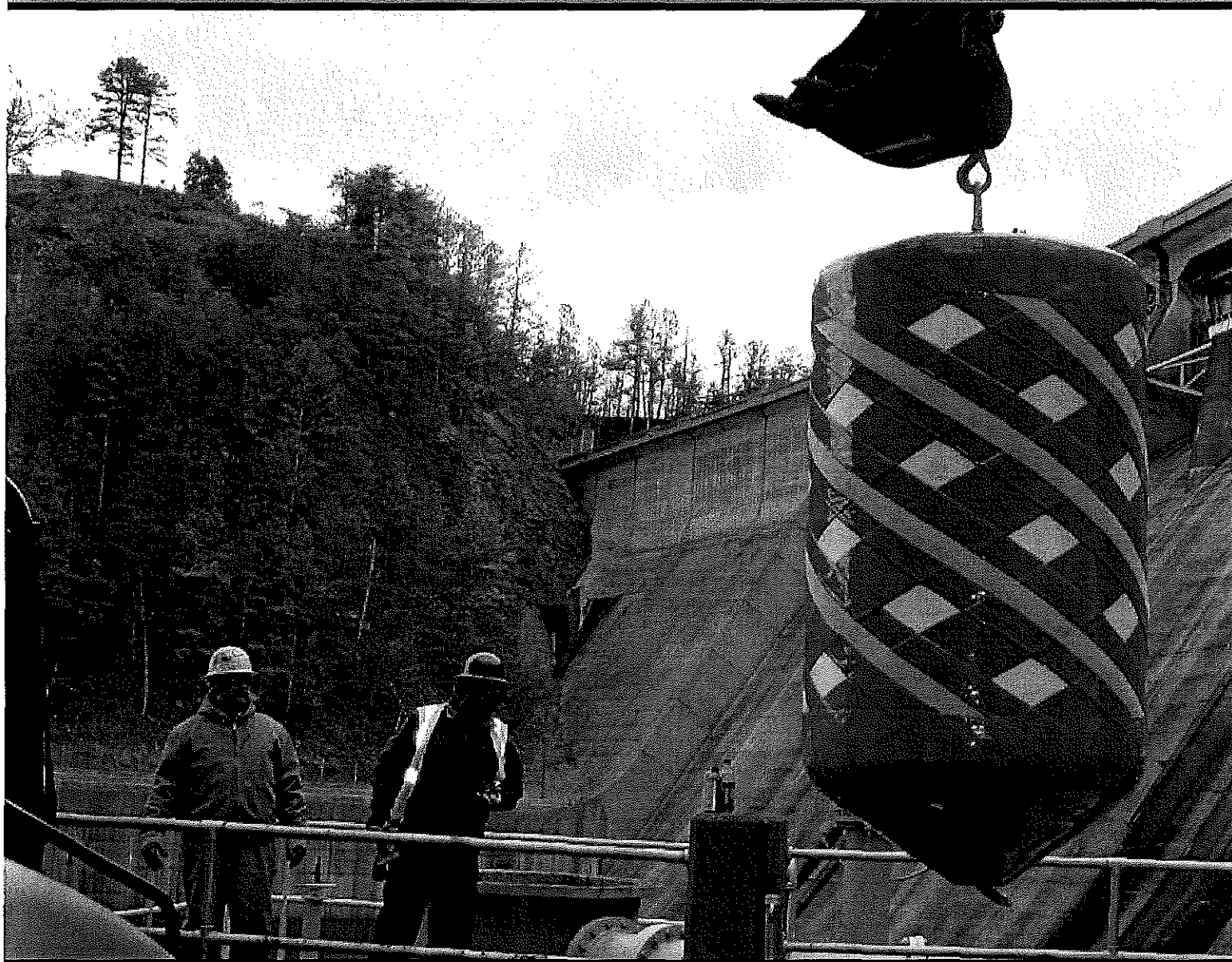
USEPA. 1993b. *Technologies and Costs for Ground Water Disinfection*. Drinking Water Technology Branch, OGWDW, USEPA. Draft Document, Malcolm Pirnie, Inc.

USEPA. 1996. Ultraviolet Light Disinfection Technology in Drinking Water Application-An Overview. Office of Water. EPA 811-R-96-002.

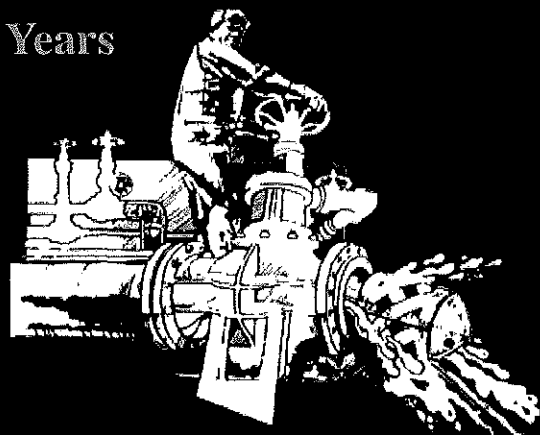
USEPA. 1997. Method 1622: *Cryptosporidium* in Water by Filtration/IMS/IFA and Viability by DAPI/PI.

Water Environment Research Foundation 1995. *Comparison of UV Irradiation to Chlorination: Guidance for Achieving Optional UV Performance-Disinfection*. Project 91-WWD-1.

FLOWMORE SERVICES



Pipeline Cleaning Specialists for Over 30 Years



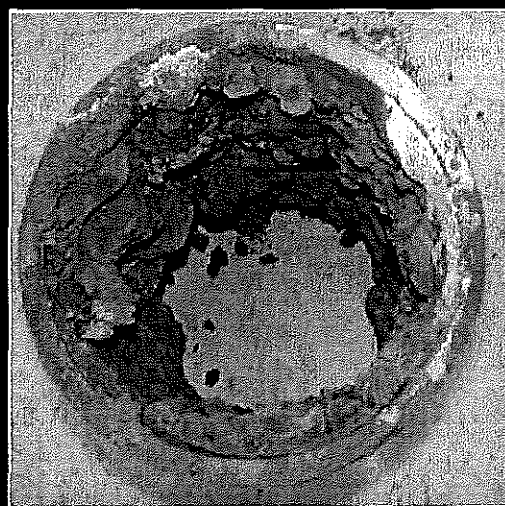
What we do...

FLOWMORE SERVICES specializes in pipeline cleaning. Flowmore crews have successfully cleaned over 5 million linear feet of piping ranging from 2" to over 72" in diameter. We are prepared and equipped to provide assistance on small or large cleaning projects.

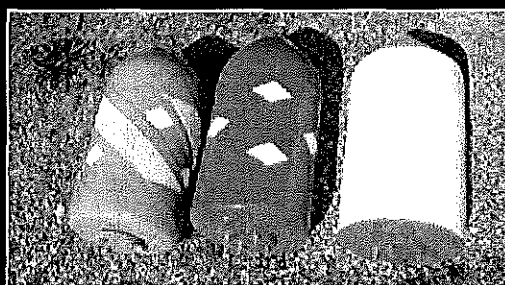
How we do it...

Flowmore Services cleans pipelines by hydraulically or pneumatically propelling a series of flexible foam **POLY-PIGS** (cleaners) through the line. In the case of heavy build-ups, the **POLY-PIGS** are introduced into the system in a progressive manner beginning with smaller and softer cleaning units working up to full sized cleaners with more abrasive qualities. This **POLY-PIG** cleaning method has proven to be the safest, fastest and most economical way to clean most pipelines.

Flowmore Services stocks a full line of pipeline cleaning equipment including **POLY-PIGS**, pig launchers, pig trackers, pipe stoppers and pumps.



Pipe with buildup of minerals reduces flow through the pipeline. Pigging the pipeline removes this buildup



Pipeline cleaning step-by-step...

The photos below demonstrate how introducing **POLY-PIGS** into the pipeline works to clean the line. Photo 2 shows dirty water being forced out of the line ahead of the pig. As each pig moves down the line, the effluent gets darker (photo 3) as more buildup is removed. Finally, the water released from the line is

clear with a highly increased flow in photos 4 and 5. Photo 6 shows used poly-pigs called swabs after their trip down the pipeline. The results of pigging include restored flow, reduced pumping costs, and a much cleaner product once impurities are removed.



Who we do it for..

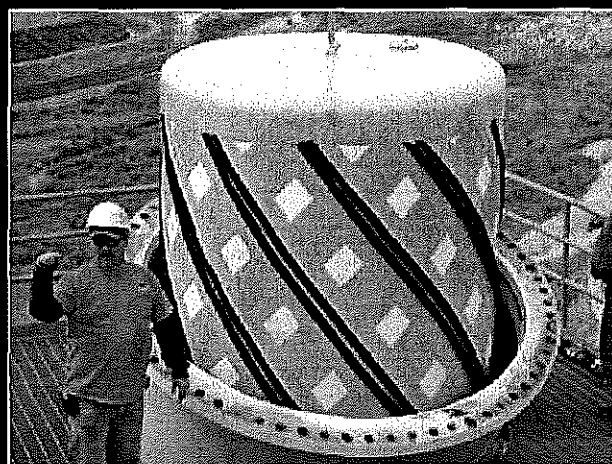
- Municipalities
- Transmission and Distribution Pipelines
- Paper Mills
- Hardwood Stock, Effluent and Process Lines
- Industrial Plants
- Oil, Gas, Process, Fire Protection Lines
- Intake and Effluent (Discharge) Pipelines
- Hydroelectric Plants
- Penstock Pipelines

The Results...

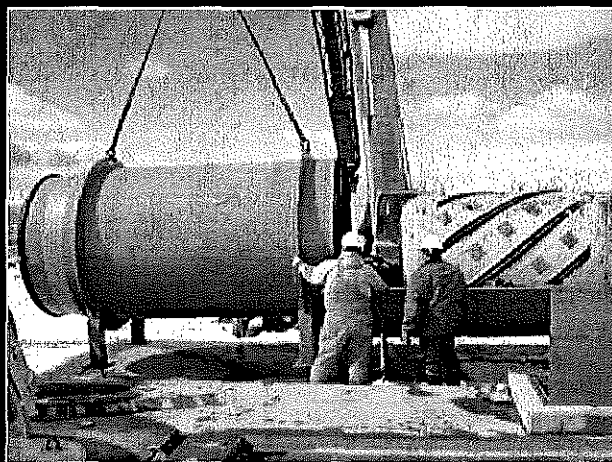
- **Restored Flow:**
It is not uncommon to see flow increases of double (or more) in old lines.
- **Reduced Pumping Costs:**
Power savings can be dramatic in large lines.
- **Cleaner Product:**
Impurities such as Red Water can be eliminated.
- **Pleased Customers:**
Due to good results and minimum service downtime.

Flowmore in action...

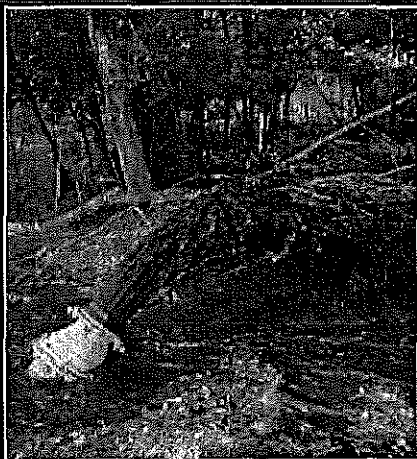
Flowmore Services offers lump sum, time/materials and per foot pricing. Contact us for budget estimates, firm quotes, references or to simply discuss your pipeline cleaning requirements. We serve both domestic and most international markets.



Flowmore pipeline cleaning specialist supervises insertion of an abrasive poly pig for a large aqueduct cleaning project.



YOUR business is important to US!



What FLOWMORE customers say...



CITY OF GILLETTE

P.O. Box 3003 • Gillette, Wyoming 82718
Phone (307) 534-9222

Department of Public Works
Water/Wastewater Division

May 7, 1985

Mr. Spencer Cubage
Flowmore Services Corporation
P.O. Box 692005
Houston, Texas 77269

Dear Spencer,

Just a note on the results of our flow tests on the fire hydrants along Ross Avenue after our pigging operation.

Location	Previous Flow	Present Flow
2nd/Ross Ave.	770 gpm	2,430 gpm
3rd/Ross Ave.	776 gpm	2,040 gpm
4th/Ross Ave.	770 gpm	1,890 gpm*

* This hydrant only has a 4" lead.

It appears that we were successful in obtaining our minimum fire flows with no problem. Thanks for the help.

Sincerely,

Ron Doba
Water/Wastewater Supt.



TIDELANDS
OIL PRODUCTION COMPANY
OFFICE (214) 436-9918 FAX (214) 436-9959

Mr. Tim Geohagan
Flowmore Services Corporation
P.O. Box 692005
Houston, Texas 77269

February 28, 1992

Dear Tim,

I just finished an economical analysis of the recent pigging job on our 2900' segment of 14" transite and I was shocked. Before the line was cleaned, TWO 100 hp pumps were required to move fluid 2900' to a 100 hp booster pump. The booster pump raised the pressure enough to prevent starving the 1500 hp injection pump on suction.

After the line was cleaned, not only did we need just one 100 hp transfer pump, but we were able to bypass the 100 hp booster pump. In turn, we are currently saving \$250.00 a day in electricity costs.

The cost of the pigging job was \$4, 207.00 and an additional \$1,1994.00 for tanks, vacuum trucks, etc. The pigging you performed paid for itself in less than 25 days.

We here at Tidelands will be sure to contact you for any further line cleaning jobs. Thanks again, Tim.

Sean J. Massey
Mechanical Engineer

FLOWMORE SERVICES
P.O. Box 692005
Houston, Texas 77269

281.351.7979

281.255.2385 Fax

800.356.9667

www.flowmoreservices.com

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, March 09, 2015 8:40 AM
To: Busch, Stephen (DEQ)
Subject: Pipe Pigging Videos

<https://www.youtube.com/watch?v=9FFCN9Xo9nQ>

https://www.youtube.com/watch?v=70QN_ho2w7w

<https://www.youtube.com/watch?v=sse2k2FPGZ4>

<https://www.youtube.com/watch?v=55yAuV81G5I>

<https://www.youtube.com/watch?v=BsZrhCm3u48>

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, August 28, 2015 11:13 AM
To: Richard Benzie P.E. (BENZIER@michigan.gov); Shekter Smith, Liane (DEQ) (SHEKTERL@michigan.gov)
Cc: prysbym@michigan.gov; Adam Rosenthal (rosenthala@michigan.gov)
Subject: Preliminary Flint TTHM results
Attachments: 3rd Qtr 2015 TTHM preliminary.doc

Richard and Liane,

A PRELIMINARY Flint TTHM compliance determination is attached. (The one month monitoring window doesn't officially end until Monday 8/31).

Note all 8 sites would now be in compliance with the LRAA, but we did have one sample this quarter over 80 ppb (site 7, 90.3 ppb). This will make messaging a little more difficult.

Shall we proceed, after August 31, to create a "TTHM return to compliance" letter?

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

02310 – City of Flint 3rd Quarter 2015 TTHMs

August 28, 2015

TTHM Results (mg/L)						
	11/20/14	2/17/15	5/18/15	8/18/15	LRAA	OEL
DBP1 McDonalds 3719 Davison	0.059	0.0162	0.0514	0.0755	0.050	0.055
DBP2 Liquor Palace 3302 South Dort Highway	0.033	0.0168	0.0635	0.0532	0.042	0.047
DBP3 North Flint Auto 6204 North Saginaw St.	0.041	0.0149	0.0452	0.0426	0.036	0.036
DBP4 University Market 2501 Flushing Road	0.094	0.0245	0.0598	0.0706	0.062	0.056
DBP5 Taco Bell 3606 Corunna Road	0.034	0.0151	0.0547	0.0619	0.042	0.049
DBP6 Rite-Aid Pharmacy 5018 Clio Road	0.054	0.0192	0.0605	0.0595	0.048	0.050
DBP7 Salem Housing 3216 MLK Boulevard	0.050	0.0285	0.0727	0.0903	0.060	0.070
DBP8 BP Gas Station 822 South Dort Highway	0.036	0.0199	0.0461	0.0549	0.039	0.044

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, September 05, 2014 1:33 PM
To: prysbym@michigan.gov
Subject: Proposed BWA area
Attachments: Flint-Site5-BWA.jpg

Attached.

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



Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, September 16, 2015 9:19 AM
To: Richard Benzie P.E. (BENZIER@michigan.gov); Shekter Smith, Liane (DEQ) (SHEKTERL@michigan.gov)
Subject: Quadrant Diagram Draft
Attachments: Flint-QuadrantDiagram-Draft.xlsx

A draft of the quadrant diagram to separate responsibilities is attached

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

DRINKING WATER - DISTRIBUTION OF RESPONSIBILITIES

Environmental Protection Agency Promulgation of Federal Safe Drinking Water Act Rules 1974 Safe Drinking Water Act 1991 Lead and Copper Rule 2000 Lead and Copper Rule Minor Revisions 2007 Lead and Copper Rule Short Term Revisions ???? Lead and Copper Rule Long Term Revisions Granting Primacy of Federal Regulations to States Auditing of State Public Water Supply Programs Provide Funding to States	Michigan Department of Environmental Quality Primacy - Michigan Safe Drinking Water Act and Administrative Rules Oversight of public water systems Inspections Construction Permitting Provide loans to water systems for public infrastructure improvements State Laboratory Services Laboratory Certification Establish monitoring requirements, quantity and frequency Verification of monitoring results Notify water systems of Action Level Exceedance Establish Water Quality Parameter Ranges, as necessary State Reporting to EPA
City of Flint Water System Certified Operation of public water system Establish Water Rates Obtain construction permits Reporting to MDEQ Coordination of lead and copper sampling Establishing a Tiered Sampling Pool Providing Sampling Kits and Instructions to customers Obtain signed statements from participating customers Obtain sample analysis Provide individual lead sample result to participants Comply with Action Levels for lead and copper Provide Annual Report (CCR) to all customers Conduct Water Quality Parameter Monitoring Recommend and Install Optimized Corrosion Control Treatment Provide Public Notification, as necessary Replace public portion of lead service, as necessary	Water Customers Participate in lead sampling as requested Request lead testing if concerned Follow lead sampling Instructions Provide signed information on how sample was collected Review individual result material Follow instructions for reducing lead exposure Replace private leaded service line and plumbing materials with lead-free products Obtain plumbing permits Pay Water Bills Read Annual Report (CCR) Read and follow Public Notification materials

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, October 09, 2015 10:42 AM
To: Krisztian, George (DEQ)
Subject: RE: 11:00 School Sampling Priority Call

1st floor Frank Balcer. It's on the far west end in the Lansing District Office.

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: Krisztian, George (DEQ)
Sent: Friday, October 09, 2015 10:23 AM
To: Busch, Stephen (DEQ)
Subject: RE: 11:00 School Sampling Priority Call

Steve, where will you be calling from. I will join you if time permits.

George

From: Busch, Stephen (DEQ)
Sent: Friday, October 09, 2015 10:07 AM
To: Dykema, Linda D. (DHHS); Howard Croft (hcroft@cityofflint.com)
Cc: Krisztian, George (DEQ)
Subject: 11:00 School Sampling Priority Call

We will conference call at 11:00. Need to ensure we have the correct "universe" of facilities identified, and prioritize a list of those who have requested the detailed testing. As it will take time to get through each facility we don't need to have all of them in order at this time, but at least know which types should get higher priority.

Conference Call #
 1-888-251-2909.
 Code 1196738#

Attached is a spreadsheet with the universe of "school" facilities we have identified in Flint. It is broken into down into 5 categories (see the tabs on the spreadsheet).

- PreK and Daycares
- K-5
- 6-12
- Universities
- Others (boy scouts, transportations centers, etc.)

There are also a few that need to be checked on regarding to what category they belong in.

I also attached the list of Flint Schools that were screen tested with a few samples each, this past week. These will be the first priority.

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

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, August 21, 2015 4:29 PM
To: 'Crooks, Jennifer'
Subject: RE: 90th percentile letter to Flint?
Attachments: City of Flint PbCu15 8_17_15.pdf

The letter that was mailed is attached.

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: Crooks, Jennifer [<mailto:crooks.jennifer@epa.gov>]
Sent: Thursday, August 20, 2015 5:07 PM
To: Prysby, Mike (DEQ); Busch, Stephen (DEQ); Rosenthal, Adam (DEQ)
Cc: Poy, Thomas
Subject: 90th percentile letter to Flint?

I was out of the office last week, and I know you all touched base with Tom Poy on the letter you are sending to Flint regarding their lead results. I'm wondering if you could send us a copy of the signed letter when it goes out? Flint has sure gotten a lot of attention over the past year; I'm going to be positive! And say that I hope this all dies down once they connect to the Karegnondi pipeline....

Thank you all!

Jennifer



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



DAN WYANT
DIRECTOR

August 17, 2015

Mr. Brent Wright
City of Flint - DPW
Flint Water Plant
4500 North Dort Highway
Flint, Michigan 48505

Dear Mr. Wright:

SUBJECT: Flint, City of WSSN: 02310
Lead and Copper Monitoring of Drinking Water Taps

The Department of Environmental Quality (DEQ), Office of Drinking Water and Municipal Assistance (ODWMA), received your report for the monitoring period January 1, 2015, through June 30, 2015.

Action Levels	Results this monitoring period			
	90th Percentile	# of Samples Above Action Level	# of Samples Required	# of Samples Collected
Lead 15 parts per billion (ppb)	11 ppb	6	60	69
Copper 1.3 parts per million (ppm)	0.16 ppm	0	60	69

Ninety percent or more of the sites you tested are within action levels under the administrative rules promulgated under the Michigan Safe Drinking Water Act, 1976 PA 399, as amended (Act 399). These results must be reported on your 2015 Consumer Confidence Report (CCR) due to our office, your customers, and the local health department, by July 1, 2016. Also include the following statement in the CCR, regardless of the lead and copper levels:

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. The City of Flint is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline at 1-800-426-4791 or at <http://www.water.epa.gov/drink/info/lead>.

Mr. Brent Wright

2

August 17, 2015

Recent changes to the Lead and Copper Rule (LCR) require the water supply to provide individual lead tap results to people who receive water from sites that were sampled, even if lead was not detected, within 30 days of learning of results. You must also send us a certification that you met all the delivery requirements along with a sample copy of your customer notice by three months after the end of the monitoring period. To download the *Lead and Copper Report and Consumer Notice of Lead Result Certificate* in Microsoft Word or PDF format, visit <http://www.michigan.gov/deq>. Click on Water, Drinking Water, Community Water Supply, and Reporting Forms under the Manuals, Forms and Brochures heading. Water supplies that fail to distribute the Consumer Notice of Lead Results must include the following statement in their CCR, "During the year, we failed to provide lead results to persons served at the sites that were tested as required by the Lead and Copper Rule."

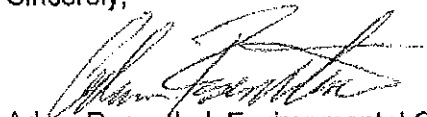
While the City's LCR compliance monitoring has continued to meet action level requirements, the LCR also requires all large systems (those serving over 50,000 people) to optimize corrosion control regardless of their 90th percentile lead concentration. One way to demonstrate fully optimized corrosion control treatment is through two consecutive six month rounds of LCR compliance monitoring in which the difference between the 90th percentile level and the highest source water lead concentration is less than the Practical Quantitative Level for lead (0.005 milligrams per liter). Since the City did not meet these criteria in both the July – December 2014, and January – June 2015, sampling periods, the City must now recommend a treatment to fully optimize corrosion control treatment within six months in accordance with requirements under Act 399, Administrative Rule 604f (R 325.10604f). **This recommendation must be provided to our office as soon as possible, but no later than January 1, 2016.**

However, given the past use of phosphate treatment by the Detroit Water and Sewerage Department (DWSD) to fully optimize corrosion control treatment when the City was a wholesale customer of DWSD, the ODWMA recommends the City select this as its recommended treatment option, and begin implementation as soon as possible to address ongoing concerns by customers regarding lead levels within their premise plumbing systems. Under the second step of this Rule, the DEQ can specify optimal corrosion control treatment.

Our office will inform you when monitoring needs to be conducted as part of the optimization of the implemented corrosion control treatment. Customer requested samples for lead shall continue to be collected and analyzed. Please make every attempt to select the same sites used in the previous monitoring period, giving Tier 1 sites first priority. If original sites are unavailable, select replacement sites based on the Tier 1, 2, and 3 criteria.

Please contact me at 517-284-6644 or rosenthala@michigan.gov at your earliest convenience to discuss how the City will be complying with the above requirements.

Sincerely,



Adam Rosenthal, Environmental Quality Analyst
Lansing District Office
Office of Drinking Water and Municipal Assistance

cc: Mr. Michael Glasgow, City of Flint

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, September 17, 2015 8:29 AM
To: Shaler, Karen (DEQ)
Cc: Shekter Smith, Liane (DEQ); Devereaux, Tracy Jo (DEQ); Rennaker, Joanne (DEQ); DEQFOIA
Subject: RE: 6429-Appeal - due on or before 9/21/2015

That is correct. It should not be something that involved executive staff.

However, I can only speak to any call(s) I would have participated in. District may have had their own calls to and from Flint and will each need to provide information they have.

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: Shaler, Karen (DEQ)
Sent: Wednesday, September 16, 2015 5:30 PM
To: Busch, Stephen (DEQ)
Cc: Shekter Smith, Liane (DEQ); Devereaux, Tracy Jo (DEQ); Rennaker, Joanne (DEQ); DEQFOIA
Subject: RE: 6429-Appeal - due on or before 9/21/2015

Steve,

Can I assume that the conference call Mr. Edwards is referring to involved ODWMA staff and not Executive Division staff (meaning that this FOIA is only intended for ODWMA to respond to)? Note that the Lead and Copper Report he attached to his appeal included this comment from the city of Flint: "Revised report after conference call with DEQ staff...." Please confirm. Thanks!

FYI, I'm including a cc to Liane because she asked me to forward Mr. Edwards' FOIA requests to her last Friday.

From: DEQFOIA
Sent: Monday, September 14, 2015 9:45 AM
To: Shaler, Karen (DEQ); Rennaker, Joanne (DEQ)
Cc: DEQFOIA
Subject: 6429-Appeal - due on or before 9/21/2015

Hello All:

Attached is an appeal for FOIA 6429-15, specifically the Insufficient Information denial regarding a conference call.

Submitted with the appeal is a copy of the Lead and Copper Report and Consumer Notice of Lead Result Certificate for Community Water Supply, prepared by Michael Glasgow, Utilities Administrator, dated 8/20/2015.

Please let me know if the appeal provides "sufficient" information to enable a search for responsive records regarding a conference call.

Please call me if you have any questions.

--Susan

Susan Vorce, FOIA Coordinator
Department of Environmental Quality
517-284-6889 or 800-662-9278
degfoia@michigan.gov

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, January 27, 2015 9:22 AM
To: Shekter Smith, Liane (DEQ); Prysby, Mike (DEQ); Benzie, Richard (DEQ)
Subject: RE: ABC12 News Flint water test results comment?

The other issue is they could cherry pick the worst results and throw away anything they think is low. We would need to obtain all results from the lab.

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

From: Shekter Smith, Liane (DEQ)
Sent: Tuesday, January 27, 2015 9:20 AM
To: Busch, Stephen (DEQ); Prysby, Mike (DEQ); Benzie, Richard (DEQ)
Subject: RE: ABC12 News Flint water test results comment?

Do we know whether they were collected at any of the same locations that Flint uses for compliance?

From: Busch, Stephen (DEQ)
Sent: Tuesday, January 27, 2015 9:18 AM
To: Prysby, Mike (DEQ); Benzie, Richard (DEQ); Shekter Smith, Liane (DEQ)
Subject: RE: ABC12 News Flint water test results comment?

I would be sure to look into:
 Who collected the samples
 What sampling protocols were used
 Is the lab certified to run this analysis
 What lab method was used

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

From: Prysby, Mike (DEQ)
Sent: Tuesday, January 27, 2015 8:55 AM
To: Busch, Stephen (DEQ); Benzie, Richard (DEQ); Shekter Smith, Liane (DEQ)
Subject: FW: ABC12 News Flint water test results comment?

I am in the position to look at these results; however, the validity of the samples may be questionable given they were most likely not collected by Flint operators or in accordance to Flint's Stage 2 DDBP plan. Any professional opinion may need to be carefully worded....

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

From: Elliott, Larry F. [<mailto:larry.f.elliott@abc12.com>]
Sent: Tuesday, January 27, 2015 7:48 AM
To: Prysby, Mike (DEQ)
Subject: ABC12 News Flint water test results comment?

Mike,
We have just completed our own independent testing of multiple sites within the Flint water system and wonder if you'd be willing to look them over and give us your professional opinion.
I could email you the reports from the testing lab we used.
Larry Elliott
ABC12 News
(810)257-2805 office
(810)877-5378 cell

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, January 27, 2015 9:18 AM
To: Prysby, Mike (DEQ); Benzie, Richard (DEQ); Shekter Smith, Liane (DEQ)
Subject: RE: ABC12 News Flint water test results comment?

I would be sure to look into:
 Who collected the samples
 What sampling protocols were used
 Is the lab certified to run this analysis
 What lab method was used

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

From: Prysby, Mike (DEQ)
Sent: Tuesday, January 27, 2015 8:55 AM
To: Busch, Stephen (DEQ); Benzie, Richard (DEQ); Shekter Smith, Liane (DEQ)
Subject: FW: ABC12 News Flint water test results comment?

I am in the position to look at these results; however, the validity of the samples may be questionable given they were most likely not collected by Flint operators or in accordance to Flint's Stage 2 DDBP plan. Any professional opinion may need to be carefully worded....

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

From: Elliott, Larry F. [<mailto:larry.f.elliott@abc12.com>]
Sent: Tuesday, January 27, 2015 7:48 AM
To: Prysby, Mike (DEQ)
Subject: ABC12 News Flint water test results comment?

Mike,
 We have just completed our own independent testing of multiple sites within the Flint water system and wonder if you'd be willing to look them over and give us your professional opinion.
 I could email you the reports from the testing lab we used.
 Larry Elliott
 ABC12 News
 (810)257-2805 office
 (810)877-5378 cell

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, February 14, 2014 2:19 PM
To: Robinson, Michael
Subject: RE: ACO

Mike,

Wanted to give you an update. We have an internal meeting on Tuesday morning to get the ACO language into a finalized draft. The language you provided in relation to the bond counsel's needs appears to be acceptable and should be added to the final version.

I will get in touch with you next Tuesday after my meeting.

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

From: Robinson, Michael [<mailto:MRobinson@wnj.com>]
Sent: Wednesday, February 12, 2014 10:53 AM
To: Busch, Stephen (DEQ)
Subject: RE: ACO

Ok, thanks

From: Busch, Stephen (DEQ) [<mailto:BUSCHS@michigan.gov>]
Sent: Wednesday, February 12, 2014 9:45 AM
To: Robinson, Michael
Cc: Daugherty Johnson
Subject: RE: ACO

I am running this up the chain and will let you know ASAP.

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

From: Robinson, Michael [<mailto:MRobinson@wnj.com>]
Sent: Monday, February 10, 2014 5:44 PM
To: Busch, Stephen (DEQ)
Cc: Daugherty Johnson
Subject: ACO

Steve, I checked with the City's bond counsel, and here is language that we MUST include in the consent order so that the City can move forward on this. Please let me know immediately if this language is or is not acceptable. If you would like to discuss it, please let me know.

Thanks,

Mike

“The respondent plans to use the Flint River as its temporary source of untreated water supply until KWA water is available. The respondent must undertake the KWA public improvement project or undertake other public improvement projects to continue to use the Flint River, such as additional water treatment plant public improvements, source water protection public improvements and public improvements to obtain back-up water supply, in order to comply with Act 399.”

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, September 16, 2015 3:57 PM
To: Pallone, Maggie (DEQ)
Cc: Wurfel, Brad (DEQ)
Subject: RE: Ananich letter
Attachments: LEG00188 Ananich / Safety and treatment of city of Flint's water

It was never assigned to ODWMA, just to you.

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: Pallone, Maggie (DEQ)
Sent: Wednesday, September 16, 2015 3:54 PM
To: Busch, Stephen (DEQ)
Cc: Wurfel, Brad (DEQ)
Subject: RE: Ananich letter

Was there a letter even started for a response to Ananich?

From: Busch, Stephen (DEQ)
Sent: Wednesday, September 16, 2015 3:53 PM
To: Pallone, Maggie (DEQ) <PalloneM@michigan.gov>
Cc: Wurfel, Brad (DEQ) <WurfelB@michigan.gov>
Subject: RE: Ananich letter

I thought Brad was doing both Kildee and Ananich.

I am still working on the FAQ document and should have the draft out shortly.

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: Pallone, Maggie (DEQ)
Sent: Wednesday, September 16, 2015 3:44 PM
To: Busch, Stephen (DEQ)
Subject: Ananich letter

Steve- Is there a draft response for the Ananich, Phelps and Neeley letter? If so, can I get a copy?

Maggie Pallone

Deputy Director

Policy and Legislative Affairs

Department of Environmental Quality

517-599-6190 (cell)

PalloneM@michigan.gov

Rennaker, Joanne (DEQ)

From: DEQ-LogLetter
Sent: Friday, September 11, 2015 2:08 PM
To: DEQ-Legislative-Contact
Cc: Thelen, Mary Beth (DEQ); Sygo, Jim (DEQ); Shaler, Karen (DEQ); Pallone, Maggie (DEQ); Wurfel, Brad (DEQ); Shekter Smith, Liane (DEQ); Busch, Stephen (DEQ); Cook, Pat (DEQ)
Subject: LEG00188 Ananich / Safety and treatment of city of Flint's water
Attachments: EXE 15 LEG00188I Ananich.pdf

Assigned to EXE (Maggie Pallone)

Letter Buckslip

11-Sep-15

ID:	LEG00188	Deputy Director _____ Deputy's Mgmt. Asst. _____ Director's Office Staff _____ Division/Office Chief _____ Division/Office Chief's Mgmt. Asst. _____ Prepared by: _____ Division/Office _____ Exec. Div. File No. _____ ☐ Delogged
Date of letter:	9/10/2015	
Date received:	9/10/2015	
Date due:	9/21/2015	
Reply date:		
Last name:	Ananich	
First name:	Jim	
Organization:	Senator	
Subject:	Safety and treatment of city of Flint's water	
Reply to:		
Author:		
Owner:	SHALERK	

<u>Action</u>	<u>Action Date</u>	<u>Due Date</u>	<u>Entity</u>	<u>Signature</u>	<u>Owner</u>	<u>CCs</u>
Assigned 1	9/11/2015	9/21/2015	EXE	HAA	SHALERK	Thelen Sygo/Shaler Maggie Pallone Brad Wurfel DEQ-Legis-Contact Liane Shekter Smith Steve Busch Pat Cook 3-1 MI Sen. & Rep. File

Comments: Original to Maggie Pallone

The letter requests a response by 9/14/15, so Maggie has a call into Eric Brown and Dennis Muchmore about scheduling a briefing instead of sending a response letter from the Director.

LEG00188

Thelen, Mary Beth (DEQ)

From: The Office of Senator Ananich <SenJAnanich@senate.michigan.gov>
Sent: Thursday, September 10, 2015 12:57 PM
To: Wyant, Dan (DEQ); Pallone, Maggie (DEQ)
Cc: Jordan.Dickinson@mail.house.gov; mayor@cityofflint.com; HCroft@cityofflint.com; hedman.susan@epa.gov; poy.thomas@epa.gov; Schock.michael@epa.gov; Lytle.darren@epa.gov; fortin.denise@epa.gov; Shekter Smith, Liane (DEQ); Cook, Pat (DEQ); Busch, Stephen (DEQ); Wurfel, Brad (DEQ); Edwards@vt.edu
Subject: Letter Regarding Water in the City of Flint
Attachments: Flint Water Letter to DEQ 09102015.pdf

Director Wyant,

Please see the attached letter regarding water in the City of Flint. For your convenience, we are also mailing a hard copy of this letter to your office.

Thank you for your prompt consideration of this urgent matter impacting our community.

Sincerely,

Jim Ananich
Senate Democratic Leader
District 27

Sheldon Neeley
State Representative
District 34

Phil Phelps
State Representative
District 49



STATE OF MICHIGAN

September 10, 2015

Michigan Department of Environmental Quality
Executive Division
DEQ Director: Dan Wyant
P.O. Box 30473
Lansing, MI 48909-7973

Director Wyant,

In light of recently released findings by the American Civil Liberties Union, independent researchers and a troubling Interim U.S. Environmental Protection Agency memo from June, we are requesting additional answers about the safety and treatment of the City of Flint's water.

Several disturbing points have been raised and we have a number of urgent questions, including:

- When did the MDEQ become aware of the June 24, 2015, Interim EPA memo and whom was it shared with?
 - Which Flint city officials also received this information?
 - Why was the memo not immediately shared with the public?
 - What response did MDEQ have to the EPA concerns raised in the memo?
 - Were any actions taken by the MDEQ as a result of the issues mentioned in the memo?
 - What steps, if any, were taken to determine the validity of the Virginia Tech study?
- Please explain why the pre-flushing method of sampling was used in this instance.
 - Is it the same method that is applied to all sampling or does the agency have the discretion to decide?
 - Who is responsible for making the decision to pre-flush?
 - The EPA memo references the Lead Copper Rule requirement that systems greater than 50,000 users maintain "corrosion control treatment." As the regulator, why did the MDEQ choose not to enforce that standard?
 - The EPA recommends allowing water to rest for at least six hours, but no more than 12 hours, before taking a sample. On MDEQ's Web site, it suggests flushing the line for five minutes before the six-hour rest. How did the department arrive at this method?
- According to a July 9, 2015, article on DeadlineDetroit.com, "Scary: Lead Water and One Flint Family's Toxic Nightmare,"

"The EPA offered Flint officials the use of agency experts to help get the situation under control," said Del Toral, but added that, to his knowledge, the city has so far declined all help.

LeeAnne Walters said that when she asked why city officials weren't taking the EPA's offer of assistance, she was told, "We don't need it."



STATE OF MICHIGAN

Flint spokesman Lorenz, on the other hand, maintained "the city continues to work closely with the MDEQ and the EPA Regional Office."

- Who refused the EPA's offer of expert assistance and why?
- Is the damage done to the pipes (as described in the EPA report) accurate?
 - If yes, will damaged pipes continue to leach lead or will properly treated water safely reach consumers?
 - What is the plan and timeline to address it?
- And most importantly, what can be done immediately to ensure safe, affordable drinking water for the citizens of Flint?

Many of the decisions that led to the current situation occurred while a state-appointed manager was in control and MDEQ personnel were consulted about testing methods and how to address the situation. In addition, MDEQ also encouraged the method of water testing used by Flint officials. We believe that there is a heightened obligation by the state to make this right.

Due to the serious public health threats of this situation, we respectfully request a response to these matters by Monday, September 14, 2015.

We will do our best to accommodate meeting requests, if necessary, but would appreciate written responses to the above questions so that we can make informed decisions swiftly to address these serious concerns.

Sincerely,

Jim Ananich
Senate Democratic Leader
District 27

Sheldon Neeley
State Representative
District 34

Phil Phelps
State Representative
District 49

cc:

U.S. Representative Dan Kildee
Mayor Dayne Walling, City of Flint
Howard Croft, City of Flint
Susan Hedman, EPA
Thomas Poy, EPA
Michael Schock, EPA-ORD
Darren Lytle, EPA-ORD
Denise Fortin, EPA
Liane Shekter-Smith, MDEQ
Pat Cook, MDEQ
Stephen Busch, MDEQ
Brad Wurfel, MDEQ
Marc Edwards, Virginia Tech

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, October 16, 2014 9:18 AM
To: 'Crooks, Jennifer'; Prysby, Mike (DEQ)
Subject: RE: Another Flint complaint

Jennifer,

Here is some info on the chloride issue GM has indicated regarding water in Flint and Mike's discussion with the reporter below. As we discussed we do not follow the secondary MCL's in Michigan, but even if we did these levels are well below the secondary level for chloride.

http://www.mlive.com/news/flint/index.ssf/2014/10/gms_decision_to_stop_using_fli.html

http://www.mlive.com/news/flint/index.ssf/2014/10/general_motors_wont_use_flint.html

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

From: Prysby, Mike (DEQ)
Sent: Monday, October 13, 2014 3:48 PM
To: Busch, Stephen (DEQ); Shekter Smith, Liane (DEQ); Wurfel, Brad (DEQ); Feuerstein, Heather (DEQ); Willard, Veronica (DEQ); Benzie, Richard (DEQ)
Subject: Media Inquiry

Ron Fonger from the Flint Journal called me today concerning the GM Engine manufacturing plant in Flint and their intent to temporarily terminate water service from Flint and purchase water from Genesee County (via Flint Twp) until Flint is either treating water from KWA or reducing their chloride concentration from their treated water that meets GM's limit for manufacturing. Ron asked if elevated chlorides are a health concern in Flint. I looked up Flint's MOR and noted that the treated water chloride concentration leaving the WTP ranges between 55 and 65 mg/l which, although not optimal (optimal being <20 mg/l), is satisfactory. Concentrations > 250 mg/l become objectionable due to taste & corrosion issues; however, based on the concentration leaving the WTP, we did not have any health-effect concerns. Ron was not able to recall the maximum chloride level acceptable to GM; however, I stressed the importance of not branding Flint's water as "corrosive" from a public health standpoint simply because it does not meet a manufacturing facility's limit for production. Ron also asked if the treatment process adds chloride. I explained that their primary coagulant is ferric chloride and this does add some chloride to the finished water; however, raw water chloride concentration is generally in the mid 40s mg/l; thus, the contribution from ferric chloride is not significant.

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

From: Crooks, Jennifer [mailto:crooks.jennifer@epa.gov]
Sent: Thursday, October 16, 2014 8:45 AM
To: Busch, Stephen (DEQ); Prysby, Mike (DEQ)
Subject: Another Flint complaint

This complaint came thru the SDWA Hotline. Interesting—this citizen reported that General Motors shut off their line to Flint water due to over-chlorination. See the link below.
Jennifer

From: Poy, Thomas
Sent: Wednesday, October 15, 2014 12:07 PM
To: Crooks, Jennifer
Subject: FW: (SDWA - FY15-122649-3715-CV) Referred to Region - Michigan

Jen: Can you use the same reply for the control to reply to this similar complaint about Flint water?

Thanks.

Tom

Tom Poy
Chief, Ground Water and Drinking Water Branch
USEPA - Region 5
(312) 886-5991

From: howard.donna@epa.gov [mailto:howard.donna@epa.gov]
Sent: Wednesday, October 15, 2014 11:46 AM
To: Poy, Thomas
Subject: FWD: (SDWA - FY15-122649-3715-CV) Referred to Region - Michigan

10/15/2014

SUBJECT: FWD: (SDWA - FY15-122649-3715-CV) Referred to Region - Michigan
FROM: howard.donna@epa.gov
TO: poy.thomas@epa.gov
CC:

-----Original Message-----

10/14/2014 9:07 AM

HQ LEAD NUMBER: FY15-122649-3715-CV

SUBJECT: Referred to Region - Michigan

FROM: ianburgess52@comcast.net

TO:

Name: Jan Burgess

Address: 720 Commonwealth Ave

City: Flint

State: Michigan

Zip: 48503

Phone: 810-235-6530

Alleged Violator's Name: City of Flint

Alleged Violator's Address: 1101 S. Saginaw St.

Alleged Violator's City: Flint

Alleged Violator's State: Michigan

Alleged Violator's Zip: 48502

Tip or Complaint: Earlier this year, the City of Flint, MI changed its water supply from the City of Detroit [Lake Huron] to the Flint River. This river has a very long history of pollution. Since this change, our drinking water has tripled in cost and the quality varies daily. Some days it smells like an over-chlorinated swimming pool; other days, like pond scum. It often is brown in color and frequently has visible particles floating in it. We've been under several boil water advisories due to e-coli contamination. Just this morning our local paper reports that General Motors Engine plant has shut off Flint River water to the plant due to the over-chlorination and the fears that the water will cause corrosion.

http://www.mlive.com/news/flint/index.ssf/2014/10/general_motors_wont_use_flint.html#cmpid=nsltr_stryheadline.

People in Flint have had to resort to buying bottled water or having purification systems installed in their homes. Some residents have even had private wells dug. The water is not safe to drink, cook or wash dishes with, or even give to pets. We worry every time we shower. The City of Flint is still very economically depressed and most citizens cannot afford to do anything other than use the river water. Many of them have NO water at all due to the extremely high water bills. There is reasonable suspicion that reports have been falsified. Some residents have had water tested privately and the results are not even close to those reported by the City. Calls to the City and State have resulted in no action whatsoever.

Violation Still Occurring? Yes

State DEP/DEQ/DEM Notified? No

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, January 22, 2014 9:13 AM
To: Zacharda, Nicole (DEQ)
Cc: Creal, William (DEQ); Shekter Smith, Liane (DEQ); Selden, Barry (DEQ); Vanderlaan, Mary (DEQ)
Subject: Re: Apologies for the phone tag (Flint)

I believe an order would be handled through owmrp regarding closure for portions of the site but if there are NPDES issues WRD should of course be involved. We are meeting internally on Thursday at 8:00

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

Sent from my iPhone

On Jan 22, 2014, at 9:07 AM, "Zacharda, Nicole (DEQ)" <ZACHARDAN@michigan.gov> wrote:

Wondering if we should meet on this response from Mike Robinson regarding an Order with Flint...

Bill- I can attend the meeting on Friday morning if you want me too, but I thought we were (trying) to step out of this.

Nicole Zacharda
Enforcement Specialist
MDEQ Water Resources Division
NEW PHONE 517-284-5497
zachardan@michigan.gov

From: Robinson, Michael [<mailto:MRobinson@wnj.com>]
Sent: Friday, January 17, 2014 4:19 PM
To: Zacharda, Nicole (DEQ)
Cc: Busch, Stephen (DEQ)
Subject: RE: Apologies for the phone tag (Flint)

Nicole, I am going to prepare a draft consent order for your review. If you have a template that I should use, please email it to me. Otherwise, I will use one our Part 31 consent orders. Also, the City (including me) will be meeting with Steve Busch and Jim Arduin next Friday at 9:30 at Con Hall. Please join us if you can. Is there anybody in the AG's office that we need to involve in this? We are on a very fast track with this. Have a good weekend and I hope your trip to Italy went well!
 Mike

From: Zacharda, Nicole (DEQ) [<mailto:ZACHARDAN@michigan.gov>]
Sent: Friday, January 17, 2014 2:25 PM
To: Robinson, Michael
Cc: Busch, Stephen (DEQ)
Subject: Apologies for the phone tag (Flint)

Hi Mike- so sorry that we keep missing one another. This week has been particularly nuts. It is unlikely that I'll be back at my desk to receive another call from you at 3:30. I have been able to confirm that the correct contact for you on Flint questions is Steve Busch in the Office of Drinking Water & Municipal Assistance. You can reach him at 517-643-2314. Steve just e-mailed me, so perhaps he'll be around at 3:30 while I'm in my meeting.

Nicole Zacharda
Enforcement Specialist
MDEQ Water Resources Division
NEW PHONE 517-284-5497
zachardan@michigan.gov

Rennaker, Joanne (DEQ)

From: Rosenthal, Adam (DEQ)
Sent: Thursday, May 15, 2014 9:57 AM
To: Busch, Stephen (DEQ)
Cc: Prysby, Mike (DEQ)
Subject: RE: April '14 MOR

ok

From: Busch, Stephen (DEQ)
Sent: Thursday, May 15, 2014 9:41 AM
To: Rosenthal, Adam (DEQ)
Cc: Prysby, Mike (DEQ)
Subject: RE: April '14 MOR

We need turbidity data on raw, settled, CFE, along with the # of monitoring periods and individual turbidity sample count. We need the front page that verifies all the data. Also note that the Plant Tap results only show a few samples at best. Hopefully they are collecting 4 hour compliance samples at the CFE and have all the individual data. We should probably conference call them tomorrow to go over the MOR and monitoring requirements.

Adam, can you provide them with a proper MOR form? Kris or other analysts have forms you can work off of if necessary.

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

From: Rosenthal, Adam (DEQ)
Sent: Thursday, May 15, 2014 9:18 AM
To: Busch, Stephen (DEQ)
Cc: Prysby, Mike (DEQ)
Subject: FW: April '14 MOR

thought he CC'd you.

Adam

From: Michael Glasgow [<mailto:mglasgow@cityofflint.com>]
Sent: Wednesday, May 14, 2014 2:33 PM
To: Rosenthal, Adam (DEQ)
Subject: Re: April '14 MOR

Adam,

Attached is a copy of our MOR. It is not complete. As you will see, it is only missing the information on plant flow. That data was in Brent's office, which was unfortunately flooded due to a replaced valve mishap. Flow coming out of the plant was shut off for a brief moment (valve was originally half open, and upon repair of the controller the valve was closed fully then re-opened) stopping flow to our pump station, and flooded the front offices with over 3 foot of water causing a lot of Brent's paper work to be saturated. He is still drying things out

and separating them. I have forwarded your original message to him and I expect to have the completed version of our MOR to you by the end of the week. I am in the process of altering the MOR to reflect our new operation, however for last month considering the fact we only distributed water a couple days, I tried to combine them together. During those couple days we were also supplementing the distribution system with Detroit water located in our reservoirs.

Mike Glasgow
City of Flint Water Plant

On Wed, May 14, 2014 at 8:52 AM, Rosenthal, Adam (DEQ) <ROSENTHALA@michigan.gov> wrote:

Morning Mike, reporters are calling and Steve is looking for the April '14 MOR, please email a copy when you get this.

Please note that since Flint submits the monthly bacti results with the MOR, it is due by the 10th of the month. Please make sure to send future MORs, or at least the bacti results so they are received by the 10th.

thanks,

Adam Rosenthal, EQA

MDEQ – Office of Drinking Water and Municipal Assistance

Lansing District – Constitution Hall 1SW

PO Box 30242

Lansing, MI 48909

517-284-6644

fax: 517-241-3571

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, May 15, 2014 9:41 AM
To: Rosenthal, Adam (DEQ)
Cc: Prysby, Mike (DEQ)
Subject: RE: April '14 MOR

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 MDEQ
 517-643-2314

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Adam Rosenthal, EQA

MDEQ – Office of Drinking Water and Municipal Assistance

Lansing District – Constitution Hall 1SW

PO Box 30242

Lansing, MI 48909

517-284-6644

fax: 517-241-3571

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, August 08, 2013 12:16 PM
To: Shekter Smith, Liane (DEQ); Thomas, Chuck (DEQ); Bloemker, Jon (DEQ); Benzie, Richard (DEQ); Donaldson, Kristina (DEQ); Lachance, Amy (DEQ)
Cc: Willard, Veronica (DEQ); Byrne, Randall (Treasury)
Subject: RE: Assistance for Treasury

Under GASB 34 old infrastructure (pre-1980) was not included in the required valuation of infrastructure assets. However, GASB 34 does provide two methods (Depreciation and Modified) for calculating the value of an infrastructure asset. Despite the 72 line being installed in 1965, perhaps one of these methods could be used to value the asset.

In addition, to estimate historical cost of infrastructure, the government has to calculate the current replacement cost of the infrastructure asset, including the costs of materials, equipment and labor used for construction. It then must apply historical consumer price index values, deflating the current value and estimating the cost of the asset at the time it was placed in service.

The only issue with an older asset such as this is what to do when the benchmark average lifecycle for that asset type is less than the actual age of the asset.

Still trying to follow this approach would at least provide something in line with current accounting and asset management standards.

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

From: Shekter Smith, Liane (DEQ)
Sent: Monday, August 05, 2013 3:43 PM
To: Thomas, Chuck (DEQ); Bloemker, Jon (DEQ); Benzie, Richard (DEQ); Busch, Stephen (DEQ); Donaldson, Kristina (DEQ); Lachance, Amy (DEQ)
Cc: Willard, Veronica (DEQ); Byrne, Randall (Treasury)
Subject: Assistance for Treasury

All –

I recently spoke with Randall Byrne (Treasury) and agreed to try to help them with a couple of items. (Randy – sorry it's taken me so long to get this note out).

1. Flint is considering selling the 72-inch pipeline. It was constructed in 1965 for \$6.5M. How would you determine fair market price for such an item? I suggested getting quotes from a couple of contractors for what it would cost to install today and figure some kind of depreciation for a 50 year old pipeline. Other ideas?
2. Highland Park is looking at contracting out their water department for the near future. At this point, they would need a company that could manage their distribution system. Could you please provide a list of names/companies that are already doing this kind of work around the state? United Water and Earth Tech were the ones that came to mind. There must be others.

Thanks much.

Liane

Liane J. Shekter Smith, P.E., Chief
Office of Drinking Water and Municipal Assistance
Michigan Department of Environmental Quality
517-373-9523

*** Effective August 12, 2013 my new number will be (517) 284-6543*

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, July 06, 2015 12:50 PM
To: 'Crooks, Jennifer'
Subject: RE: Bios for Mike Schock and Darren Lytle from EPA's Office of Research and Development

I passed the bio info for Mike and Darren on this morning. Not sure if the City has any intention to utilize them at this point.

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

From: Busch, Stephen (DEQ)
Sent: Monday, June 29, 2015 3:54 PM
To: 'Crooks, Jennifer'; Prysby, Mike (DEQ); Cook, Pat (DEQ)
Cc: Shekter Smith, Liane (DEQ); Benzie, Richard (DEQ); Philip, Kris (DEQ)
Subject: RE: Bios for Mike Schock and Darren Lytle from EPA's Office of Research and Development

Jennifer,

Mike has been out and won't likely return until next Monday 7/6. I have not been in touch with the City on this yet. The City's Pb/Cu monitoring period ends tomorrow 6/30, so by 7/10 we should also have a better idea where the City stands.

As you saw from the June 9, TTHM MCL VN, only one compliance sample (out of 24) in the last 9 months exceeded 80 ppb (Site DBP4, 94 ppb, 11/20/14).

TOC removal has been effective at the WTP, and with the upcoming GAC filter media changeout should be even more effective.

Total Coliform has not been an issue for the last 9 months, since September 2014, and work on the distribution system has improved chlorine residuals (with additional transmission main work planned over the next couple of years).

So at this point I don't think we have any questions.

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

From: Crooks, Jennifer [<mailto:crooks.jennifer@epa.gov>]
Sent: Friday, June 26, 2015 5:41 PM
To: Busch, Stephen (DEQ); Prysby, Mike (DEQ); Cook, Pat (DEQ)
Cc: Shekter Smith, Liane (DEQ); Benzie, Richard (DEQ); Philip, Kris (DEQ)
Subject: Bios for Mike Schock and Darren Lytle from EPA's Office of Research and Development

Steve and Mike; referring to the bios I sent you all last Monday, 6/22, of Mike Schock and Darren Lytle, I was wondering if you've had a chance to discuss Mike and Darren's participation in evaluating treatment/water quality/lead levels with the City of Flint?

Perhaps I can answer any questions you might have about their participation with you all?

Jennifer

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, June 29, 2015 3:54 PM
To: 'Crooks, Jennifer'; Prysby, Mike (DEQ); Cook, Pat (DEQ)
Cc: Shekter Smith, Liane (DEQ); Benzie, Richard (DEQ); Philip, Kris (DEQ)
Subject: RE: Bios for Mike Schock and Darren Lytle from EPA's Office of Research and Development

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

From: Crooks, Jennifer [<mailto:crooks.jennifer@epa.gov>]
Sent: Friday, June 26, 2015 5:41 PM
To: Busch, Stephen (DEQ); Prysby, Mike (DEQ); Cook, Pat (DEQ)
Cc: Shekter Smith, Liane (DEQ); Benzie, Richard (DEQ); Philip, Kris (DEQ)
Subject: Bios for Mike Schock and Darren Lytle from EPA's Office of Research and Development

Steve and Mike; referring to the bios I sent you all last Monday, 6/22, of Mike Schock and Darren Lytle, I was wondering if you've had a chance to discuss Mike and Darren's participation in evaluating treatment/water quality/lead levels with the City of Flint?

Perhaps I can answer any questions you might have about their participation with you all?

Jennifer

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, September 30, 2015 11:02 AM
To: Pieper, Julia (DEQ)
Cc: Krisztian, George (DEQ); Shane, Kirby (DEQ)
Subject: RE: Bottles for flint Public Schools

Mike Prysby is on his way over. Thanks!

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: Pieper, Julia (DEQ)
Sent: Wednesday, September 30, 2015 10:44 AM
To: Busch, Stephen (DEQ)
Cc: Krisztian, George (DEQ); Shane, Kirby (DEQ)
Subject: Bottles for flint Public Schools
Importance: High

Steve,

The order of 50 lead/copper bottles for Flint Public Schools is ready. The boxes are in the lobby at the laboratory waiting for pick up. Each bottle has a green sticker reading "Flint Public Schools" for easy identification when it arrives at the laboratory. All of the forms are together in the smaller of the two boxes. These forms have "FLINT LEAD TESTING" written in red at the top of the form.

Julia Pieper
 Drinking Water Coordinator
 Organic Sub-Unit Manager
 DEQ-RRD-Laboratory Services
pieperj2@michigan.gov
 (517)-335-8076 phone
 (517)-335-8562 fax

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, March 17, 2014 10:53 AM
To: Brim, Richard (DEQ)
Cc: Shekter Smith, Liane (DEQ); Craig, John (DEQ)
Subject: RE: Bray road consent order

Rich,

In response to Mr. Robinson's request to copy language from the Statement of Purpose and create a Section 3.13 in the Compliance Program, I have drafted the following language:

3.13

Public improvement projects under Act 399 required to be completed by the Respondent to receive water from KWA, continue to use the Flint River, or obtain a back-up water supply in order to comply with Act 399, shall not initiate construction, alteration, addition or improvement until the Respondent has obtained a valid construction permit(s) from the ODWMA issued under Section 4 of Act 399.

Copying the language word for word would not appear to comply with compliance program requirements, so I have attempted to restate the language in a manner that may fit within the compliance program structure. This draft language should also relieve OWMRP from any implied authority under Act 399, by directing the respondent to ODWMA for Act 399 compliance.

Hope that works.

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

From: Busch, Stephen (DEQ)
Sent: Friday, March 14, 2014 12:43 PM
To: Arduin, Jim (DEQ)
Cc: Brim, Richard (DEQ)
Subject: RE: Bray road consent order

He doesn't appear to understand the difference between WRD and OWMRP.

I don't see a need to make any of the modifications, other than modified dates. I also wouldn't move the DW stuff in the Statement of Purpose to a new 3.13.

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

From: Arduin, Jim (DEQ)
Sent: Friday, March 14, 2014 11:06 AM

To: Busch, Stephen (DEQ)
Subject: FW: Bray road consent order

Steve,

You may want to look at the Statement of Purpose section to see if you can live with Mike's proposed changes.

Jim

James Arduin
Senior Geologist
Michigan Department of Environmental Quality
Office of Waste Management and Radiological Protection
(517) 284-6652

From: Robinson, Michael [<mailto:MRobinson@wnj.com>]
Sent: Friday, March 14, 2014 8:28 AM
To: Arduin, Jim (DEQ); Brim, Richard (DEQ)
Subject: Bray road consent order

Here is the draft consent order with the City's comments. Jim, I will call you in about 20 minutes. You should focus on Sections 1-3.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, June 24, 2014 9:02 AM
To: Johnson, Mark; Crooks, Jennifer
Cc: Poy, Thomas; Prysby, Mike (DEQ); Shoven, Heather; Murphy, Thomas
Subject: RE: Briefing -- Flint River for drinking water, Michigan

Finished water (plant tap) pH levels ranged from 7.1-7.7 for the entire month of May.

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

From: Johnson, Mark [mailto:johnson.mark@epa.gov]
Sent: Monday, June 23, 2014 6:24 PM
To: Crooks, Jennifer
Cc: Poy, Thomas; Prysby, Mike (DEQ); Busch, Stephen (DEQ); Shoven, Heather; Murphy, Thomas
Subject: FW: Briefing -- Flint River for drinking water, Michigan

Jennifer

Here is an initial response from Joe Carpenter, a water quality engineer at the CDC Waterborne Disease Prevention Program in Atlanta. His comments focus on the pH of the finished water as a possible contributor to the reports of skin rashes. In this files that were provided, there were pH measurements for the last week of April. Are there additional data available to determination if pH fluctuations in the distribution system may correspond to the complaints?

Just looking at it from a chemical perspective, I don't see anything in the analysis that would be of a health concern. We can have a follow-up discussion with CDC staff about other constituents if that would be helpful.

Mark

Mark D. Johnson, PhD, DABT
 Regional Director/ Senior Environmental Health Scientist
 Agency for Toxic Substances and Disease Registry (ATSDR)
 77 West Jackson Blvd.
 Chicago, IL 60604
 e-mail: mdjohnson@cdc.gov
 phone: 312-353-3436 (office)

From: Carpenter, Joe (CDC/OID/NCEZID) [mailto:jcc0@cdc.gov]
Sent: Saturday, June 21, 2014 4:46 PM
To: Beach, Michael J. (CDC/OID/NCEZID); Johnson, Mark
Cc: Yoder, Jonathan S. (CDC/OID/NCEZID); Robinson, Felecia (CDC/OID/NCEZID) (CTR); Gargano, Julia Marie W. (CDC/OID/NCEZID); Sarisky, John (CDC/ONDIEH/NCEH); Blake, Robert G. (CDC/ONDIEH/NCEH)
Subject: RE: Briefing -- Flint River for drinking water, Michigan

Here is a recent article (06/12/2014) about the changes in lime addition at the Flint water plant. It might be a bit challenging to make pH adjustments quickly in the finished water if they had to make this significant lime addition adjustment. High pH from lime softening plants has been associated with consumer issues in the past. See below for a background document about lime softening and a WHO document about the health effects of both high and low pH values. Skin rashes are known to be caused by extreme pH variations in drinking water.

Hope some of this info is helpful.

Joe Carpenter

[http://www.mlive.com/news/flint/index.ssf/2014/06/treated flint river water meet.html](http://www.mlive.com/news/flint/index.ssf/2014/06/treated_flint_river_water_meet.html)

FLINT, MI -- Workers at the city's water treatment plant have bumped up their use of lime in an effort to cut down on both water hardness and rising customer complaints.

Daugherty Johnson, utilities administrator at Flint's water treatment plant, said today, June 12, that 75 percent of raw water is now being treated with lime compared to 25 percent treatment when the city made the **initial switch** from using Lake Huron to using the Flint River as a drinking water source on April 25.

Background info about lime softening:

[http://www.nesc.wvu.edu/pdf/dw/publications/ontap/2009_tb/lime_softening DWFSOM41.pdf](http://www.nesc.wvu.edu/pdf/dw/publications/ontap/2009_tb/lime_softening_DWFSOM41.pdf)

Health Effects of pH -- WHO

http://www.who.int/water_sanitation_health/dwq/chemicals/en/ph.pdf

EFFECTS ON HUMANS

Exposure to extreme pH values results in irritation to the eyes, **skin**, and mucous membranes. Eye irritation and exacerbation of skin disorders have been associated with pH values greater than 11. In addition, solutions of pH 10–12.5 have been reported to cause hair fibres to swell (10). In sensitive individuals, gastrointestinal irritation may also occur. Exposure to low pH values can also result in similar effects. Below pH 4, redness and irritation of the eyes have been reported, the severity of which increases with decreasing pH. Below pH 2.5, damage to the epithelium is irreversible and extensive (10). In addition, because pH can affect the degree of corrosion of metals as well as disinfection efficiency, it may have an indirect effect on health.

From: Beach, Michael J. (CDC/OID/NCEZID)

Sent: Saturday, June 21, 2014 12:53 PM

To: Johnson, Mark (EPA) (CDC epa.gov)

Cc: Carpenter, Joe (CDC/OID/NCEZID); Yoder, Jonathan S. (CDC/OID/NCEZID); Robinson, Felecia (CDC/OID/NCEZID) (CTR); Beach, Michael J. (CDC/OID/NCEZID); Gargano, Julia Marie W. (CDC/OID/NCEZID); Sarisky, John (CDC/ONDIEH/NCEH); Blake, Robert G. (CDC/ONDIEH/NCEH)
Subject: FW: Briefing -- Flint River for drinking water, Michigan

Mark,
 Am cc'ing our water engineer, Joe Carpenter, for his take on this. We have heard of the rashes related to switch to chloramine (not happening here) w, which has become very activist oriented but not sure from the data here what this might be. Also including the EH services Branch for input
 Michael

Michael J. Beach, Ph.D.
 Associate Director for Healthy Water
 National Center for Emerging and Zoonotic Infectious Diseases
 Centers for Disease Control and Prevention
 Mailstop C-09
 1600 Clifton Rd NE
 Atlanta, GA 30329-4018

Tel: 404-639-1591
 E-mail: mbeach@cdc.gov
 Visit CDC's Healthy Water website at www.cdc.gov/healthywater



Please only print this e-mail if necessary.

From: Johnson, Mark (EPA) (CDC epa.gov)
Sent: Friday, June 20, 2014 5:57 PM
To: Beach, Michael J. (CDC/OID/NCEZID); Roberts, Virginia (CDC/OID/NCEZID)
Subject: FW: Briefing -- Flint River for drinking water, Michigan

Michael and Virginia

We were contacted by USEPA this week regarding complaints from residents of Flint, Michigan associated with the quality of their drinking water. There have been recent taste and odor complaints, but also claims of people developing rashes. The complaints seem to correspond to the timeframe the City of Flint switching from purchasing water from the City of Detroit to utilizing their own treatment system that takes water from the Flint River, which began in late April, 2014.

Although this is a regulatory compliance issue, ATSDR was contacted to assist in addressing health concerns in the community. Although the analytical testing does not indicate the presence of chemicals that appear to be a health concern, the fact that their raw water is coming from a new source raises questions about other constituents that have not been evaluated. We will be contacting the Michigan Dept. of Community Health, but we also wanted to contact your program to see if you get involved with these situations and can offer some advice.

Let me know what you think.

Mark

Mark D. Johnson, PhD, DABT
 Regional Director/ Senior Environmental Health Scientist
 Agency for Toxic Substances and Disease Registry (ATSDR)
 77 West Jackson Blvd.
 Chicago, IL 60604

e-mail: mdjohnson@cdc.gov
 phone: 312-353-3436 (office)

From: Crooks, Jennifer

Sent: Friday, June 20, 2014 3:07 PM

To: Johnson, Mark

Cc: Poy, Thomas; Prysby, Mike (DEQ); Busch, Stephen (DEQ); Shoven, Heather; Murphy, Thomas

Subject: Briefing -- Flint River for drinking water, Michigan

Mark—as we discussed earlier this week, below is a briefing containing the information we discussed regarding the Flint, Michigan water supply. I am out of the office this coming week; if you have questions, please contact Tom Poy, Ground Water and Drinking Water Branch Chief.

Thank you for your time!

Jennifer

Drinking Water in Flint, Michigan

ISSUE: Flint began pumping/treating/distributing Flint River water as their drinking water source on April 25, 2014, and beginning in mid-May, there have been numerous complaints to the Region 5 Ground Water and Drinking Water Branch regarding the drinking water, including rotten egg smell, swamp water smell, people developing rashes. The Region immediately contacted and involved the Drinking Water program at the Michigan Dept of Environmental Quality (MDEQ).

BACKGROUND: Flint has been purchasing finished drinking water from Detroit for decades (source water is Lake Huron). It has been delivered by a large single pipeline from Detroit. In the late 1980's, the State drinking water staff requested that Flint renovate their old surface water treatment plant to meet the State's redundancy requirements, in case the single pipeline from Detroit was unable to transmit finished drinking water. Flint would treat Flint River water periodically throughout the year, to verify that the water treatment plant (WTP) was able to treat Flint River water that met Safe Drinking Water Act (SDWA) standards.

Over the past 15 years or so, Detroit has seen a decrease in its City population, and an increase in poverty/low income residents. Detroit currently has an Emergency Manager due to poor financial situation. (As an aside, last year the City of Highland Park told Detroit it was unable to pay its water/sewer bills, and currently has an Emergency Manager. Highland Park was unable to obtain funding to retrofit its surface water treatment plant, so Detroit is providing water/sewer currently to Highland Park for free.) In order to continue to provide adequately treated water that meets SDWA Health standards, the suburbs have been subsidizing the lower income residents for years. Consequently, communities like Flint have decided to find an alternate source of drinking water.

A regional water authority was formed in 2010, the Karegnondi Water Authority (KWA), which will serve water in mid-Michigan and the Thumb areas. Members of the KWA include Flint, Lapeer; and Genesee, Lapeer and Sanilac Counties. The KWA is currently constructing the Karegnondi pipeline to bring raw water from Lake Huron. It will be completed in about 2 years. Flint has an Emergency Manager now, and I think on paper, it looked like a savings to pump and treat Flint River water for the 2-year interim period prior to connecting to the Karegnondi pipeline, than to continue to pay Detroit prices for finished drinking water. MDEQ has worked long and hard with the City of Flint and water operators to get the WTP ready to treat Flint River water for the next few years. Complete operation/treatment began April 25, 2014.

In mid-May, Region 5 Ground Water and Drinking Water Branch began receiving calls from Flint citizens regarding the quality of the Flint drinking water. Complaints include rotten egg smell, swamp water smell, people developing rashes. I talked with Richard Benzie, the Community Drinking Water Unit Chief, at MDEQ about any possible chemical releases into the Flint River, and neither he nor Mike Prysby, the Lansing District engineer for Flint, have heard of anything such as this. The normal procedure of chemical releases is that Mike Prysby and Richard would be alerted/notified through the Pollution Emergency Alert System (PEAS), and that hasn't happened.

Mike Prysby has been working quite closely with the Operator-in-Charge at the Flint Water Treatment plant to prepare the WTP and operators to treat the Flint River water. Attached are several analytical results: July 2013 Test Run of Phase 2/5 contaminants conducted on the Flint River, sampled in July 2013; no exceedances are noted; detects of barium and selenium. The April 2014 Monthly Operation Report (MOR) which includes bacteriological analyses, was finalized in mid-May (includes only April 25-30 operation activity) with the following test results (sampled in May 2014), that were provided last week by Steve Busch, the MDEQ Supervising District Engineer: Total Organic Carbon (TOC), Metals, Volatile Organic Carbon (VOC), Synthetic Organic Contaminants (SOC) (all 3 categories), and partial chemistry (which includes nitrates). As the WTP only operated for the last 6 days in April, the MOR results provide limited information. The Bacteriological Portion of the May Operating Period were due 6/10, but the operational monitoring won't be reported until 6/30.

FINDINGS: So, bottom line—yes, the raw water is a different quality and more variable than Lake Huron raw water that Detroit is using. The Flint River is not as high a quality water as Lake Huron, but they are pretreating with ozone, conducting softening to reduce hardness and organic precursors, and are working with chlorine application. And, the Flint River is an interim source of raw water until the Karogondi pipeline is constructed to bring raw Lake Huron water to Flint for treatment.

When you look at the July 2013 Test Run analyses attached, note:

The sample was taken at the Filter Effluent—normally it would be taken at the plant tap, but they were running Flint River water through most of the plant last summer to test treatment, and the filters were the last stop before the clear well/plant tap which were filled with Detroit water they were serving last year. Note: Trihalomethanes (TTHM) are detected, but no exceedances. Detects could be due to: Softening had not been introduced to the treatment process last summer which would reduce the hardness and also remove some of the organic precursor that would add to TTHM levels. Softening is being conducted now in the treatment process. Last summer, chlorine was added in mid-treatment which also could have added to the TTHM level. Now, chlorine is added just before the filters. Also, since it's summer surface water, there will be more run-off, thus more precursor in the raw water. Mike Prysby, the MDEQ District Engineer, believes that today's operation of the plant and quality of drinking water produced is much better than the test runs done over the past year, due to the adjusting of the treatment, such as the softening process and the chlorine application.

Mike received Flint's first Monthly Operation Report (MOR) for the timeframe of April 25-30. Ozone pretreatment is provided to the raw water, and there is ozone destruction at the end of the pretreatment. The Filter Effluent has never been over 0.3 NTU, the ave range is 0.12-0.21 NTU. The chlorine residual at the plant tap is 0.9-1.0 free chlorine. The distribution chlorine residual ranged from 0.7-1.0 of free chlorine, which is acceptable. Bacti samples are pulled every 3-4 hours starting on April 25-30, and all were clear.

CONCLUSION: The analyses show some detects of regulated contaminants, but no exceedances. Thus, we have no report on any regulated contaminant that might be causing rashes, and the complaints we're hearing. I did ask Steve Busch at MDEQ, if there was a possibility of the existence of cyanotoxins from algae on the Flint River. Steve has worked with systems in Southeast Michigan and with Ohio EPA on algae issues, and he didn't think the conditions of the Flint River would support an algae bloom that would cause cyanotoxins to be present.

We would like to know if ATSDR would be interested in looking into this situation, to determine if there are other unregulated contaminants causing complaints of poor water quality.

Mike Prysby: 517-290-8817; prysbym@michigan.gov.

Steve Busch: 517-643-2314; buschs@michigan.gov

Jennifer

Jennifer Kurtz Crooks

Michigan Program Manager/Set-Aside Coordinator

Ground Water and Drinking Water Branch

U.S. EPA, Region 5

77 West Jackson Blvd., WG-15J

Chicago, Illinois 60604

(312) 886-0244

(312) 582-5853 (fax)

crooks.jennifer@epa.gov

Rennaker, Joanne (DEQ)

From: Benzie, Richard (DEQ)
Sent: Thursday, May 15, 2014 2:02 PM
To: Crooks, Jennifer; Prysby, Mike (DEQ); Cook, Pat (DEQ)
Cc: Busch, Stephen (DEQ); Shekter Smith, Liane (DEQ)
Subject: RE: Call from MI citizen in Flint

I suspect there may have been excessive runoff and storm water discharges with the weather we have been experiencing, but you will have to ask the Water Resources Division for details. If a release or overflow is unusual or not expected, both we and the systems should get contacted through the PEAS contact lists.

We expect surface water treatment plants to be capable of treating their source adequately from a microbial standpoint regardless of deteriorating source water quality.

One answer to his question is that any time a system is unable to meet drinking water standards or suspects there may be a water quality problem as a result of an unexpected event (spill, pressure loss, etc.), they are required to notify the consumers and provide appropriate precautionary advice. So no news should be considered good news.

We can talk more next week.

From: Crooks, Jennifer [mailto:crooks.jennifer@epa.gov]
Sent: Thursday, May 15, 2014 11:16 AM
To: Prysby, Mike (DEQ); Cook, Pat (DEQ); Benzie, Richard (DEQ)
Subject: FW: Call from MI citizen in Flint

The citizen, Mr. Lathan Jefferson, contacted Mindy Eisenberg at Headquarters. I will follow up with you all next week at her request. Mike, if I could get copies of the lab analyses for regulated contaminants and their MOR for the new Flint water, I'd appreciate it. Richard and Mike, Mindy is wondering if there were any contaminant releases recently into the Flint River? See my response below.

Jennifer

From: Crooks, Jennifer
Sent: Thursday, May 15, 2014 9:57 AM
To: Eisenberg, Mindy
Cc: Poy, Thomas
Subject: RE: Call from MI citizen in Flint to you

I will talk with Mike, Pat and Richard next Monday and get the analyses from Mike, and send to you next week. Thank you again, Mindy.
 Jennifer

From: Eisenberg, Mindy
Sent: Thursday, May 15, 2014 9:55 AM
To: Crooks, Jennifer
Cc: Poy, Thomas
Subject: RE: Call from MI citizen in Flint to you

Thanks Jennifer,

I told him that I would make some calls to find out what is going on and then would get back to him. He mentioned that he was on his way to talk with the Flint treatment plant, so we'll see how that goes.

Mindy

Mindy Eisenberg
Chief, Protection Branch
Office of Ground Water and Drinking Water
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW, mailcode 4606M
Washington, DC 20460
(202) 566-1290
eisenberg.mindy@epa.gov

From: Crooks, Jennifer
Sent: Thursday, May 15, 2014 10:52 AM
To: Eisenberg, Mindy
Cc: Poy, Thomas
Subject: RE: Call from MI citizen in Flint to you

Hi, Mindy. Thank you for listening to him. Mike Prysby, the DEQ district engineer who oversees Flint water treatment and distribution, doesn't have Flint's Monthly Operating Report yet, but he has results from Phase 2/5 and other required contaminant analyses (required to meet so the plant could be put on-line), and health standards are being met, he said. I will ask Mike to send me copies of their Phase 2/5 results and the MOR, and his analysis. I didn't specifically ask about any contaminant releases, but DEQ has historically been consistently reliable in reporting to us any contaminant releases—but I will ask Mike that also. Richard Benzie is out of the office til Friday or Monday, but I will be in Lansing auditing set-asides next Monday, so I will touch base with him also.

Pat Cook is the DEQ drinking water treatment expert, who Lathan Jefferson talked to at MI DEQ this week. Pat Cook was out of the office at training so I was unable to find out what he told Mr. Jefferson. Mr. Jefferson refused to take Mike Prysby's phone number, which is why he didn't mention Mike's name to you.

Jennifer

From: Eisenberg, Mindy
Sent: Thursday, May 15, 2014 9:36 AM
To: Crooks, Jennifer
Cc: Poy, Thomas; Hyde, Tinka
Subject: RE: Call from MI citizen in Flint to you

Hi Jennifer,
Yes, I just spoke with him and he explained the situation. He didn't mention Mike Prysby but did mention a Pat Cook from DEQ who he has spoken with about the health issues. What analyses is Flint doing? Do they have any analyses for the Phase 2/5 rules? He expressed concern about closed GM plants along the river. Could there be releases? Have you spoken with Richard Benzie?

Thanks

Mindy Eisenberg
Chief, Protection Branch

Office of Ground Water and Drinking Water
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Mindy—A Mr. Lathan Jefferson has talked with Tinka, and also with me just now about his drinking water quality. Flint has just switched from Detroit water (from Lake Huron) to Flint River water within the past couple of weeks. Flint River quality is not great, but there is a surface water treatment plant producing water that is currently meeting SDWA standards, according to the MI DEQ district engineer, Mike Prysby. The water has more hardness, and pH and alkalinity may be different from Detroit water. Mike will have more information on the difference in water quality when he receives Flint's first monthly operation report this week. Mr. Jefferson said he and many people have rashes from the new water. He said his doctor says the rash is from the new drinking water, and I told him to have his doctor document this and he can bring to the attention of the MI DEQ, since lab analyses to date show that the drinking water is meeting all health-based standards. He has no interest in speaking with Mike Prysby; he doesn't trust anyone in MI government. He asked me for free drinking water lab analyses, which I was unable to provide. He only wants to speak with someone from EPA Headquarters.

Jennifer

Jennifer Kurtz Crooks
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Chicago, Illinois 60604
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Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, May 16, 2014 12:02 PM
To: Benzie, Richard (DEQ); Shekter Smith, Liane (DEQ)
Cc: Cook, Pat (DEQ); Prysby, Mike (DEQ)
Subject: RE: Call from MI citizen in Flint

Richard and Liane,

FYI.

Mike, Adam, and I had a conference call with Flint this morning to go over some MOR and monitoring details.

We have received bacti and distribution CI data, but only have some preliminary MOR data. Remaining MOR data will be provided as required by the end of the month.

They appear from what we discussed to be conducting the required monitoring and preliminary data suggest everything is meeting standards. Unit 37 samples will be collected next week, but as previously indicated we do have results from test runs that demonstrate everything was meeting standards.

The WTP has not been Fluoridating at this time, as we suggested they focus on required treatment until things settle down. They indicated they should be ready by June 1 to start Fluoridation. They do have around 0.15 ppm in the raw water.

If want any additional info just let us know.

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

From: Benzie, Richard (DEQ)
Sent: Thursday, May 15, 2014 2:02 PM
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Jennifer

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Cc: Poy, Thomas; Hyde, Tinka
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government. He asked me for free drinking water lab analyses, which I was unable to provide. He only wants to speak with someone from EPA Headquarters.

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(312) 582-5853 (fax)
crooks.jennifer@epa.gov

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, December 04, 2014 8:43 AM
To: 'Crooks, Jennifer'; Prysby, Mike (DEQ)
Subject: RE: Can Flint share monitoring data?

Jennifer,

Sorry. I have been out of the office for a while, I will get back to you by tomorrow on this.

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

From: Crooks, Jennifer [<mailto:crooks.jennifer@epa.gov>]
Sent: Monday, December 01, 2014 4:58 PM
To: Prysby, Mike (DEQ); Busch, Stephen (DEQ)
Subject: Can Flint share monitoring data?

Tom Poy and I were just discussing Flint's citizen concerns over the water. I know there is no data system in MI that would allow the public sharing of the drinking water analyses with the public, like Drinking Water Watch. But does the City of Flint have a way to share monitoring data with the public electronically? Or just the CCR in July?
Jennifer

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, February 06, 2015 11:27 AM
To: Benzie, Richard (DEQ)
Subject: RE: CAZ description - Flint River

Is updating of the CAZ every 3 years part of our commitment to EPA regarding SWA's?

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

From: Benzie, Richard (DEQ)
Sent: Friday, February 06, 2015 11:22 AM
To: Prysby, Mike (DEQ)
Cc: Busch, Stephen (DEQ); Berndt, Jason (DEQ)
Subject: FW: CAZ description - Flint River

Mike,

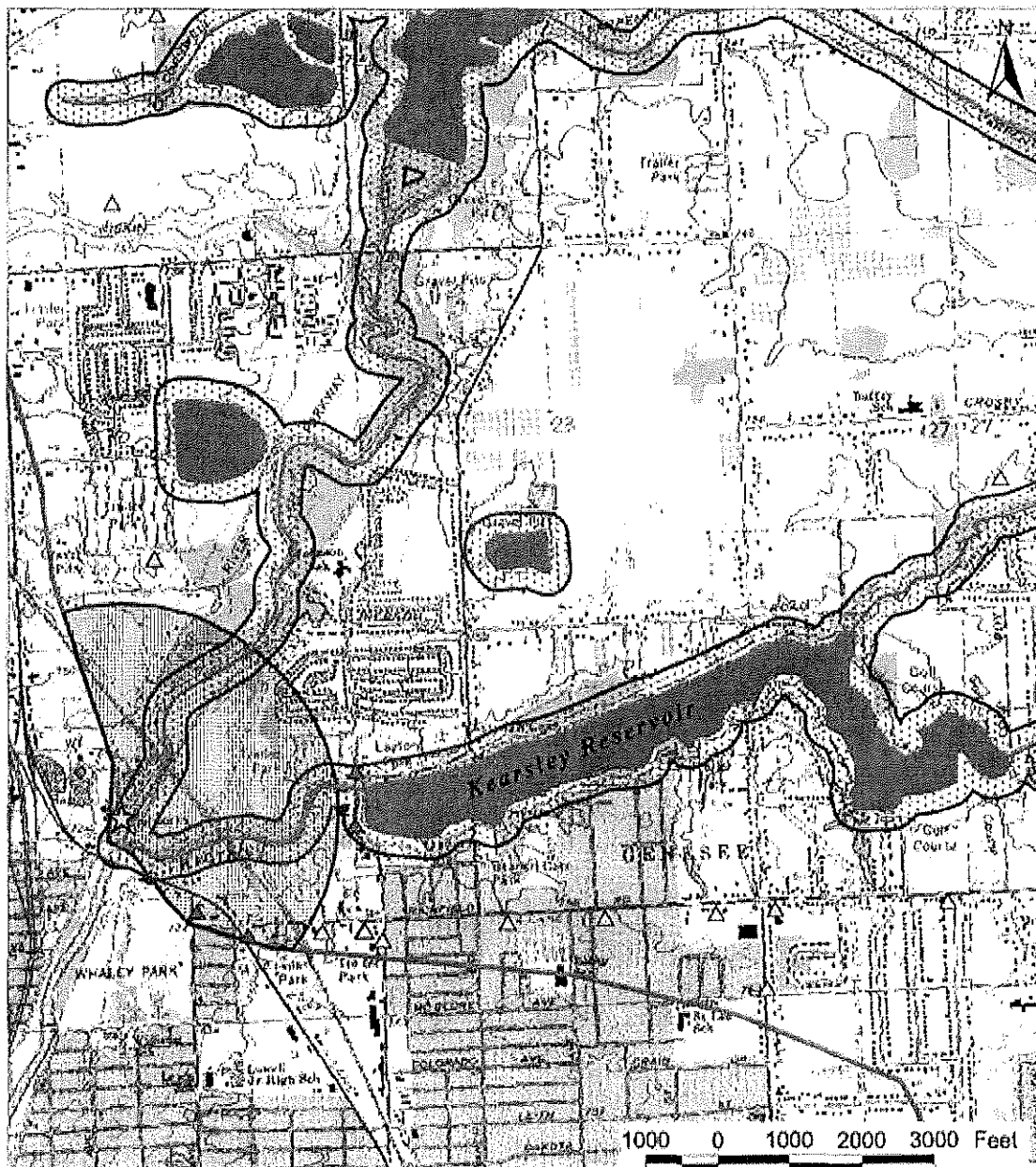
According to the recent dialogue below, there was an assessment of the Flint River. I believe they (Brad Brogren) addressed all standby intakes when they conducted the initial round of assessments. CAZ stands for Critical Assessment Zone. Contact Jason to find out more, but the file should be in our condensed files on 4 South (hopefully).

From: Berndt, Jason (DEQ)
Sent: Wednesday, January 28, 2015 10:53 AM
To: Benzie, Richard (DEQ)
Cc: Shekter Smith, Liane (DEQ); Fisher, Brant (DEQ)
Subject: RE: CAZ description

Yes, the Sault Ste. Marie intake is in a connecting channel, but not part of the flow analysis as described below.

Yes, there was a CAZ and assessment on the Flint Intake, see below: There may not be a need, but there is some good information available in the assessment.

We should be assessing our new intakes, however, it's quite a project to complete following the protocol. Set aside \$'s??



Explanation

☆ Flint Water-supply Intake	■ Lakes
△ Potential Contaminant Source (PCS)	▨ Critical Assessment Zone
— SWA Boundary	▤ Susceptible Area
— Rivers and Creeks	

From: Benzie, Richard (DEQ)
Sent: Wednesday, January 28, 2015 10:44 AM
To: Berndt, Jason (DEQ)
Cc: Shekter Smith, Liane (DEQ); Fisher, Brant (DEQ)
Subject: RE: CAZ description

Not that it matters for your discussion, but Sault Ste. Marie is also in a connecting channel. Maybe DeTour as well?

Did we ever develop a CAZ for the Flint River? Do we need to if it will only be a rarely used, emergency intake in another 18 months?

From: Berndt, Jason (DEQ)
Sent: Wednesday, January 28, 2015 9:28 AM
To: Goodwin, Kevin (DEQ)
Cc: Benzie, Richard (DEQ); Shekter Smith, Liane (DEQ); Fisher, Brant (DEQ)
Subject: RE: CAZ description

Hi Kevin,

The assessment methodology for the intakes is slightly different based on the three surface water supply types. There are approximately 55 Great Lakes intakes, 14 Great Lakes connecting channel intakes, and 8 inland river intakes.

The Great Lakes (55) and connecting channels intakes (14) used the "Assessment Protocol for Great Lakes Sources" which was developed by a Region 5 states workgroup in August 2000. Your statement was correct on the two factors used to calculate sensitivity of each intake is length (L) of the intake pipeline and depth (D) of the intake structure. Sensitivity equals $L \times D$ as a unit less value. Sensitivity < 25k has a CAZ radius of 3000 feet, 25k – 125k with radius of 2000 feet, and >125k a radius of 1,000 feet. The other factors you mentioned contributing to the CAZ, as well potential contaminant sources, discharges, and water quality are taken into consideration with the Sensitivity analysis to determine an overall Susceptibility of the intake.

The connecting channel intakes (approx. 14) from roughly Port Huron to Wyandotte also utilized a flow model analysis of the St. Clair – Detroit River Waterway. This program included MDEQ, USGS, USACE, USEPA, and DWSD. This helped to identify concerns in contaminant tracking and develop contingency plans.

The inland river intakes (approx. 8) were watershed based assessments. In addition to the CAZ based on a Sensitivity analysis, these assessments identified buffers in the watershed upstream of the intake. These 300-foot buffers or susceptible areas were created along the shoreline of all drainages upstream of the intake. These were additional areas to identify potential risks or contaminant sources.

I attached an example of a watershed based assessment for Blissfield. More source water assessment program information is available on our website at:

http://www.michigan.gov/deq/0,4561,7-135-3313_3675_3693---,00.html

Also, we should meet to follow up on our water quality standards comparisons for our programs and proceed with the integration toolkit. I will be in Lansing tomorrow and again on February 18th.

Jason Berndt
Environmental Quality Analyst
Office of Drinking Water and Municipal Assistance
Gaylord Field Office
517-284-6513
989-705-3420

From: Goodwin, Kevin (DEQ)
Sent: Tuesday, January 27, 2015 3:08 PM
To: Berndt, Jason (DEQ)
Subject: CAZ description

Hi Jason –

Was going to give you a call this p.m. to discuss some CAZ ‘stuff’ – but looks like you’re out of the office. Until we can talk – I wanted to see if the description below (quoted), which is currently in our Assessment Methodology of the Integrated Report, is relevant to inland surface water intakes as well (e.g. Raisin River)? This language is worded relative to Great Lakes/Connecting Channels, but based on the GIS layer we have (which I’m told came from the drinking water program originally) it looks like a similar approach is applied inland perhaps.

“For public water supply intakes that are located in the Great Lakes or connecting channels, a concept of a Critical Assessment Zone (CAZ) around each intake was developed based on a Sensitivity Factor calculated for each intake. The two attributes used to develop the Sensitivity Factor are the water depth above the intake structure and the perpendicular distance from shore or length of the intake pipeline. Other factors such as localized flow patterns, thermal effects, wind effects, lake bottom characteristics, benthic nepheloid layers, etc., may be used to complete the sensitivity analysis. A radius for the CAZ, ranging from 3,000 feet for the most sensitive intakes to 1,000 feet for the least sensitive intakes, is assigned based on the Sensitivity Factor. A shape with this radius is then drawn around the intake to illustrate the CAZ. If the CAZ intersects the shoreline, then the geographic extent of the assessment unit is determined on a case-by-case basis as the most influential 12-digit HUCs that are along the shoreline within the CAZ. For intakes that are located in open waters of the Great Lakes where the CAZ does not intersect the shoreline, the geographic extent of the assessment unit is 1.5 square miles.”

That said, I seem to remember from a Source Water Protection standpoint that anything ‘upstream’ was considered? If so, I’m just trying to wrap my head around how that differs from a CAZ...(and if not, well...I’m wrong, which is likely). It’d be helpful to chat if you have some time in the next day or so. Thanks...

Kevin Goodwin
Senior Aquatic Biologist
Water Resources Division- DEQ
517-284-5552 (ph)
517-241-9003 (fx)

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, May 08, 2015 11:41 AM
To: Prysby, Mike (DEQ)
Subject: RE: CCCP letter to Flint
Attachments: Visit Ltr - April 2015-revised.doc

See attached revisions.

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

From: Prysby, Mike (DEQ)
Sent: Thursday, May 07, 2015 3:02 PM
To: Busch, Stephen (DEQ)
Subject: CCCP letter to Flint

Steve,

Attached is a draft letter for your review to the city of Flint regarding their CCCP.

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

May 7, 2015

Mr. Howard Kroft, Director of Public Works
City Of Flint
1101 South Saginaw Street
Flint, MI 48502

WSSN: 02310

Dear Mr. Kroft:

SUBJECT: Flint Cross Connection Control Program

This letter confirms my site visit on April 29, 2015 with Mr. Glen Thomas, Utilities/Cross Connection Division Inspector for the City of Flint. Mr. Stephen Busch from our office was also present. The purpose of the visit, in part, was to discuss the city's Cross Connection Control Program (CCCP).

The City of Flint has made significant progress in recent years regarding the implementation of the City's approved CCCP. This effort has included identification of accounts, inspection and re-inspection of accounts at the approved frequencies, and ensuring the testing of backflow prevention assemblies in accordance with approved frequencies. However, the City's most recent report of annual CCCP activities for 2014 indicates a significant decrease in these activities below minimum requirements, and this deficiency must be address.

Our office fully recognizes the recent staffing loss of the City's previous plumbing inspector and the importance of these plumbing inspection services in providing public health protection, but these activities should not be borne at the cost of the City's CCCP and the protections it provides. Given the bacterial detections that occurred in the City's water distribution system in August and September 2014, along with customer complaints regarding aesthetic water quality, the need for protection through cross connection control are very evident.

We also realize that implementing a CCCP of for a community water system of this magnitude requires a significant commitment of time and personnel. We encourage the city to review CCCP staffing needs and authorize the workforce necessary to comply with the City's approved CCCP requirements.

Should you require further information, please contact me at the telephone number below; via e-mail at prysbym@michigan.gov; or Department of Environmental Quality, P.O. Box 30242, Lansing, Michigan 48909.

Sincerely,

Michael F. Prysby, P.E.
District Engineer
Office of Drinking Water and

Municipal Assistance
Lansing District Office
(517) 290-8817

mfp/jlr

cc Mr. Glen Thomas
Mr. Stephen Busch, P.E.

CERTIFICATION:

WSSN: 02310

I certify that this water supply has fully complied with the public notification requirements in the Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the administrative rules.

Signature

Title

Date Distributed

Reminder to water supplier: This notice / certification must be sent to the DEQ.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Monday, March 16, 2015 12:16 PM
To: Scherbarth, John (AG)
Subject: RE: CIT FLINT WATER SUPPLY SYSTEM
Attachments: City of Flint VN - MCL TTHM 3-5-15.pdf

John,

Attached is a copy of the Violation Notice and Public Notice Template that was sent to the City of Flint by the DEQ Office of Drinking Water and Municipal Assistance regarding an exceedance of the Maximum Contaminant Level (MCL) standard for Total Trihalomethanes at certain locations within the City's drinking water distribution system.

This violation notice is in response to updated monitoring completed in February 2015, which shows the locational running annual average for two of the City's eight compliance sampling locations continue to exceed MCL standard of 0.080 mg/L. It is however, important to note that all individual compliance sample results collected in February were well below the 0.080 mg/L levels. (The highest was 0.029 mg/L)

The City is continuing to deal with complaints regarding aesthetic issues such as taste, odor, and color.

The next quarterly round of TTHM monitoring is in May. At that point some of the high levels from May of last year will drop out of the annual average compliance calculation, and the City may be able to achieve compliance in May or August if levels remain low.

There are 47 community water supply systems in Genesee County, but the 2 major water systems in Genesee County are the City of Flint and Genesee County. All Community Water Supply systems set their own water rate and fee structure. In the case of most local governments, the rates are adopted by the City Council, Twp. Board, etc. Many private water systems such as Apartment communities or manufactured housing communities don't have water rates, but just obtain funds for their water system through their rent charges.

If you need anything else please let me know.

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

From: Scherbarth, John (AG)
Sent: Monday, March 16, 2015 11:23 AM
To: Busch, Stephen (DEQ)
Subject: CIT FLINT WATER SUPPLY SYSTEM

Who controls the water rates in Flint/Genesee County?

Thanks for providing me an update on the situation involving the Flint water supply system.

John C. Scherbarth

Environment, Natural Resources, and Agriculture Division
Michigan Department of Attorney General
P.O. Box 30755
Lansing, MI 48909

Telephone: 517-373-7540
Fax: 517-241-3473



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



DAN WYANT
DIRECTOR

March 5, 2015

Mr. Brent Wright, Operations Supervisor
City Of Flint - DPW
Flint Water Plant
4500 North Dort Highway
Flint, Michigan 48505

WSSN: 02310

Dear Mr. Wright:

SUBJECT: Violation Notice (VN) – Maximum Contaminant Level for Total
Trihalomethanes (TTHM)
Operational Evaluation – Total Trihalomethanes
1st Quarter 2015 Monitoring Period

The Department of Environmental Quality (DEQ), Office of Drinking Water and Municipal Assistance (ODWMA), records show that the city of Flint (City) is in violation of the Safe Drinking Water Act, 1976 PA 399, as amended (Act 399); R 325.10610, *Maximum contaminant levels for disinfection byproducts (MCLs)*, of the 1979 Administrative Code.

In accordance with R 325.10610, *MCLs*, of the 1979 Administrative Code, the MCL for disinfection byproduct TTHM is 0.080 milligrams per liter (mg/L) as a Locational Running Annual Average (LRAA) at each monitoring location. As listed in the table below, our records show that the City's highest TTHM locational running annual average (LRAA), based on the last four quarters, ending February 28, 2015, is 0.105 mg/L which exceeds the standard, and that two of the eight sample site locations exceed the standard of 0.080 mg/L.

Further, in accordance with R 325.107191, *Disinfection byproducts: operational evaluation levels*, of the 1979 Administrative Code, when an operational evaluation level (OEL) at a monitoring location for TTHM exceeds 0.080 mg/L, a supply shall conduct an operational evaluation and submit a written report of the evaluation to the DEQ not later than 90 days after being notified of the analytical result that causes the supply to exceed the operational evaluation level. As listed in the table below, our records show that the TTHM OELs for the City exceed 0.080 mg/L at one of the City's eight sample site locations.

Mr. Brent Wright

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March 5, 2015

TTHM Results (mg/L)						
	5/21/14	8/21/14	11/20/14	2/17/15	LRAA	OEL
DBP1 McDonalds 3719 Davison	0.162	0.145	0.059	0.0162	0.096	0.059
DBP2 Liquor Palace 3302 S. Dort Highway	0.112	0.127	0.033	0.0168	0.072	0.049
DBP3 North Flint Auto 6204 N. Saginaw St.	0.097	0.118	0.041	0.0149	0.068	0.047
DBP4 University Market 2501 Flushing Road	0.106	0.196	0.094	0.0245	0.105	0.085
DBP5 Taco Bell 3606 Corunna Road	0.079	0.181	0.034	0.0151	0.078	0.063
DBP6 Rite-Aid Pharmacy 5018 Clio Road	0.088	0.144	0.054	0.0192	0.076	0.059
DBP7 Salem Housing 3216 MLK Boulevard	0.082	0.112	0.050	0.0285	0.068	0.055
DBP8 BP Gas Station 822 S. Dort Highway	0.075	0.112	0.036	0.0199	0.061	0.047

Our investigation consisted of a review of ODWMA files for laboratory reports received for compliance monitoring. Our investigation is considered complete. This violation began on March 1, 2015, and will continue until TTHM LRAA is below the MCL at all sample sites.

We are encouraged by the results from the most recent round of compliance samples collected on February 17, 2015, which now show individual TTHM levels at less than half of the 0.080 mg/L standard at all locations throughout the City's system. Operational Evaluation Reports from December 2014, and February 2015, have identified possible causes and corrective measures for the previous elevated TTHM levels which we encourage the City to continue implementing. These modifications have likely contributed in part to the reduction in TTHM levels reported in the most recent quarter, and suggest the City may be able to achieve compliance with the TTHM standard at all sites by continuing these efforts.

Our office is currently reviewing the Operational Evaluation Report dated February 27, 2015, and will provide the City and their consultant with comments, as needed, to help address this MCL violation.

Water systems that exceed the OEL must complete and submit an Operational Evaluation in accordance with Administrative Rule 719I (R 325.10719I) within 90 days of being notified of the violation. **An updated Operational Evaluation report, which incorporates the most recent sample results, must now be completed and received by our office by no later than Friday, May 29, 2015.**

If you have any other factual information you would like us to consider regarding the violation identified in this VN, please provide them in a written response by March 19, 2015.

Mr. Brent Wright

3

March 5, 2015

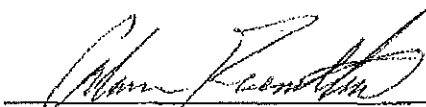
Administrative rule R 325.10403 of Act 399 requires that suppliers provide public notice (PN) as soon as practical, but no later than thirty (30) days after the supplier learns of this type of violation, by mail or direct delivery and by any other means reasonably calculated to reach customers not normally reached by mail. Enclosed is a sample PN which contains the minimum required language. The City is encouraged to include additional information regarding its response efforts to this violation. **Please notify your consumers by April 1, 2015, and send us a signed and dated copy of the notice that you issued within ten (10) days of distributing the public notice.** This violation must also be included in your 2015 Consumer Confidence Report, due by July 1, 2016. The PN must be repeated every quarter until you no longer exceed the TTHM standard. Failure to issue a PN for this violation will result in a fine of at least \$1,000 per event, with a maximum of \$5,000 per violation.

We anticipate and appreciate your continued cooperation in resolving this matter. If you have any questions regarding this VN, please contact us at the numbers below; at prysbym@michigan.gov; or rosenthala@michigan.gov; or at DEQ, P.O. Box 30242, Lansing, Michigan 48909-7742.

Sincerely,



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



Adam Rosenthal, Environmental Quality
Analyst
Lansing District Office
Office of Drinking Water and Municipal
Assistance
517-284-6644

Enclosure

cc: Ms. Jennifer Crooks, U.S. Environmental Protection Agency, Region 5
Mr. Jerry Ambrose, Emergency Manager, City of Flint
Mr. Robert Bincsik, City of Flint
Mr. Howard Croft, City of Flint
Mr. Daughtry Johnson, City of Flint
Genesee County Health Department
Ms. Liane Shekter Smith, DEQ
Mr. Richard Benzie, DEQ
Mr. Stephen Busch, DEQ

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

City of Flint Did Not Meet Treatment Requirements

Our water system recently violated a drinking water standard. Although this incident was not an emergency, as our customers, you have a right to know what happened and what we are doing to correct this situation.

We routinely monitor for the presence of drinking water contaminants. Samples were collected for total trihalomethanes (TTHM) analysis from eight locations on a quarterly basis (May 21, August 21, November 20 of 2014, and February 17, 2015). The average of the results at ANY of the eight locations must not exceed the maximum contaminant level (MCL) for TTHMs, otherwise our water system exceeds the MCL. The standard for TTHMs is 80 micro grams per liter ($\mu\text{g/L}$). The location reporting the highest TTHM level was 105 $\mu\text{g/L}$; thus, our water system exceeds the TTHM MCL.

What should I do?

- There is nothing you need to do unless you have a severely compromised immune system, have an infant, or are elderly. These people may be at increased risk and should seek advice about drinking water from their health care providers.
- You do not need to boil your water or take other corrective actions. If a situation arises where the water is no longer safe to drink, you will be notified within 24 hours.

What does this mean?

This is not an emergency. If it had been an emergency, you would have been notified within 24 hours.

People who drink water containing trihalomethanes in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous system, and may have an increased risk of getting cancer.

What is being done?

We are currently working on solutions to correct the problem. We anticipate resolving the problem in 2015. Our most recent individual sample results were all less than half the 80 $\mu\text{g/L}$ standard, however since compliance is calculated using a locational running annual average (LRAA) of the most recent four quarters, we are still out of compliance with the MCL at two of eight locations.

For more information, please contact Mr. Brent Wright at 517-787-6537, or the Flint Water Plant at 4500 North Dort Highway, Flint, Michigan 48505.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by the City of Flint.

CERTIFICATION:

WSSN: 02310

I certify that this water supply has fully complied with the public notification requirements in the Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the administrative rules.

Signature	Title	Date Distributed
Reminder to water supplier: This notice/certification must be sent to the Department of Environmental Quality.		

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, September 09, 2014 3:17 PM
To: 'Crooks, Jennifer'; Prysby, Mike (DEQ)
Cc: Poy, Thomas; Benzie, Richard (DEQ)
Subject: RE: Citizen complaint call from man who lives in Flint, MI

Jennifer

All of the sample results today were non-detect so the boil water advisory has been lifted. In addition chlorine residuals are beginning to show improvement in the area.

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

From: Crooks, Jennifer [<mailto:crooks.jennifer@epa.gov>]
Sent: Tuesday, September 09, 2014 11:03 AM
To: Busch, Stephen (DEQ); Prysby, Mike (DEQ)
Cc: Poy, Thomas; Benzie, Richard (DEQ)
Subject: RE: Citizen complaint call from man who lives in Flint, MI

Thank you, Steve, for your prompt response. We appreciate your update in locating the source of contamination, and the results of your ongoing TC sampling. Please let us know when you lift the BWA—when you get a minute—we know you've got your hands full; we've been keeping our management informed.

Jennifer

From: Busch, Stephen (DEQ) [<mailto:BUSCHS@michigan.gov>]
Sent: Tuesday, September 09, 2014 9:19 AM
To: Crooks, Jennifer; Prysby, Mike (DEQ)
Cc: Poy, Thomas; Benzie, Richard (DEQ)
Subject: RE: Citizen complaint call from man who lives in Flint, MI

Jennifer,

The City has found two transmission valves that were closed (36 inch and 24 inch) which transport water to that section of the system. This likely contributed to more stagnant water conditions and lower chlorine residuals in that area. The 36 inch valve has been opened but the 24 inch is inoperable and will need to be repaired or replaced.

Given these valve issues, I have inquired whether low pressure conditions less than 35 psi, would be present in this portion of the system? If low pressure conditions exist, a cross connection or siphon condition where leaks or breaks are present may be occurring. While longer transmission times may contribute to lower chlorine residual, the presence of coliform bacteria suggests contaminants have entered the system and their regrowth and resurgence could be assisted by the presence of a biofilm or tuberculation on the pipe walls.

They are continuing to investigate to identify and address any such issues.

All 6 samples collected Saturday came back ND on Sunday, but we had 1 of 6 sites come back TC positive yesterday (collected Sunday) and they collected the normal full distribution set (10+1 samples) Monday which we expect results early this afternoon. If all results are ND today the BWA could be lifted.

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

From: Crooks, Jennifer [<mailto:crooks.jennifer@epa.gov>]
Sent: Tuesday, September 09, 2014 10:00 AM
To: Prysby, Mike (DEQ); Busch, Stephen (DEQ)
Cc: Poy, Thomas; Benzie, Richard (DEQ)
Subject: Citizen complaint call from man who lives in Flint, MI

Hi, Steve and Mike. We heard about the boil water advisory for Flint for 9/3 last week. Tom Poy also had several calls from Lathan Jefferson yesterday, re-iterating his past calls/claims that the Flint water is unfit to drink.

Any update as to the source of positive bacti? I heard no E.coli, which is good.

Thank you for your time

From: Murphy, Thomas
Sent: Monday, September 08, 2014 1:48 PM
To: Poy, Thomas
Cc: Shoven, Heather; Crooks, Jennifer
Subject: Citizen complaint call from man who lives in Flint, MI

I checked Flint's website and found the attached 9/3/2014 Boil Water Notice (affected area expanded on 9/5/2014) for an apparent monthly total coliform bacteria MCL violation.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, September 09, 2014 10:19 AM
To: 'Crooks, Jennifer'; Prysby, Mike (DEQ)
Cc: Poy, Thomas; Benzie, Richard (DEQ)
Subject: RE: Citizen complaint call from man who lives in Flint, MI

Jennifer,

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

From: Crooks, Jennifer [<mailto:crooks.jennifer@epa.gov>]
Sent: Tuesday, September 09, 2014 10:00 AM
To: Prysby, Mike (DEQ); Busch, Stephen (DEQ)
Cc: Poy, Thomas; Benzie, Richard (DEQ)
Subject: Citizen complaint call from man who lives in Flint, MI

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Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, February 07, 2013 4:16 PM
To: Benzie, Richard (DEQ); Cook, Pat (DEQ); Prysby, Mike (DEQ)
Subject: RE: City of Flint emergency services contractor

Mike,

I didn't review the RFP, but the contractor should have to demonstrate some long term history of doing this type of work and having some other municipal references. (No good ol' boys club, or brothers-cousins-boyfriends contractors)

The City may also want to do a comparison of what their internal costs would be for the work. (I'm sure the DPW union will already be requesting this)

I am also in agreement with the responses from Pat and Richard.

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

From: Benzie, Richard (DEQ)
Sent: Thursday, February 07, 2013 3:57 PM
To: Cook, Pat (DEQ); Prysby, Mike (DEQ)
Cc: Busch, Stephen (DEQ)
Subject: RE: City of Flint emergency services contractor

I pretty much agree with Pat except I would expect that the OIC for a distribution system would be providing oversight for the repair/maintenance crews even if they are "contract employees." That may not necessarily mean he's standing over the ditch in every case, but he should be there for major jobs and there should be periodic reviews of procedures and protocols that are being followed in the field. And he is certainly there to answer any questions or deal with unusual circumstances. I would also say that you could make that a point of emphasis in your discussions with the city about contractual services. Either the contractor should have an S-1 operator or they agree to follow city spec's and be subject to unannounced onsite inspections.

From: Cook, Pat (DEQ)
Sent: Thursday, February 07, 2013 2:00 PM
To: Prysby, Mike (DEQ)
Cc: Busch, Stephen (DEQ); Benzie, Richard (DEQ)
Subject: RE: City of Flint emergency services contractor

Hi Mike,

I'm not aware of any large water supplies like Flint that contract with outside companies for main/hydrant repairs and shut-off services. However, you may wish to post this question on the Team Room page to see if any other engineers have experience in this type of arrangement.

I think you raise some valid concerns about outside parties being able to repair breaks, especially about the testing (flushing, disinfection, sampling, etc.) that may be necessary after a main repair. As you know, it's not a one-size fits-all protocol and greatly depends on if the main was repaired under pressure or no pressure.

I don't think we can require the contractors to have licensed operators since the Operator Cert rules of Act 399 only require the OIC and designated backup to be licensed. DWSD has several crews that their only job is to find and repair main leaks/breaks. I'm not 100% sure, but I bet that very few if any of those guys have distro licenses and it's highly unlikely that the OIC is providing oversight on each job.

I think we can raise the question to Flint about providing oversight by a city employee/licensed operator when the outside contractor is on site to see what they say, but my guess is that they are going to balk since that will cost them staff time and money.

pat

From: Prysby, Mike (DEQ)
Sent: Wednesday, February 06, 2013 4:22 PM
To: Cook, Pat (DEQ); Benzie, Richard (DEQ); Busch, Stephen (DEQ)
Subject: FW: City of Flint emergency services contractor

I am a bit concerned about the city of Flint considering the idea of privatizing water distribution system repairs. I am not aware of other communities that utilize outside contractors on the scale of systems like Flint. I have a few very small rural communities (ie village of Metamora) who contract with a company (United Water in Metamora's case) to operate and maintain the water system. United Water provides certified contractors. These independent contractors may have some limited ability to conduct emergency repairs but it has been my experience that they contract out watermain repairs. The contract operator's role is to oversee the work to insure that proper procedures are followed (isolation, flushing, disinfection, sampling, notification, etc.).

Back to Flint.....my first take is that any outside vendor who will be conducting emergency services such as repairing broken mains and appurtenances should hold some level of water distribution certification. Although requiring them to hold an S-1 license may be asking too much.....some level of certification makes it more likely that contractor is aware of the proper procedures and the need to protect public health.

Other items:

- Require oversight of repairs by certified Flint water utility operator
- Security issues – vendor must constantly have access to as-built plans, general plan, access to Water Service Center
- Conformance to Flint standard specs – again verified by proper oversight
- Changes the city's focus trying to re-establish a "well-operated" water utility

If you are aware of other utilities of this scale that privatize emergency repairs, please share that with me. Also, if there are other items or concerns that this could raise, feel free to add them. Thanks.

Michael Prysby, P.E.
District Engineer
Office of Drinking Water and Municipal Assistance
517 335-6122

From: Daugherty Johnson [<mailto:djohnson@cityofflint.com>]
Sent: Wednesday, February 06, 2013 1:50 PM
To: Prysby, Mike (DEQ)
Subject: City of Flint emergency services contractor

Hello Mike. I have been directed to develop an RFP to have outside vendors under contract with the City for emergency services. The work could include anything from residential emergency turn offs to Main break repairs. Among the questions I have is what standards or qualifications would the State require of vendors? Also, how do other communities ensure adherence to State drinking water standards when vendors are performing the services. I have attached a general scope of services we intend to put out for bid. Your input would be greatly appreciated. Give me a call when you get a chance (810) 577-8906 or email your thoughts.

Thanks
Daugherty 'Duffy' Johnson
Utilities Administrator

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, March 11, 2015 9:19 AM
To: Prysby, Mike (DEQ)
Subject: RE: City of Flint February 2015 MOR

I assume you are referring to the one confluence sample above 0.3 NTU. It would be a good idea to verify with the City their filter operation protocols. If they had the ability to filter to waste or move the filter(s) directly into backwash prior to hitting 0.3 that would have been preferable. It also be worth looking at the trending data for each filter to see if it was across the board or a particular filter and at what point it was at in the filter run cycle.

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

From: Prysby, Mike (DEQ)
Sent: Tuesday, March 10, 2015 1:47 PM
To: Busch, Stephen (DEQ)
Subject: FW: City of Flint February 2015 MOR

Steve,

The cold water and high flows challenged the city's ability to maintain acceptable treatment. Although they met standards according to our rules, the high treatment rate later in the month and low water temp did have some impact.

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

From: Michael Glasgow [<mailto:mglasgow@cityofflint.com>]
Sent: Tuesday, March 10, 2015 9:46 AM
To: Prysby, Mike (DEQ)
Subject: City of Flint February 2015 MOR

Mike,

Good morning, I just wanted to get you a copy of the February MOR. A copy will go out in the mail today.

Mike Glasgow
 City of Flint Water Plant

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, July 11, 2014 12:01 PM
To: Prysby, Mike (DEQ); Rosenthal, Adam (DEQ)
Subject: RE: City of Flint June 2014 MOR

Let's try and troubleshoot distribution system operational modification recommendations on Monday. The treatment seems to be good. They are getting total chlorine residual in all distribution samples.

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

From: Prysby, Mike (DEQ)
Sent: Friday, July 11, 2014 11:42 AM
To: Rosenthal, Adam (DEQ)
Cc: Busch, Stephen (DEQ)
Subject: FW: City of Flint June 2014 MOR

Adam,

Here's Flint's June 2014 MOR...as we discussed, the distribution system CL2 residual problem has worsened not to mention 2 positives (from their reservoirs). I will confirm with Brent as to whether they installed chlorination at the Westside/Cedar St. PSs for SDWIS update as he indicated in my most recent site visit.

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

From: Michael Glasgow [<mailto:mglasgow@cityofflint.com>]
Sent: Thursday, July 10, 2014 3:11 PM
To: Prysby, Mike (DEQ)
Subject: City of Flint June 2014 MOR

Mike,

Good afternoon, I hope you had an enjoyable holiday weekend. Attached is a copy of our June 2014 MOR. There were a few alterations as per our discussion in early June. A copy is being sent out in the mail today. I just thought you might like a copy a few days before it arrives in the mail.

Mike Glasgow
 City of Flint Water Plant

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, December 20, 2013 11:49 AM
To: Bean, Lawrence (DEQ)
Cc: Prysby, Mike (DEQ); Craig, John (DEQ)
Subject: Re: City of Flint- Request from Mike Robinson

At this time flint has contracted an engineering firm and they are working on a redesign-reconstruction of the facility. There is no ODWMA order related to the facility at this time. We will be able to tell you more once we get the preliminary designs

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

Sent from my iPhone

On Dec 20, 2013, at 11:38 AM, "Bean, Lawrence (DEQ)" <BEANL@michigan.gov> wrote:

Hi Steve and Mike

Can you describe the Part 115 solid waste compliance issue at the City of Flint water treatment plant? John Craig from our Enforcement Section was copied on the notes but was not supplied with specific information related at any waste issues. Is this related to residual from the lagoon? Do you need assistance from the OWMRP? If you develop an order and need language for any Part 115 violations then we can help with that.

Larry Bean
 Jackson & Lansing District Supervisor
 Office of Waste Management and Radiological Protection
 Michigan Department of Environmental Quality
 Phone 517-416-4375
BEANL@michigan.gov

From: Craig, John (DEQ)
Sent: Friday, December 20, 2013 10:58 AM
To: Bean, Lawrence (DEQ)
Cc: Lee, Lonnie (DEQ)
Subject: FW: City of Flint- Request from Mike Robinson

Larry, Are you aware of the Part 115 compliance issue? John

John Craig, Chief,
 Enforcement Section* | Office of Waste Management and Radiological Protection | Department of Environmental Quality |
 Constitution Hall – Lansing
 ☎ Phone: 517-284-6546 | 📠 Facsimile 517-373-4797
** Supporting the Office of Drinking Water and Municipal Assistance | Office of Oil, Gas, and Minerals | Office of Waste Management and Radiological Protection*

From: Maul, Sue (DEQ)
Sent: Friday, December 20, 2013 9:53 AM
To: Shekter Smith, Liane (DEQ); Busch, Stephen (DEQ)
Cc: Benzie, Richard (DEQ); Craig, John (DEQ)
Subject: RE: City of Flint- Request from Mike Robinson

I am not aware of any drinking water enforcement issues with the City of Flint. It would seem a Consent Order would be more appropriate in this case since the City has something to gain. A Director's Order under Section 15 of Act 399 is more for cases when the water supply will not sign a consent order, like Highland Park. I have cc'd John Craig since possible Part 115 violations are mentioned below.

Sue Maul
 Office of Drinking Water and Municipal Assistance
 Office of Oil, Gas, and Minerals
 Department of Environmental Quality
 517-284-6536
 Fax: 517-241-1328
mauls@michigan.gov

From: Shekter Smith, Liane (DEQ)
Sent: Friday, December 20, 2013 9:09 AM
To: Busch, Stephen (DEQ)
Cc: Benzie, Richard (DEQ); Maul, Sue (DEQ)
Subject: RE: City of Flint- Request from Mike Robinson

Steve –

Can you help me understand this proposal. Is ODWMA in enforcement over this issue? I'm not seeing the similarity to Three Rivers. With them, an ACO made sense because there were drinking water violations. And if there are violations related to the residual lagoon, shouldn't that be a WRD lead similar to Plainfield Township? What am I missing?

Liane J. Shekter Smith, P.E., Chief
 Office of Drinking Water and Municipal Assistance
 Michigan Department of Environmental Quality

*** Effective August 12, 2013 my new number will be (517) 284-6543*

From: Zacharda, Nicole (DEQ)
Sent: Thursday, December 19, 2013 4:11 PM
To: Creal, William (DEQ)
Cc: Shekter Smith, Liane (DEQ); Busch, Stephen (DEQ); Selden, Barry (DEQ); Vanderlaan, Mary (DEQ); Ruzs, Rick (DEQ)
Subject: City of Flint- Request from Mike Robinson

Good afternoon,

I've just met with Lansing District Staff for WRD and the Drinking Water program. Yesterday I received a call from Mike Robinson (he'd initially contacted Barry) seeking what I'd characterize as a 'sweetheart' ACO intended to ease the City's ability to access bond funding for their possible new water intake from Lake Huron. As a trade of sorts, Mike was suggesting that his client would resolve Part 31 issues at their

water treatment residual lagoon. I told Mike that while I understood the Part 31 angle, this really seems like a Drinking Water program lead. I did provide him with a copy of the City of Three Rivers, SDWA Section 15 Order that I did a few years ago as an example and told Mike I'd be following up with district staff prior to briefing you.

Having met with Steve Busch and others (including Mary Vanderlaan and Rick Rusz), my suspicions have been confirmed and this really does not strike me as our issue in the WRD. In fact, Mr. Robinson and Dept. of Treasury officials have already been communicating with Steve about an Order of some sort in light of Flint's financial situation.

Provided that you & Liane concur, my recommendation at this point is that I check back in with Mike Robinson and suggest that he work through Steve and his staff, with other Divisions (there is also a Part 115 issue) assuring that our concerns are covered behind the scenes through Drinking Water's permit review, which should compel lagoon improvements.

Please let me know if you have any questions,
Nicole

Nicole Zacharda
Enforcement Specialist
MDEQ Water Resources Division
NEW PHONE 517-284-5497
zachardan@michigan.gov

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, April 24, 2015 2:33 PM
To: Johnson, Shannon (DCH)
Cc: prysbym@michigan.gov
Subject: RE: City of Flint water testing results
Attachments: Flint-WaterQualityData-3-2015.pdf

Shannon,

Attached is what I have through March.

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

From: Johnson, Shannon (DCH)
Sent: Thursday, April 23, 2015 4:15 PM
To: Busch, Stephen (DEQ)
Subject: City of Flint water testing results

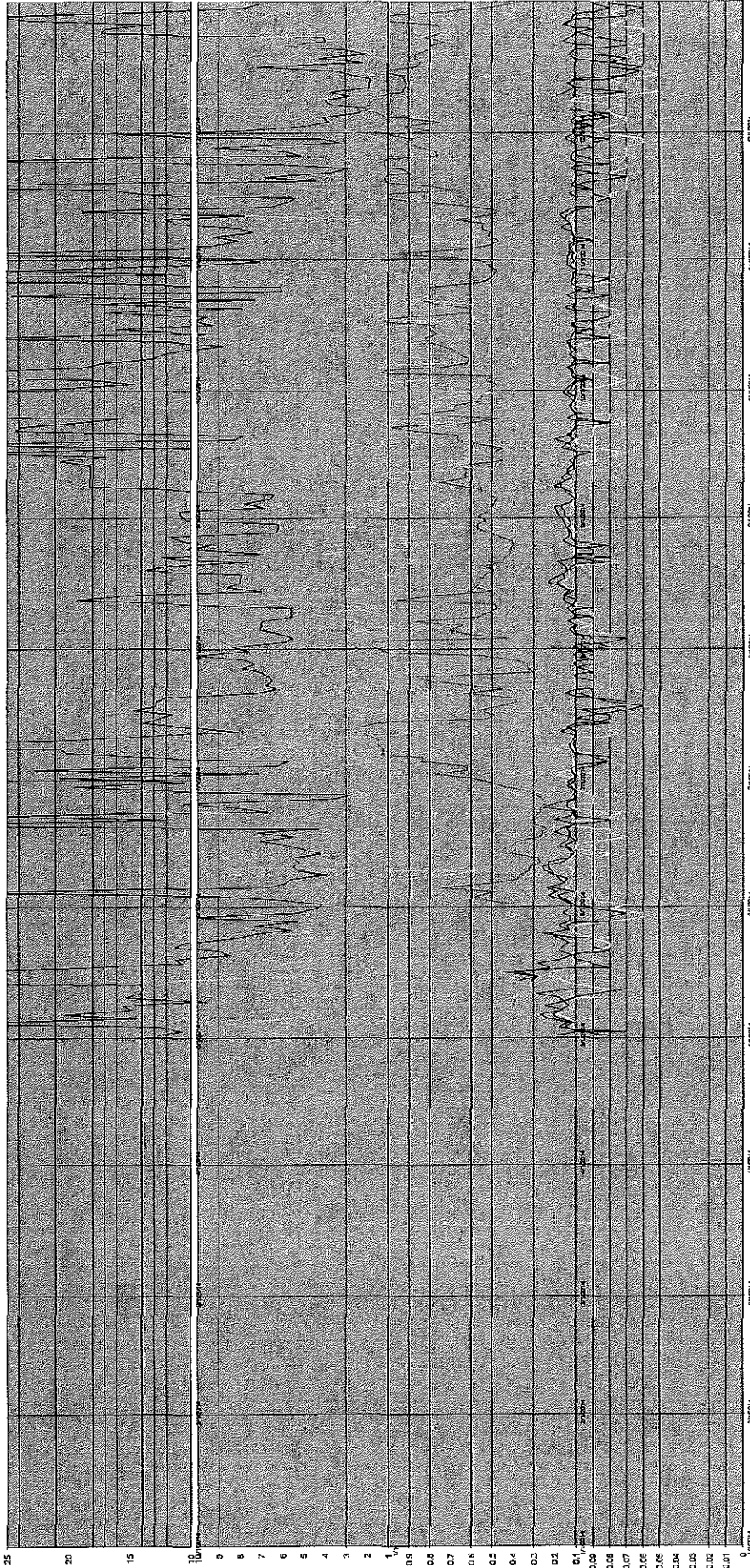
Hi Steve,

You had mentioned in our meeting the other week that you would be able to share the water testing spreadsheet. Would it be possible for us to get a copy of that so we can share it with the Genesee Health Department? I know this was part of the information they were looking for.

Thanks for your help.

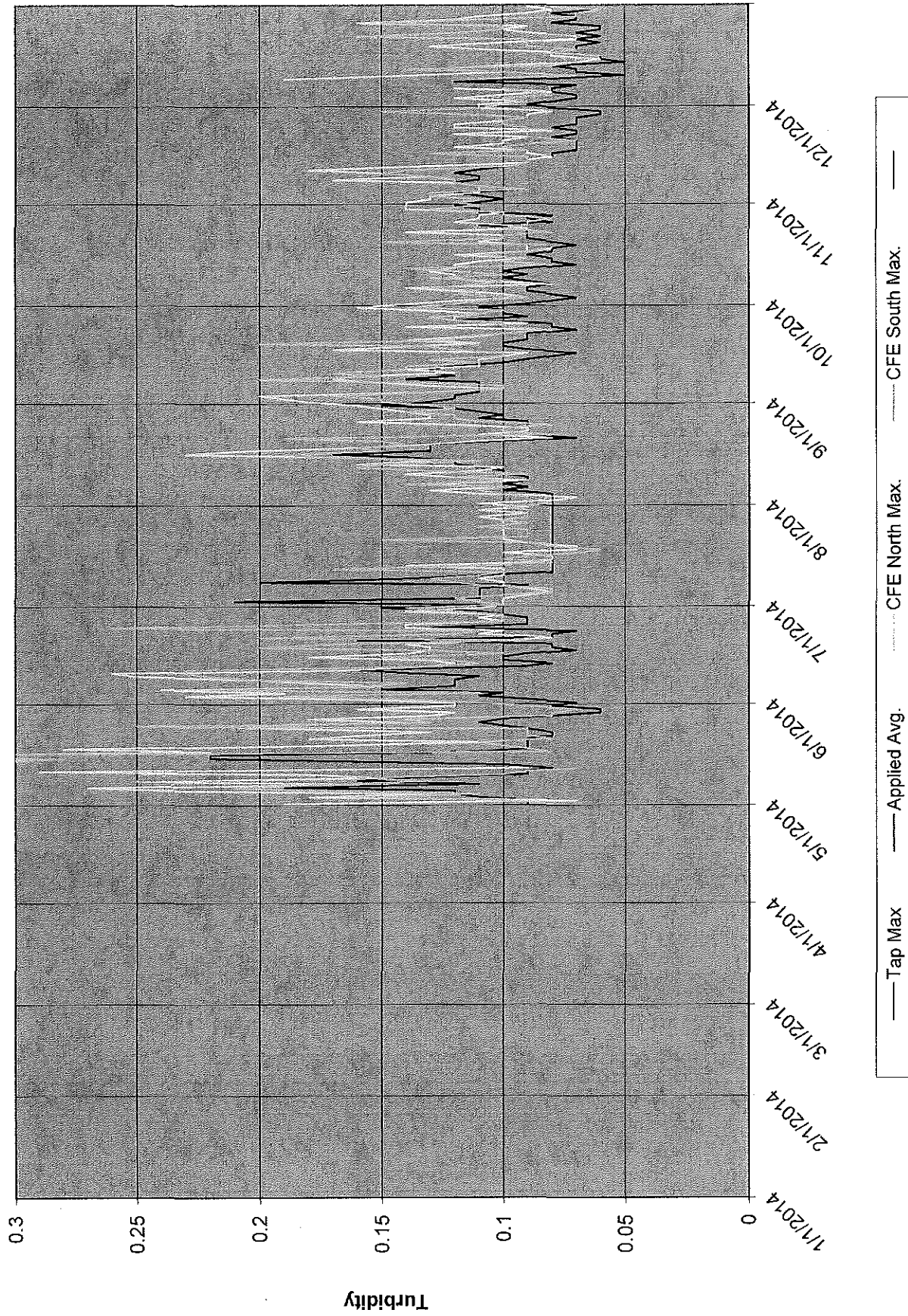
Best,
Shannon Andrews Johnson, MPH
Infectious Disease Epidemiologist
Michigan Dept. of Health and Human Services
201 Townsend St., CVB 5th Floor
Lansing, MI 48913
Phone: 517-335-8165
Fax: 517-335-8263

Flint WTP 2014 Turbidity Comparison

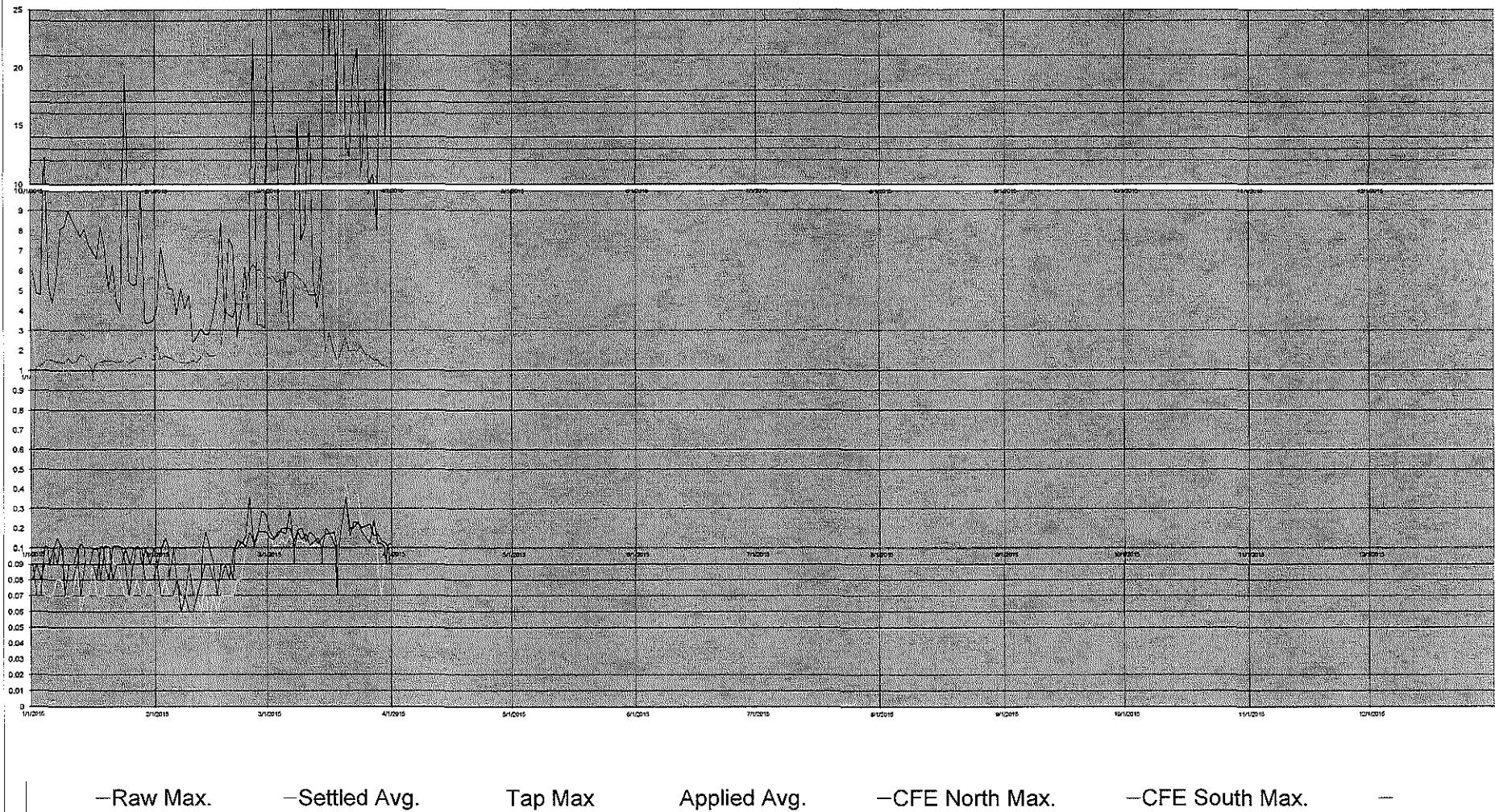


—Raw Max. —Settled Avg. Tap Max Applied Avg. —CFE North Max. —CFE South Max. —

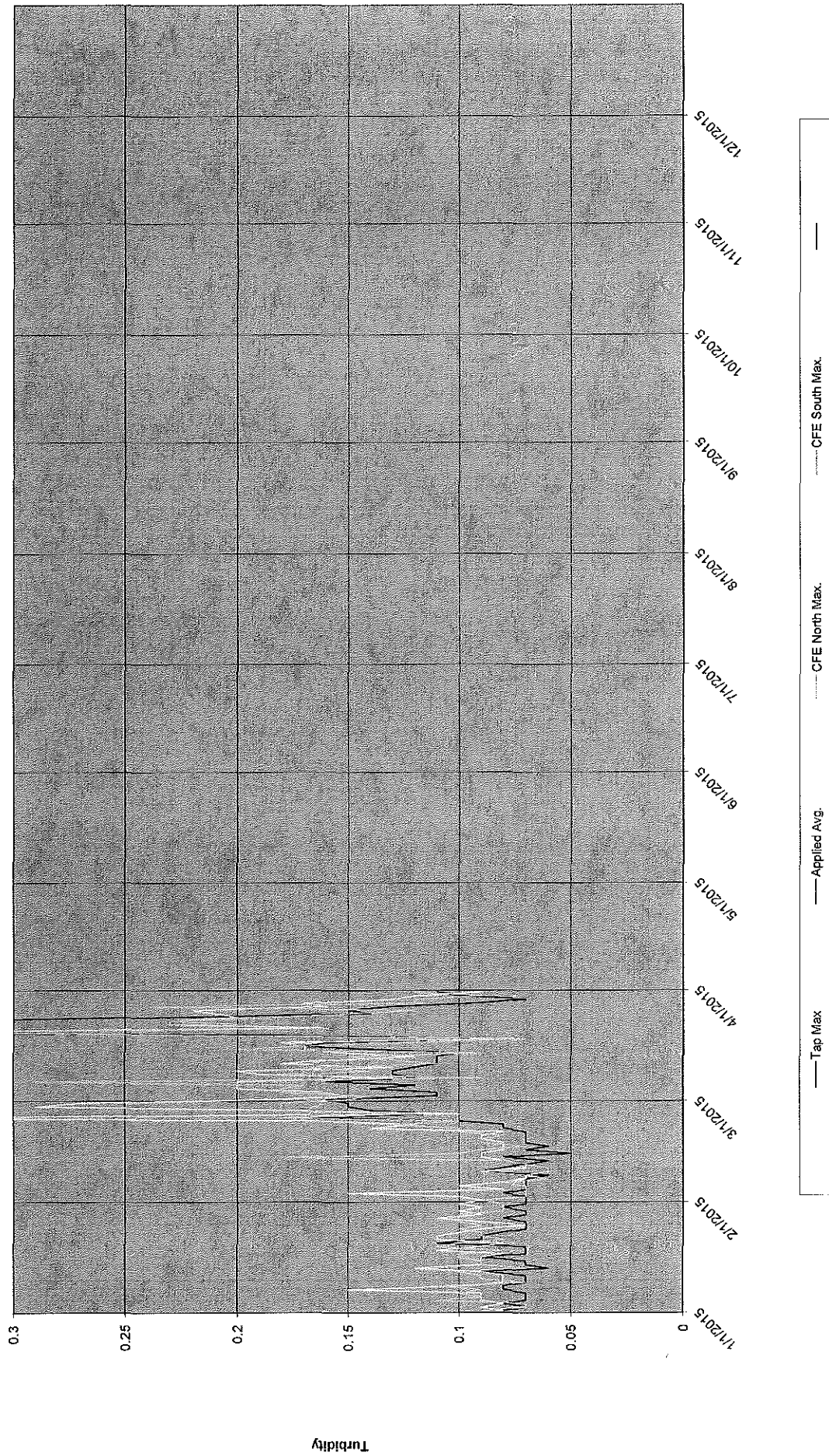
Flint WTP 2014 Finished Water Turbidity



Flint WTP 2015 Turbidity Comparison



Flint WTP 2015 Finished Water Turbidity



2014 Flint WTP Water Quality Data

Raw Water 2014		Hardness (ppm)			Turbidity (NTU)			Color			Alkalinity (ppm)			Total Coliform (Cts/100 mL)			TOC			Nitrate (ppm)			Fluoride (ppm)			TTHM (ppb)			HAA5 (ppb)			pH			HPC		
Days		Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.			
January	31																																				
February	28																																				
March	31																																				
April	30																																				
May	31	254	286	232	12.3	71.7	3.5				207	216	184	2191	16328	126							0.15	0.16	0.14	NS	NS	NS	NS	NS	NS	8.27	8.44	8.05	9170	14760	16.1
June	30	268	280	252	4.55	39.4	1.9				223	232	216	3640	12262	52	9	9	9				0.16	0.18	0.14	NS	NS	NS	NS	NS	NS	8.1	8.34	7.88	4822	12460	960
July	31	249	273	227	8.41	49.5	4.9				205	226	182	9056	48329	1666	8.44	8.44	8.44				0.18	0.22	0.15	NS	NS	NS	NS	NS	NS	8.13	8.51	7.68	7255	14760	1180
August	31	235	248	221	6.23	19.3	4.7				194	200	185	5171	22398	1232	8.48	8.48	8.48				0.19	0.2	0.16	NS	NS	NS	NS	NS	NS	8.09	8.39	7.59	6831	14760	900
September	30	243	251	235	9.13	73.4	5.5				202	209	192	8097	31062	1918	7.36	7.36	7.36				0.19	0.24	0.16	NS	NS	NS	NS	NS	NS	8.13	8.41	7.78	4398	14760	1360
October	31	261	280	249	9.23	48.2	5.7				214	237	202	1979	15402	148	7.38	7.38	7.38				0.21	0.23	0.18	NS	NS	NS	NS	NS	NS	8.25	8.4	7.97	2914	14760	200
November	30	301	321	281	6.17	36.3	2.5				240	255	149	1502	19608	20	7.27	7.27	7.27				0.22	0.26	0.18	NS	NS	NS	NS	NS	NS	8.4	8.57	8.16	1467	5140	40
December	31	317	334	289	4.95	25.6	1.6				258	270	232				6.49	6.49	6.49				0.22	0.24	0.19	NS	NS	NS	NS	NS	NS	8.24	8.43	7.99	1670	14760	0
Annual		179	334	221	5.1	73.4	1.6	0.0	0	0	146	270	149	1039	1500	0	8.29	9	6.49	NS	NS	NS	0.13	0.26	0.14	NS	NS	NS	NS	NS	NS	5.50	8.57	7.59	4480.1	14760	0

Treated Water 2014	Hardness (ppm)			Turbidity (NTU)			Color			Alkalinity (ppm)			Total Coliform (Cts/100 mL)			TOC			Nitrate (ppm)			Fluoride (ppm)			TTHM (ppb)			HAA5 (ppb)			pH			HPC		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.			
January																																				
February																																				
March																																				
April																																				
May	206	242	120	0.12	0.45	0.06				113	138	60	0	0	0	3.63	3.63	3.63	0.4	0.4	0.4	0.16	0.34	0.13	100.0	162	75	49.6	64	38	7.37	7.71	7.07	0	2	0
June	205	266	156	0.13	0.26	0.08				108	172	66	0	0	0	3.63	3.63	3.63				0.16	0.45	0.12							7.48	7.81	7	0	0	0
July	169	193	147	0.1	0.21	0.05				62	85	31	0	0	0	2.67	2.67	2.67				0.63	0.88	0.14							7.62	7.94	7.35	0	2	0
August	155	176	139	0.1	0.23	0.06				82	101	50	0	0	0	4.06	4.06	4.06				0.66	0.83	0.53	142.0	196	112	30.9	43	17	7.78	8.09	7.43	0	2	0
September	153	175	120	0.1	0.2	0.07				82	104	51	0	0	0	3.3	3.3	3.3				0.67	0.72	0.57							7.82	8.11	7.44	0	2	0
October	163	197	144	0.11	0.15	0.06				80	107	68	0	0	0	2.98	2.98	2.98	0	0	0	0.67	0.74	0.59							7.71	8.11	7.41	0	0	0
November	175	213	146	0.09	0.18	0.06				88	122	60	0	0	0	3.41	3.41	3.41				0.64	0.76	0.46	50.0	94	33	16.4	24	5	7.87	8.45	7.29	0	2	0
December	192	210	168	0.07	0.19	0.05				88	111.5	60	0	0	0	2.59	2.59	2.59				0.66	0.77	0.58							8.07	8.49	7.41	1	4	0
Annual	119	266	120	0.07	0.45	0.05	0	0	0	59	111.5	31	0	0	0	3.55	4.06	2.59		0.4	0	0.36	0.88	0.12	97.3	196	33	32.3	64	5	5.18	8.49	7	0.08	4	0

2015 Flint WTP Water Quality Data

Raw Water 2015	Days	Hardness (ppm)			Turbidity (NTU)			Color			Alkalinity (ppm)			Total Coliform (Cts/100 mL)			TOC			Nitrate (ppm)			Fluoride (ppm)			TTHM (ppb)			HAA5 (ppb)			pH			HPC		
		Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
January	31	324	344	311	5.17	19.4	2.7				258	272	245	820	2994	40	7.62	7.62	7.62				0.21	0.25	0.19	NS	NS	NS	NS	NS	NS	7.95	8.31	7.59	981	5980	60
February	28	352	366	339	3	22.5	2.1				260	295	228	141	365	41	5.95	5.95	5.95				0.23	0.24	0.21	NS	NS	NS	NS	NS	NS	7.95	8.11	7.75	114	183	62
March	31	290	366	211	8.7	47.2	2.4				233	297	171	8788	48392	98	7.22	7.22	7.22				0.2	0.26	0.14	NS	NS	NS	NS	NS	NS	7.98	8.27	7.55	3155	14760	43
April	30																								NS	NS	NS	NS	NS	NS							
May	31																								NS	NS	NS	NS	NS	NS							
June	30																								NS	NS	NS	NS	NS	NS							
July	31																								NS	NS	NS	NS	NS	NS							
August	31																								NS	NS	NS	NS	NS	NS							
September	30																								NS	NS	NS	NS	NS	NS							
October	31																								NS	NS	NS	NS	NS	NS							
November	30																								NS	NS	NS	NS	NS	NS							
December	31																								NS	NS	NS	NS	NS	NS							
Annual		79	366	211	1.4	47.2	2.1	0.0	0	0	63	297	171	1247	1600	0	1.72	7.62	5.95	NS	NS	NS	0.05	0.26	0.14	NS	NS	NS	NS	NS	NS	1.95	8.31	7.55	0.0	14760	43

Treated Water 2015	Days	Hardness (ppm)			Turbidity (NTU)			Color			Alkalinity (ppm)			Total Coliform (Cts/100 mL)			TOC			Nitrate (ppm)			Fluoride (ppm)			TTHM (ppb)			HAA5 (ppb)			pH			HPC		
		Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
January		189	218	165	0.07	0.15	0.05				73	98	44	0	0	0	3.21	3.21	3.21				0.47	0.7	0.19							7.74	8.24	7.31	2	38	0
February		197	244	168	0.08	0.36	0.05				76	127	47	0	0	0	2.07	2.07	2.07	1.3	1.3	1.3	0.57	0.64	0.48	20	29	15	8.1	9	2	7.84	8.69	7.54	0	0	0
March		208	243	151	0.13	0.42	0.07				104	135	58	0	0	0	2.97	2.97	2.97				0.57	0.66	0.48							7.89	9.9	7.3	0	0	0
April																																					
May																																					
June																																					
July																																					
August																																					
September																																					
October																																					
November																																					
December																																					
Annual		49	244	151	0.02	0.42	0.05	0	0	0	21	135	44	0	0	0	0.68	3.21	2.07	0	1.3	1.3	0.13	0.7	0.19	#DIV/0!	29	15	#DIV/0!	9	2	1.93	9.9	7.3	0.17	38	0

[illegible]

Pro*	Inter
#DIV/0!	#DIV/0!

OVERALL AVG.

Pro ^o	Intor
#DIV/0!	#DIV/0!

MINIMUM RESIDUAL

[illegible]

[illegible]

Average Filter Run (Hours)

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Overall Monthly Avg.
January		76										76.00
February		86										86.00
March		96										96.00
April												#DIV/0!
May	101											101.00
June	74											74.00
July	65											65.00
August	78											78.00
September	97											97.00
October	84											84.00
November	76											76.00
December	74											74.00
Maximum	101	96	0	0	0	0	0	0	0	0	0	
Minimum	65	76	0	0	0	0	0	0	0	0	0	
Average	54.44	21.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

OVERALL AVG.	6.88	0.00	15.13
OVERALL MAX.	101	0	101
OVERALL MIN.	0	0	0

Average Percentage Wash Water Use

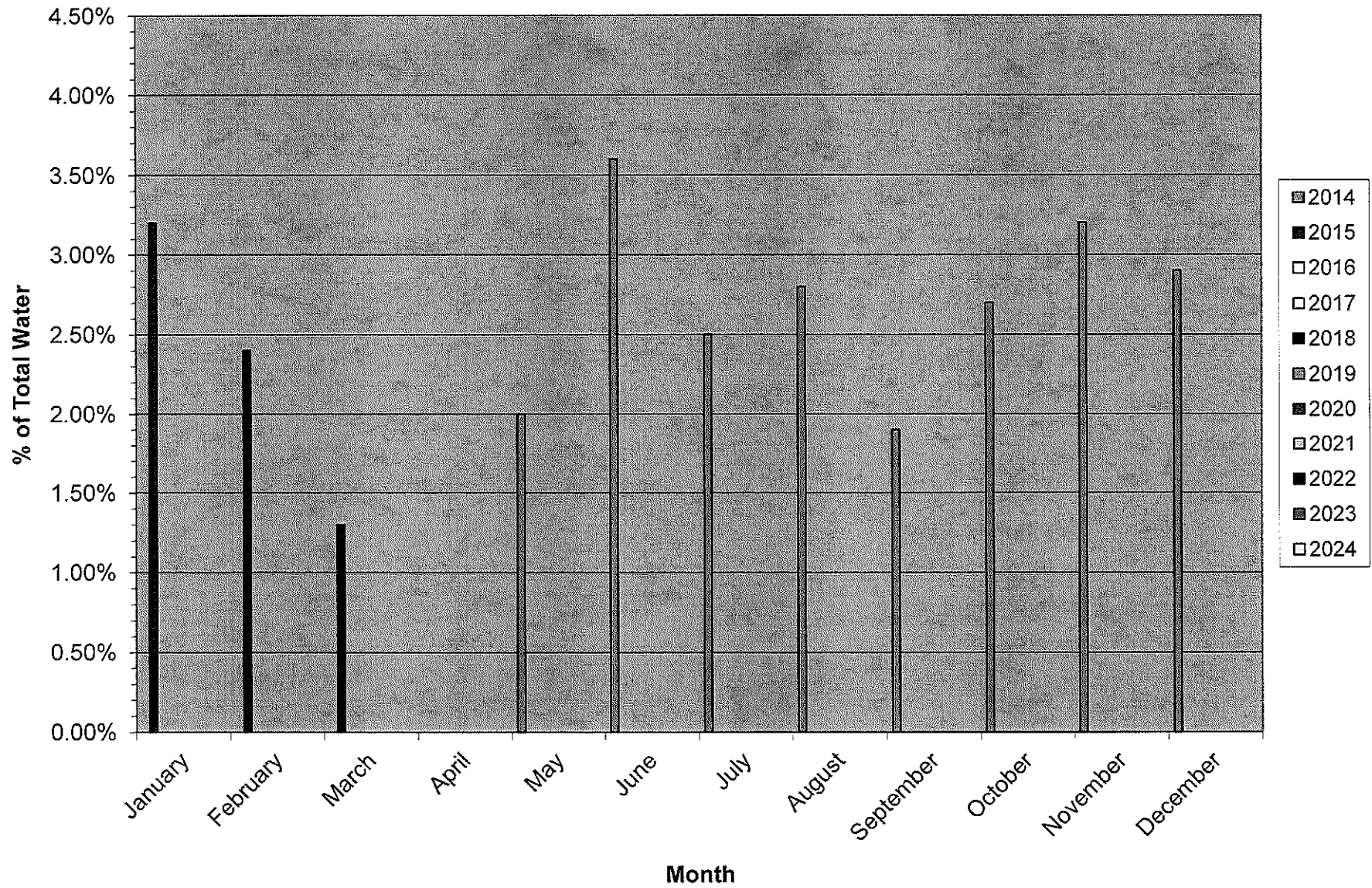
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Overall Monthly Avg.
January		3.20%										3.20%
February		2.40%										2.40%
March		1.30%										1.30%
April												#DIV/0!
May	2.00%											2.00%
June	3.60%											3.60%
July	2.50%											2.50%
August	2.80%											2.80%
September	1.90%											1.90%
October	2.70%											2.70%
November	3.20%											3.20%
December	2.90%											2.90%
Average	1.81%	0.57%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	

OVERALL AVG.	0.22%
	0.48%
	0.00%

Average Filtration Rate Monthly Comparison

Average Filter Run Hours Monthly Comparison

Average Washwater Use Monthly Comparison



Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, January 14, 2015 8:46 AM
To: 'Rennaker, Joanne (DEQ) (RENNAKERJ@michigan.gov)'
Cc: Prysby, Mike (DEQ); Shekter Smith, Liane (DEQ); Howes, Sarah (DEQ)
Subject: RE: City of Flint-2014 Letters sent by DEQ

Importance: High

Jo Anne,

Please work with Mike and provide Sarah with copies of Flint correspondence as requested below. Thanks.

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

From: Howes, Sarah (DEQ)
Sent: Wednesday, January 14, 2015 8:42 AM
To: Busch, Stephen (DEQ)
Cc: Prysby, Mike (DEQ); Shekter Smith, Liane (DEQ)
Subject: RE: City of Flint-2014 Letters sent by DEQ

Yes---Sorry. All formal correspondence that was send on DEQ letterhead.

From: Busch, Stephen (DEQ)
Sent: Wednesday, January 14, 2015 8:41 AM
To: Howes, Sarah (DEQ)
Cc: Prysby, Mike (DEQ); Shekter Smith, Liane (DEQ)
Subject: Re: City of Flint-2014 Letters sent by DEQ

Sarah,

Could you be a little more specific. If you want all correspondence including emails it will be quite a bit and take some time.

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

Sent from my iPhone

On Jan 13, 2015, at 5:10 PM, Howes, Sarah (DEQ) <HowesS1@michigan.gov> wrote:

Mike or Steve,

Could one of you send me copies of all documents that were sent to the City of Flint re drinking water in 2014 as soon as you get a chance?

Thanks,
Sarah

Sarah M. Howes | Legislative Liaison
Department of Environmental Quality
517.284.6707 O | C 517.282.9204

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Wednesday, January 14, 2015 8:41 AM
To: Howes, Sarah (DEQ)
Cc: Prysby, Mike (DEQ); Shekter Smith, Liane (DEQ)
Subject: Re: City of Flint-2014 Letters sent by DEQ

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Lansing and Jackson District Supervisor
Office of Drinking Water and Municipal Assistance
MDEQ
517-643-2314

Sent from my iPhone

On Jan 13, 2015, at 5:10 PM, Howes, Sarah (DEQ) <HowesS1@michigan.gov> wrote:

Mike or Steve,

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Thanks,
Sarah

Sarah M. Howes | Legislative Liaison
Department of Environmental Quality
517.284.6707 O | C 517.282.9204

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Thursday, May 28, 2015 12:13 PM
To: Howes, Sarah (DEQ)
Cc: Benzie, Richard (DEQ); Devereaux, Tracy Jo (DEQ); Shaler, Karen (DEQ); Potter, Jodi (DEQ); Shekter Smith, Liane (DEQ); Prysby, Mike (DEQ); 'Wurfel, Brad (DEQ) (WurfelB@michigan.gov)'; Wyant, Dan (DEQ); Thelen, Mary Beth (DEQ); Sygo, Jim (DEQ); Shaler, Karen (DEQ); Potter, Jodi (DEQ); Pallone, Maggie (DEQ)
Subject: RE: Communications between City of Flint and DEQ
Attachments: Flint-2015-02-13-AnnualMonSched.pdf; Flint-2015-03-05-TTHM-VN-15-1.pdf; Flint-2015-03-30-PbCu90.pdf; Flint-2015-04-03-LT2ESWTR.pdf; Flint-2015-04-03-Permit151018.pdf; Flint-2015-05-06-CCR-reminder.pdf; Flint-2015-05-11-CCCP.pdf; S2 Grant Project No 9204.01 City of Flint.pdf; RE: Premise plumbing; Water Quality Optimization Strategy; call; Flint MORs; Flint River Source Water Assessment; FW: PEAS call; FW: Schematics for LT2 sampling plans; FW: Water Supply Sources; Premise plumbing; RE: City of Flint - March Bromate Results; RE: City of Flint March 2015 MOR; RE: City Water Tech Team; RE: HC Letter & FAQ's; RE: May_Technical Advisory Meeting; RE: PEAS call; RE: RE: Flint Water Age map; RE: TTHM Draft Letter; RE: Water Supply Sources; Residential customers; Watermain breaks; distribution WQPs; January '15 MOR; Lead Copper Cert form; RE: City of Flint Water Plant Monitoring Results; RE: distribution WQPs; RE: distribution WQPs; RE: January '15 MOR

Sarah,

Per the request from Representative Neely, attached are communications from the DEQ Office of Drinking Water and Municipal Assistance (ODWMA) to the City of Flint dating back to February 2015.

This includes:

- 1 construction permit
- 7 letters
- 7 emails from Adam, Rosenthal, Environmental Quality Analyst
- 18 emails from Mike Prysby, District Engineer
- 2 emails from Steve Busch, District Supervisor

Please let us know if we can provide any further assistance in addressing Representative Neely's request or if they have any questions or issues we could help answer.

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

From: Shekter Smith, Liane (DEQ)
Sent: Tuesday, May 26, 2015 1:59 PM
To: Busch, Stephen (DEQ); Prysby, Mike (DEQ)
Cc: Benzie, Richard (DEQ); Devereaux, Tracy Jo (DEQ); Howes, Sarah (DEQ); Shaler, Karen (DEQ); Potter, Jodi (DEQ)
Subject: FW: Communications between City of Flint and DEQ
Importance: High

Note the deadline of COB Thursday to Sarah.

From: Pallone, Maggie (DEQ)
Sent: Tuesday, May 26, 2015 1:21 PM
To: Shekter Smith, Liane (DEQ)
Cc: Wurfel, Brad (DEQ); Wyant, Dan (DEQ); Howes, Sarah (DEQ); Thelen, Mary Beth (DEQ); Sygo, Jim (DEQ); Shaler, Karen (DEQ); DEQ-Legislative-Contact; Potter, Jodi (DEQ)
Subject: Communications between City of Flint and DEQ

Liane,

Rep Neely has requested any communications that DEQ has had with City of Flint between February 2015 and today. Could you please pull that information together and get it to Sarah by COB on Thursday? She will then forward it the Representative's office.

Please let me know if you need any additional details.

Thanks,
Maggie

Maggie Pallone
Director of Legislative Affairs
Department of Environmental Quality
517-599-6190 (cell)
PalloneM@michigan.gov



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



DAN WYANT
DIRECTOR

February 13, 2015

Mr. Brent Wright
City Of Flint - D P W
Flint Water Plant
4500 North Dort Highway
Flint, MI 48505

WSSN: 02310

Dear Mr. Wright:

SUBJECT: Drinking Water Monitoring Schedule – 2015
Annual Reports

Enclosed is your Drinking Water Monitoring Schedule for calendar year 2015 outlining the minimum requirements for your public water supply. Collect samples early in the monitoring period of the year indicated on the schedule. If you use a private laboratory you are required to report the results to us within the first ten days of the month following the month that you received the results. To receive credit for monitoring, the "WSSN" (water supply serial number), the "Site Code," and "County" must appear on the sample result. Bottles will NOT be mailed automatically. If you use the DEQ Laboratory, you can order bottles by calling 517-335-8184. Be certain of the EPA sampling and analysis method requirements for hold times.

The Michigan Safe Drinking Water Act requires certain reports to be submitted to this office each year. Please remember that cross connection reports and annual pumpage reports are due by March 31, and the Consumer Confidence Report is due by July 1.

Also enclosed is the document "2015 Monitoring and Reporting Requirements." This provides additional details about monitoring and reporting requirements. If you have any questions, please contact us by telephone or email using the information below.

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

Adam Rosenthal, EQA
Lansing District Office
Office of Drinking Water and
Municipal Assistance
517-284-6644

MFP:AR:JR

Enclosure
cc/encl: Mr. Mike Glasgow, City Of Flint

2015 Monitoring Schedule

FLINT, CITY OF

WSSN: 02310

Collect samples early in the monitoring period. This schedule reflects your expected routine monitoring and is subject to change. To receive credit for monitoring, include the WSSN, Site Code, and County on your request for analysis form. Collect Bacteriological and Automated Partial Chemistry samples close to the shipping time and send overnight delivery. Send all sample results to your Department of Environmental Quality (DEQ) district office unless you use the DEQ laboratory. Test codes, sample units, and costs are listed to help you complete the DEQ laboratory form. Prices are subject to change without notice. The DEQ laboratory is closed on state holidays.

Location: Plant Tap

Collect these samples at the entry point to the distribution system (after treatment, if applicable.)

Sample Type	# Samples/ Frequency	Collect Before	Site Code	Fee	Unit Number	Test Code
Automated Partial Chemistry	This DEQ lab scan includes nitrate, nitrite, fluoride, and sodium whose monitoring frequency requirements differ from one another. Before requesting analyses from a laboratory other than the DEQ laboratory, check with your DEQ district staff for the specific monitoring requirements.					
	1/3 months	Quarterly	TP001	\$18.00	32	R
Volatile Organic Compounds	1/3 months	Quarterly	TP001	\$100.00	36VO	CXVO
Complete Metals	1/36 months	09/30/2017	TP001	\$102.00	36ME	CMET2
Arsenic	1/3 months	Quarterly	TP001	\$18.00	36ME	CAS
Cyanide	1/3 months	Quarterly	TP001	\$25.00	36CNa	CCN
SOC – Pesticides	1/3 months	Quarterly	TP001	\$125.00	36PT	CXPT
SOC – Herbicides	1/3 months	Quarterly	TP001	\$120.00	36HB	CXHB
SOC – Carbamates	1/3 months	Quarterly	TP001	\$120.00	36LP	CXLP
Bromate	1/1 months	Monthly	TP001	Not performed at the DEQ Laboratory. A list of certified labs is at www.michigan.gov/DEQ . Select Water, Drinking Water, Community Water Supply, then Certified Labs under Programs and Activities.		
Gross Alpha (Radiological)	1/3 months	Quarterly	TP001			
Radium 226 & Radium 228	1/3 months	Quarterly	TP001			
Water Quality Parameters	25/3 months	Quarterly	TP001	Various	Various	Various
Total Organic Carbon (TOC)	Pair/Monthly	Monthly	TP001	\$35.00	36TO	CTOC
	Monitor for TOC in the source water before any treatment at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as "paired samples." Collect the treated water sample not later than the point of combined filter effluent turbidity monitoring and representative of treated water.					
Expanded SOCs						
Dalapon & Haloacetic Acids	1/12 months	Between 04/01 and 09/30/2015	TP001	\$130.00	36HA	CXHA
Diquate	1/12 months	Between 04/01 and 09/30/2015	TP001	\$150.00	36DQ	CXDQ
Endothall	1/12 months	Between 04/01 and 09/30/2015	TP001	\$150.00	36EN	CXEN
EDB & DBCP	1/12 months	Between 04/01 and 09/30/2015	TP001	\$70.00	36VO	CXEV

2015 Monitoring Schedule

FLINT, CITY OF
WSSN: 02310

Collect samples early in the monitoring period. This schedule reflects your expected routine monitoring and is subject to change. To receive credit for monitoring, include the WSSN, Site Code, and County on your request for analysis form. Collect Bacteriological and Automated Partial Chemistry samples close to the shipping time and send overnight delivery. Send all sample results to your Department of Environmental Quality (DEQ) district office unless you use the DEQ laboratory. Test codes, sample units, and costs are listed to help you complete the DEQ laboratory form. Prices are subject to change without notice. The DEQ laboratory is closed on state holidays.

Location: Distribution System

Sample Type	Collect Samples According to the	# Samples/Frequency	Collect	Site Code	Fee	Unit Number	Test Code
Bacteriological – coliforms	TCR Sampling Site Plan	100/Monthly	Monthly	DIST	\$16.00	30	BPTC
Chlorine Residual	DBP Monitoring Plan	If serving chlorinated water, measure the residual disinfectant level at the same point and at the same time as the bacteriological sample and report the average to the DEQ.					
Total Trihalomethanes	DBP Monitoring Plan	8/3 months	During February, May, August and November 2015	See DBP Monitoring Plan	\$65.00	36VO	CXTM
Haloacetic Acids		8/3 months	During February, May, August and November 2015	See DBP Monitoring Plan	\$130.00	36HA	CXHA
Water Quality Parameters	Representative Sites	25/Quarterly	Quarterly	DIST	Various	Various	Various
Lead Copper for Corrosion Control	Lead and Copper Sampling Pool	100/6 months	Between 1/1 and 6/30/2015	DIST	\$26.00	36CC	CCUB

Community Water Supply 2015 Monitoring and Reporting Requirements

Please Monitor Early: Collect samples early in the monitoring period (month, quarter, year) of the year indicated on the schedule. Bacteriological and partial chemistry samples should be collected close to the shipping time and sent overnight delivery to assure sample holding times are not exceeded (30 and 48 hour hold times respectively). We also recommend avoiding mailing bacteriological samples immediately preceding or following a holiday because samples tend to exceed the 30 hour hold time. When this occurs, a repeat sample must be collected as soon as possible upon notification.

If you use a private laboratory please report the results to us within the first ten days of the month following the month that you received the results. A list of certified laboratories is available on request. If samples are not collected as indicated on your monitoring schedule, you will incur a monitoring violation and possibly a fine. For information on the fines policy, visit <http://michigan.gov/deqwater>. Click on Drinking Water, Community Water Supply, and Administrative Fines (under Laws and Rules).

To receive credit for monitoring, you must include the "WSSN" (water supply serial number), the "Site Code," and the "County" when you submit samples for analysis. Site codes are listed on your monitoring schedule.

Special Instructions If You Use The DEQ Laboratory: Bottles will NOT be mailed automatically. To order bottles, call the DEQ Laboratory at 517-335-8184 or download the form EQP 2301 *Requisition for Water Sample Units* from www.michigan.gov/deq. Click on Key Topics, Laboratory Services, Drinking Water, Obtaining The Necessary Sampling Units, and 'test list'. Please note that the DEQ laboratory is closed on most state holidays. The DEQ laboratory prices are subject to change without notice.

Special Instructions For Automated Partial Chemistry, VOC and TTHM Samples: These sample bottles must be cooled and preserved during shipment to the laboratory. If you use the DEQ laboratory, you will receive the ice pack, acid dropper (if necessary) and small cooler when you request the bottles. Samples must be preserved correctly to be used for compliance purposes. To avoid resampling follow instructions contained with the sample bottle. If you would like more information, contact the DEQ lab, at 517-335-8184, or contact this office.

Cyanide: Previously, supplies that chlorinated the water were waived from monitoring for cyanide. The U.S. EPA now requires all supplies to sample the entry point for cyanide.

UCMR3 Monitoring: You may have monitoring requirements in 2015 under the third Unregulated Contaminant Monitoring Rule (UCMR3). The U.S. EPA will contact you directly if your water supply is required to monitor in 2015. A list of laboratories certified to analyze the samples collected for UCMR3 is available at <http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/ucmr3/upload/lablist.pdf>. Contact the U.S. EPA with questions.

Reminder if Lead and Copper Monitoring Due This Year: Provide individual lead tap results to people who receive water from sites that you sampled, even if lead was not detected, within 30 days of learning the results. Send us a certification that you met all the delivery requirements along with a sample copy of the customer notice within 3 months after the end of the monitoring period. Water supplies that failed to distribute the Consumer Notice of Lead Results must include the following statement in their CCR, "During the year, we failed to provide lead results to persons served at the sites that were tested as required by the Lead and Copper Rule." To download the *Lead and Copper Report and Consumer Notice of Lead Result Certificate* in Microsoft Word or PDF format, visit www.michigan.gov/deqwater. Click on Drinking Water, Community Water Supply, and Reporting Forms (under Manuals, Forms & Brochures).

Annual Reports: These reports are due to this office each year.

- The **Cross Connection Report**, due by March 31, describes the status of your local cross connection control program. Manufactured housing communities are exempt from this requirement until 2016.

Each year, water supplies must submit this report, even if a formal program has not been implemented. If cross connections do not exist in your water system, indicate so on the report. Download the Cross Connection Report form from <http://michigan.gov/deqwater>. Click on Drinking Water, Community Water Supply, Reporting Forms (under Manuals, Forms & Brochures). Instructions are included with the form.

- The **Annual Pumpage/Usage Report**, due by March 31, is required of water supplies that do not submit monthly operation reports.

This summary of water pumpage and water use must be submitted by each water supply that does not submit a monthly operation report. To manage our natural resources, pumpage data are compiled to determine water use demands in Michigan. Download the Annual Pumpage/Usage Report form from <http://michigan.gov/deqwater>. Click on Drinking Water, Community Water Supply, Reporting Forms (under Manuals, Forms & Brochures). Please be sure to indicate the appropriate units on the report (e.g. million gallons or gallons).

- The **Consumer Confidence Report**, due by July 1 to your customers, to your local health department and to this office, describes the quality of the water and characterizes the risks, if any, from exposure to contaminants detected..

Electronic delivery methods may be used to distribute the CCR to bill-paying customers, provided the method is direct. A paper copy must be delivered to bill-paying customers who request it or known to be unable to receive the CCR electronically. For more information on e-delivery, visit www.michigan.gov/deqwater. Click on Drinking Water, Community Water Supply, Consumer Confidence Report Rule (under Laws and Rules).



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



DAN WYANT
DIRECTOR

March 5, 2015

Mr. Brent Wright, Operations Supervisor
City Of Flint - DPW
Flint Water Plant
4500 North Dort Highway
Flint, Michigan 48505

WSSN: 02310

Dear Mr. Wright:

SUBJECT: Violation Notice (VN) – Maximum Contaminant Level for Total
Trihalomethanes (TTHM)
Operational Evaluation – Total Trihalomethanes
1st Quarter 2015 Monitoring Period

The Department of Environmental Quality (DEQ), Office of Drinking Water and Municipal Assistance (ODWMA), records show that the city of Flint (City) is in violation of the Safe Drinking Water Act, 1976 PA 399, as amended (Act 399); R 325.10610, *Maximum contaminant levels for disinfection byproducts (MCLs)*, of the 1979 Administrative Code.

In accordance with R 325.10610, *MCLs*, of the 1979 Administrative Code, the MCL for disinfection byproduct TTHM is 0.080 milligrams per liter (mg/L) as a Locational Running Annual Average (LRAA) at each monitoring location. As listed in the table below, our records show that the City's highest TTHM locational running annual average (LRAA), based on the last four quarters, ending February 28, 2015, is 0.105 mg/L which exceeds the standard, and that two of the eight sample site locations exceed the standard of 0.080 mg/L.

Further, in accordance with R 325.10719, *Disinfection byproducts: operational evaluation levels*, of the 1979 Administrative Code, when an operational evaluation level (OEL) at a monitoring location for TTHM exceeds 0.080 mg/L, a supply shall conduct an operational evaluation and submit a written report of the evaluation to the DEQ not later than 90 days after being notified of the analytical result that causes the supply to exceed the operational evaluation level. As listed in the table below, our records show that the TTHM OELs for the City exceed 0.080 mg/L at one of the City's eight sample site locations.

Mr. Brent Wright

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March 5, 2015

TTHM Results (mg/L)						
	5/21/14	8/21/14	11/20/14	2/17/15	LRAA	OEL
DBP1 McDonalds 3719 Davison	0.162	0.145	0.059	0.0162	0.096	0.059
DBP2 Liquor Palace 3302 S. Dort Highway	0.112	0.127	0.033	0.0168	0.072	0.049
DBP3 North Flint Auto 6204 N. Saginaw St.	0.097	0.118	0.041	0.0149	0.068	0.047
DBP4 University Market 2501 Flushing Road	0.106	0.196	0.094	0.0245	0.105	0.085
DBP5 Taco Bell 3606 Corunna Road	0.079	0.181	0.034	0.0151	0.078	0.063
DBP6 Rite-Aid Pharmacy 5018 Clio Road	0.088	0.144	0.054	0.0192	0.076	0.059
DBP7 Salem Housing 3216 MLK Boulevard	0.082	0.112	0.050	0.0285	0.068	0.055
DBP8 BP Gas Station 822 S. Dort Highway	0.075	0.112	0.036	0.0199	0.061	0.047

Our investigation consisted of a review of ODWMA files for laboratory reports received for compliance monitoring. Our investigation is considered complete. This violation began on March 1, 2015, and will continue until TTHM LRAA is below the MCL at all sample sites.

We are encouraged by the results from the most recent round of compliance samples collected on February 17, 2015, which now show individual TTHM levels at less than half of the 0.080 mg/L standard at all locations throughout the City's system. Operational Evaluation Reports from December 2014, and February 2015, have identified possible causes and corrective measures for the previous elevated TTHM levels which we encourage the City to continue implementing. These modifications have likely contributed in part to the reduction in TTHM levels reported in the most recent quarter, and suggest the City may be able to achieve compliance with the TTHM standard at all sites by continuing these efforts.

Our office is currently reviewing the Operational Evaluation Report dated February 27, 2015, and will provide the City and their consultant with comments, as needed, to help address this MCL violation.

Water systems that exceed the OEL must complete and submit an Operational Evaluation in accordance with Administrative Rule 719I (R 325.10719I) within 90 days of being notified of the violation. **An updated Operational Evaluation report, which incorporates the most recent sample results, must now be completed and received by our office by no later than Friday, May 29, 2015.**

If you have any other factual information you would like us to consider regarding the violation identified in this VN, please provide them in a written response by March 19, 2015.

Mr. Brent Wright

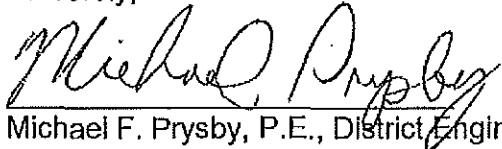
3

March 5, 2015

Administrative rule R 325.10403 of Act 399 requires that suppliers provide public notice (PN) as soon as practical, but no later than thirty (30) days after the supplier learns of this type of violation, by mail or direct delivery and by any other means reasonably calculated to reach customers not normally reached by mail. Enclosed is a sample PN which contains the minimum required language. The City is encouraged to include additional information regarding its response efforts to this violation. **Please notify your consumers by April 1, 2015, and send us a signed and dated copy of the notice that you issued within ten (10) days of distributing the public notice.** This violation must also be included in your 2015 Consumer Confidence Report, due by July 1, 2016. The PN must be repeated every quarter until you no longer exceed the TTHM standard. Failure to issue a PN for this violation will result in a fine of at least \$1,000 per event, with a maximum of \$5,000 per violation.

We anticipate and appreciate your continued cooperation in resolving this matter. If you have any questions regarding this VN, please contact us at the numbers below; at prysbym@michigan.gov; or rosenthala@michigan.gov; or at DEQ, P.O. Box 30242, Lansing, Michigan 48909-7742.

Sincerely,



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



Adam Rosenthal, Environmental Quality
Analyst
Lansing District Office
Office of Drinking Water and Municipal
Assistance
517-284-6644

Enclosure

cc: Ms. Jennifer Crooks, U.S. Environmental Protection Agency, Region 5
Mr. Jerry Ambrose, Emergency Manager, City of Flint
Mr. Robert Bincsik, City of Flint
Mr. Howard Croft, City of Flint
Mr. Daughtry Johnson, City of Flint
Genesee County Health Department
Ms. Liane Shekter Smith, DEQ
Mr. Richard Benzie, DEQ
Mr. Stephen Busch, DEQ

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

City of Flint Did Not Meet Treatment Requirements

Our water system recently violated a drinking water standard. Although this incident was not an emergency, as our customers, you have a right to know what happened and what we are doing to correct this situation.

We routinely monitor for the presence of drinking water contaminants. Samples were collected for total trihalomethanes (TTHM) analysis from eight locations on a quarterly basis (May 21, August 21, November 20 of 2014, and February 17, 2015). The average of the results at **ANY** of the eight locations must not exceed the maximum contaminant level (MCL) for TTHMs, otherwise our water system exceeds the MCL. The standard for TTHMs is 80 micro grams per liter ($\mu\text{g/L}$). The location reporting the highest TTHM level was 105 $\mu\text{g/L}$; thus, our water system exceeds the TTHM MCL.

What should I do?

- There is nothing you need to do unless you have a severely compromised immune system, have an infant, or are elderly. These people may be at increased risk and should seek advice about drinking water from their health care providers.
- You do not need to boil your water or take other corrective actions. If a situation arises where the water is no longer safe to drink, you will be notified within 24 hours.

What does this mean?

This is not an emergency. If it had been an emergency, you would have been notified within 24 hours.

People who drink water containing trihalomethanes in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous system, and may have an increased risk of getting cancer.

What is being done?

We are currently working on solutions to correct the problem. We anticipate resolving the problem in 2015. Our most recent individual sample results were all less than half the 80 $\mu\text{g/L}$ standard, however since compliance is calculated using a locational running annual average (LRAA) of the most recent four quarters, we are still out of compliance with the MCL at two of eight locations.

For more information, please contact Mr. Brent Wright at 517-787-6537, or the Flint Water Plant at 4500 North Dort Highway, Flint, Michigan 48505.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by the City of Flint.

CERTIFICATION:

WSSN: 02310

I certify that this water supply has fully complied with the public notification requirements in the Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the administrative rules.

Signature	Title	Date Distributed
Reminder to water supplier: This notice/certification must be sent to the Department of Environmental Quality.		



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING



DAN WYANT
DIRECTOR

March 30, 2015

Mr. Brent Wright
City Of Flint - DPW
Flint Water Plant
4500 North Dort Highway
Flint, Michigan 48505

Dear Mr. Wright:

Subject: City Of Flint- WSSN: 02310
Lead and Copper Monitoring of Drinking Water Taps

We received your report for the monitoring period July 1, 2014, through December 31, 2014.

Action Levels	Results this monitoring period		Next monitoring period	
	90 th Percentile	# of Samples Above Action Level	# of Samples Required	Take Samples Within These Dates
Lead 15 parts per billion (ppb)	6.0 ppb	2	100	1/1 and 6/30/2015 Submit results to this office by July 10, 2015
Copper 1.3 parts per million (ppm)	0.11 ppm	0		

Ninety percent of the sites you tested are within action levels under the administrative rules promulgated under the Michigan Safe Drinking Water Act, 1976 PA 399, as amended. These results must be reported on your 2014 Consumer Confidence Report (CCR) due to our office, your customers, and the local health department, by July 1, 2015. Also include the following statement in the CCR, regardless of the lead and copper levels:

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. The City of Flint is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline at 1-800-426-4791 or at <http://water.epa.gov/drink/info/lead>.

Mr. Brent Wright

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March 30, 2015

Recent changes to the Lead and Copper Rule require you to provide individual lead tap results to people who receive water from sites that were sampled, even if lead was not detected, within 30 days of learning of results. You must also send us a certification that you met all the delivery requirements along with a sample copy of your customer notice by 3 months after the end of the monitoring period. To download the *Lead and Copper Report and Consumer Notice of Lead Result Certificate* in Microsoft Word or PDF format, visit <http://michigan.gov/deq>. Click on Water, Drinking Water, Community Water Supply, and Reporting Forms. Water supplies that fail to distribute the Consumer Notice of Lead Results must include the following statement in their CCR, "During the year, we failed to provide lead results to persons served at the sites that were tested as required by the Lead and Copper Rule."

Samples due the next monitoring period mark your second six month round of monitoring. Please make every attempt to select the same sites used in the previous monitoring period, giving Tier 1 sites first priority. If original sites are unavailable, select replacement sites based on the Tier 1, 2, and 3 criteria. We strongly encourage you to sample early in the monitoring period.

Bottles will NOT be mailed automatically. To order bottles, call the Department of Environmental Quality laboratory at 517-335-8184, or download the form EQP 2301 *Requisition for Water Sample Units* from www.michigan.gov/deq. Click on Key Topics, Laboratory Services, Drinking Water, Obtaining the Necessary Sampling Units, and test list.

Sincerely,



Adam Rosenthal, EQA
Office of Drinking Water and Municipal Assistance
Lansing District
517-284-6644
rosenthala@michigan.gov

ar/jlr
Enclosures

cc: Mr. Michael Glasgow, City of Flint



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



DAN WYANT
DIRECTOR

April 3, 2015

Mr. Brent Wright
City of Flint Water Plant
4500 North Dort Highway
Flint, Michigan 48505

Dear: Mr. Wright

SUBJECT: Long Term 2 Enhanced Surface Water Treatment Rule (LT2 Rule)
2nd Round of Source Water Monitoring Requirements

The LT2 Rule was promulgated by the United States Environmental Protection Agency on January 5, 2006. The Department of Environmental Quality (DEQ) adopted this rule into the Administrative Rules in December, 2009. All public water systems that are supplied by a surface water source, and systems supplied by a ground water source under the direct influence of surface water (GWUDI), are subject to this rule.

According to the LT2 Rule, systems are required to conduct an initial and a second round of source water monitoring for each plant that treats a surface water or GWUDI source. Please keep in mind that grandfathering data will not be accepted for the second round of monitoring. This monitoring includes at least one source water *Cryptosporidium*, *E. coli*, and turbidity sample per month for a period of 24 months for systems serving populations greater than 10,000 people. Systems will be assigned to a "treatment bin" based on the results of source water monitoring. The treatment bin specifies the level of *Cryptosporidium* removal and/or inactivation that the system must achieve.

Our records indicate that your system is required to comply with the source water monitoring requirements on Schedule 2 as stated below in Table 1. Therefore, your system is required to submit to the DEQ, a source water monitoring plan for each plant by July 1, 2015, and start the 2nd round of monitoring in October, 2015.

Table 1 – LT2 Milestone Dates for 2nd Round of Source Water Sampling

System Population	Schedule	Must submit Source Water Sampling Plan by...	Must begin second round of source water monitoring...
At least 100,000	1	January 1, 2015	April 1, 2015
50,000 – 99,999	2	July 1, 2015	October 1, 2015
10,000 – 49,999	3	July 1, 2016	October 1, 2016
<10,000	4	July 1, 2017	October 1, 2017

Mr. Brent Wright

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April 3, 2015

Enclosed with this letter is a Source Water Sampling Plan template that you can complete and submit to this office to comply with the July 1, 2015, deadline. The template includes instructions and a worksheet that will assist the DEQ in determining if your plan meets the requirements of the LT2 Rule.

If you have any questions about this subject, feel free to contact me at 517-290-8817; prysbym@michigan.gov; or Department of Environmental Quality, Office of Drinking Water and Municipal Assistance, Lansing District Office, 525 West Allegan Street, 1st Floor South, P.O. Box 30242, Lansing, Michigan 48909-7742.

Sincerely,



Michael F. Prysby, P.E.
District Engineer
Field Operations Section
Office of Drinking Water and
Municipal Assistance

Enclosures

cc: Mr. Howard Kroft, City of Flint

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

PERMIT APPLICATION FOR WATER SUPPLY SYSTEMS
 (CONSTRUCTION - ALTERATION - ADDITION OR IMPROVEMENT) AS DESCRIBED HEREIN
Required under the Authority of 1976 PA 399, as amended

This application becomes an Act 399 Permit only when signed and issued by authorized Michigan Department of Environmental Quality (DEQ) Staff. See instructions below for completion of this application.

Municipality or Organization, Address and WSSN that will own or control the water facilities to be constructed. This permit is to be issued to: City of Flint Water Service Center 3310 E. Court Street Flint, MI 48506 WSSN: 2310	Permit Stamp Area (DEQ use only) MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY PERMIT NO. W 151018 APR 3 2015 EXAMINED AND APPROVED FOR COMPLIANCE WITH ACT 399, P.A. 1976 <i>MFP</i>	
Owner's Contact Person (provide name for questions): Contact: Rob Bincsik Title: Supervisor of Water Distribution & Sewer Phone: (810)766-7202		
Project Name (Provide phase number if project is segmented): 4-inch Water Main Replacement (contract/phase 1)	4. Project Location (City, Village, Township): City of Flint	5. County (location of project): Genesee

ISSUED UNDER THE AUTHORITY OF THE DIRECTOR OF THE DEPARTMENT OF ENVIRONMENT QUALITY

cc:

Issued by:

Reviewed by:

☐ If this box is marked see attached special conditions.

Instructions: Complete items 1 through 5 above and 6 through 21 on the following pages of this application. Print or type all information except for signatures. Mail completed application, plans and specifications, and any attachments to the DEQ District Office having jurisdiction in the area of the proposed construction.

Please Note:

- This **PERMIT** only authorizes the construction, alteration, addition or improvement of the water system described herein and is issued solely under the authority of 1976 PA 399, as amended.
- The issuance of this **PERMIT** does not authorize violation of any federal, state or local laws or regulations, nor does it obviate the necessity of obtaining such permits, including any other DEQ permits, or approvals from other units of government as may be required by law.
- This **PERMIT** expires two (2) years after the date of issuance in accordance with R 325.11306, 1976 PA 399, administrative rules, unless construction has been initiated prior to expiration.
- Noncompliance with the conditions of this permit and the requirements of the Act constitutes a violation of the Act.
- Applicant must give notice to public utilities in accordance with 1974 PA 53, (MISS DIG), being Section 460.701 to 460.718 of the Michigan Compiled Laws, and comply with each of the requirements of that Act.
- All earth changing activities must be conducted in accordance with the requirements of the Soil Erosion and Sedimentation Control Act, Part 91, 1994 PA 451, as amended.
- All construction activity impacting wetlands must be conducted in accordance with the Wetland Protection Act, Part 303, 1994 PA 451, as amended.
- Intentionally providing false information in this application constitutes fraud which is punishable by fine and/or imprisonment.
- Where applicable for water withdrawals, the issuance of this permit indicates compliance with the requirements of Part 327 of Act 451, Great Lakes Preservation Act.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

Permit Application for Water Systems (Continued)

6. **Facilities Description** – In the space below provide a detailed description of the proposed project. Applications without adequate facilities descriptions will be returned. SEE EXAMPLES BELOW. Use additional sheets if needed.

8400 Feet of 24-inch water main from Pasadena Avenue and Iroquois Avenue, South, 20 blocks, along Iroquois Avenue from Pasadena Ave. to Stockdale St.
 East, Jog of Approx. 100 feet, along Stockdale Street from Iroquois Ave. to Euclid Ave.
 South, 1 block, along Euclid Avenue from Stockdale St. to Welch Blvd.
 West, 1 block, along Welch Boulevard from Euclid Ave. to Seminole St.
 South Southwest, 3 blocks, along Seminole Street from Welch Blvd. to DuPont St.
 South, 10 blocks, along Dupont Street from Seminole St. to Mackin Road.
 Water main is stubbed south of Mackin Road for future additions.

EXAMPLES – EXAMPLES – EXAMPLES – EXAMPLES – EXAMPLES – EXAMPLES

Water Mains	500 feet of 8-inch water main in First Street from Main Street north to State Street. OR 250 feet of 12-inch water main in Clark Road from an existing 8-inch main in Third Avenue north to a hydrant.
Booster Stations	A booster station located at the southwest corner of Third Avenue and Main Street, and equipped with two, 15 Hp pumps each rated 150 gpm @ 200 feet TDH. Station includes backup power and all other equipment as required for proper operation.
Elevated Storage Tank	A 300,000 gallon elevated storage tank located in City Park. The proposed tank shall be spherical, all welded construction and supported on a single pedestal. The tank shall be 150 feet in height, 40 feet in diameter with a normal operating range of 130 – 145 feet. The interior coating system shall be ANSI/NSF Standard 61 approved or equivalent. The tank will be equipped with a cathodic protection system, and includes a tank level control system with telemetry.
Chemical Feed	A positive displacement chemical feed pump, rated at 24 gpd @ 110 psi to apply a chlorine solution for Well No. 1. Chlorine is 12.5% NaOCL, ANSI/NSF Standard 60 approved and will be applied at a rate of 1.0 mg/l of actual chlorine.
Water Supply Well	Well No. 3, a 200 foot deep well with 170 feet of 8-inch casing and 30 feet of 8-inch, 10 slot screen. The well will be equipped with a 20 Hp submersible pump and motor rated 200 gpm @ 225 feet TDH, set at 160 feet below land surface.
Treatment Facilities	A 5 million gpd water treatment plant located at the north end of Second Avenue. The facility will include 6 low service pumps, 2 rapid mix basins, 4 flocculation/sedimentation basins, 8 dual media filters, 3 million gallon water storage reservoir and 6 high service pumps. Also included are chemical feed pumps and related appurtenances for the addition of alum, fluoride, phosphate and chlorine.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

Permit Application for Water Systems (Continued)

General Project Information – Complete all boxes below.	
7. Design engineer's name, engineering firm, address, phone number, and email address: Jeffrey B. Markstrom, P.E. ROWE Professional Services Company P.O. Box 3748 Flint, MI 48502 (810)341-7500 jmarkstrom@rowepsc.com	8. Indicate who will provide project construction inspection: ☐ Organization listed in Box 1. ☒ Engineering firm listed in Box 7. ☐ Other - name, address, and phone number listed below.
9. Is a basis of design attached? ☐ YES ☒ NO If no, briefly explain why a basis of design is not needed.	
10. Are sealed and signed engineering plans attached? ☒ YES ☐ NO If no, briefly explain why engineering plans are not needed.	
11. Are sealed and signed construction specifications attached? ☒ YES ☐ NO If specifications are not attached, they need to be on file at DEQ.	
12. Were Recommended Standards for Water Works, Suggested Practice for Water Works, AWWA guidelines, and the requirements of Act 399 and its administrative rules followed? ☒ YES ☐ NO If no, explain which deviations were made and why.	
13. Are all coatings, chemical additives and construction materials ANSI/NSF or other adequate 3rd party approved? ☒ YES ☐ NO If no, describe what coatings, additives or materials did not meet the applicable standard and why.	
14. Are all water system facilities being installed in the public right-of-way or a dedicated utility easement? (For projects not located in the public right-of-way, utility easements must be shown on the plans.) ☒ YES ☐ NO If no, explain how access will be obtained.	
15. Is the project construction activity within a wetland (as defined by Section 324.30301(d)) of Part 303, 1994 PA 451? ☐ YES ☒ NO If yes, a wetland permit must be obtained.	
16. Is the project construction activity within a 100-year floodplain (as defined by R 323.1311(e)) of Part 31, 1994 PA 451, administrative rules? ☐ YES ☒ NO If yes, a flood plain permit must be obtained.	
17. Is the project construction activity within 500 feet of a lake, reservoir, or stream? ☒ YES ☐ NO If yes, a Soil and Erosion Control Permit must be obtained or indicate if the owner listed in box 2 of this application is an Authorized Public Agency (Section 10 of Part 91, 1994 PA 451) ☐ Owner is APA.	

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

Permit Application for Water Systems (Continued)

18. Will the proposed construction activity be part of a project involving the disturbance of five (5) or more acres of land?

☐ YES ☒ NO

If yes, is this activity regulated by the National Pollutant Discharge Elimination System storm water regulations?

☐ YES: NPDES Authorization to discharge storm water from construction activities must be obtained.

☐ NO: Describe why activity is not regulated:

Please call 517-241-8993 with questions regarding the applicability of the storm water regulations.

19. Is the project in or adjacent to a site of suspected or known soil or groundwater contamination?

☐ YES ☒ NO

If yes, attach a copy of a plan acceptable to the DEQ for handling contaminated soils and/or groundwater disturbed during construction. Contact the local DEQ district office for listings of Michigan sites of environmental contamination.

20. IF YOU ARE A CUSTOMER/WHOLESALE/BULK PURCHASER, COMPLETE THE FOLLOWING

1) Name and WSSN of source water supply system (seller) City of Flint

2) Does the water service contract require water producer/seller to review and approve customer/wholesale/bulk purchaser water system construction plans?

☐ YES ☒ NO

If yes to #2, the producer/seller approval letter must be attached when submitted to DEQ.

21. **Owner's Certification** The owner of the proposed facilities or the owner's authorized representative shall complete the owner's certification. It is anticipated that the owner will either be a governmental agency (city, village, township, county, etc.) or a private owner (individual, company, association, etc.) of a Type I public water supply.

OWNER'S CERTIFICATION

I, Daugherty Johnson (name), acting as the Utilities Administrator (title/position) for

City of Flint

(print)

(entity owning proposed facilities) certify that this project has

been reviewed and approved as detailed by the Plans and Specifications submitted under this application, and is in compliance with the requirements of 1976 PA 399, as amended, and its administrative rules.

Daugherty Johnson
Signature*

3/20/15
Date

810 766-7135
Phone

*Original signature only, no photocopies will be accepted.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

Permit Application for Water Systems (Continued)

PROJECT BASIS OF DESIGN – FOR WATER MAIN PROJECTS

PROJECT NAME: _____

For this PROJECT the following information must be provided per Act 399 unless waived by the Department. For projects other than water main installation, or if additional space is needed, attach separate sheet(s) with detailed Basis of Design calculations.

- A. A general map of the initial and ultimate service areas
☐ Included on engineering plans ☐ Attached separately
- B. Number of service connections served by this permit application _____
- C. Total number of service connections ultimately served by entire project _____
- D. Residential Equivalent Units (REUs) served by this permit application _____
- E. Total Residential Equivalent Units (REUs) ultimately served by entire project _____
- F. Water flow rates for proposed project based on REUs listed in "D" and "E" above
1. Initial design average day flow (mgd) _____
 2. Initial design maximum day flow (mgd) _____
 3. Total design average day flow (mgd) _____
 4. Total design maximum day flow (mgd) _____
 5. Required fire flows: ⁽¹⁾ _____ gpm for _____ hours
- G. Actual flows and pressures of existing system at the connection point(s) ⁽²⁾
- | |
|------------------------|
| _____ gpm at _____ psi |
| _____ gpm at _____ psi |
| _____ gpm at _____ psi |
| _____ gpm at _____ psi |
- H. Estimated minimum flows and pressures within the proposed water main system ⁽³⁾
- | |
|------------------------|
| _____ gpm at _____ psi |
|------------------------|

(1) Every water system must decide what levels of fire fighting flows they wish to provide. Fire flow should be appropriate for the area (residential, commercial, industrial) being served by the project. Typical fire flow rates can be obtained from the water supply, local fire dept., ISO or AWWA. The water system must then be designed to be able to provide the required fire flows while maintaining at least 20 psi in all portions of the distribution system.

(2) Flows and pressures at the connection points must be given to determine if the existing water main(s) are able to deliver water to the new service area. These numbers can be obtained from a properly modeled and calibrated distribution system hydraulic analysis or hydrant flow tests performed in the field. If more than one connection is proposed, list as needed.

(3) List what the estimated minimum flows can be expected in the proposed water mains based on estimated water demands, head losses, elevation changes and other factors that may affect flows, such as dead end mains.



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



DAN WYANT
DIRECTOR

TO: Water Supply Superintendent or Operator-in-Charge

FROM: Adam Rosenthal, Office of Drinking Water and Municipal Assistance, Lansing District Office

DATE: May 6, 2015

SUBJECT: New Lansing District e-mail address for all submittals
2014 Consumer Confidence Report Reminder
Updated Lansing District Responsibilities

New Lansing District e-mail address for all submittals:

The Lansing District Office has created a new e-mail account to be used for all future submittals: **DEQ-DWMA-Lansing@michigan.gov**

Please forward future electronic submittals to the above e-mail address. This includes monthly operating reports, laboratory reports, reporting forms and siting plans. No further submittals will be accepted into an individual's e-mail inbox after May 31, 2015. Please make sure to inform any laboratory or consultant who has agreed to submit documents on your behalf of this change. Mailed hard copies and faxed documents will still be accepted.

2014 Consumer Confidence Report Reminder:

Your annual Consumer Confidence Report (CCR) is due to be delivered by July 1st.

You may use any combination of mail, door-to-door, or electronic methods to deliver to bill paying customers. This means you may mail and/or e-mail a message that the CCR is available on the internet or attached to the e-mail. If using the internet, the CCR must be on the internet when customers receive the message and the internet address displayed in the message must lead directly to the entire CCR. The message should tell customers how to request a paper copy. If you normally publish a non-English language CCR, then the notification of CCR availability should also be in that language.

Refer to last year's report and your most recent sample results when preparing this year's report. For more information on preparing your CCR, visit <http://michigan.gov/deq>. Click on Water, Drinking Water, Community Water Supply, and Consumer Confidence Report Rule.

In addition to delivering your CCR to your consumers by July 1st, you are required to send a copy to the Department of Environmental Quality and to your local health department. Also send us documentation certifying how you delivered the CCR. Certification of delivery is due to us by October 1st, but we encourage you to send it to us when you deliver the CCR by July 1st. You can download the *CCR Certificate of Distribution Form* from the web page noted above. **If you e-delivered the CCR, send**

us a sample copy of the notification of CCR availability. For example, you may have put the notification on a water bill.

Did anybody monitor UCMR in 2014? Did the United States Environmental Protection Agency (U.S. EPA) direct you to monitor for unregulated contaminants during 2014? Report the average and range of each contaminant detected. Also, provide an explanation of this required monitoring, such as, "Unregulated contaminants are those for which the U.S. EPA has not established drinking water standards. Monitoring helps the U.S. EPA to determine where certain contaminants occur and whether it needs to regulate those contaminants. We monitored for these contaminants and results of monitoring are available on request."

Please contact us with your questions. We would like to be available to answer all your questions as you draft your CCR, but we have found that our office is inundated with questions as the deadline nears. You might be best served if you contact us before the end of May.

Failure to deliver the CCR by July 1st is a reporting violation and will result in an administrative fine. Contact our office for more information.

Updated Lansing District Responsibilities:

Please make note of the following updates to the Lansing staff and their responsible areas:

Michael Prysby, P.E., is responsible for District 11, which includes Genesee County. Mike can be reached on his cell phone at 517-290-8817.

Bethel Skinker, P.E., is responsible for District 12, which includes the counties of Eaton, Ingham, and Clinton (minus manufactured housing). Bethel can be reached on her cell phone at 517-290-0686.

Mark Joseph, P.E., is responsible for District 13, which includes Livingston County and the City of Ann Arbor in Washtenaw County. Mark can be reached on his cell phone at 517-290-0170.

Kurt Swendsen, Engineer, is responsible for District 14, which includes the counties of Gratiot, Lapeer, Shiawassee, and all manufactured housing community supplies in Clinton County. Kurt can be reached at 517-525-1487.

All Livingston County water supplies are again regulated through the Lansing District Office.



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE



DAN WYANT
DIRECTOR

May 11, 2015

Mr. Howard Kroft, Director of Public Works
City of Flint
1101 South Saginaw Street
Flint, Michigan 48502

WSSN: 02310

Dear Mr. Kroft:

SUBJECT: Flint Cross Connection Control Program

This letter confirms my site visit on April 29, 2015, with Mr. Glen Thomas, Utilities/Cross Connection Division Inspector for the city of Flint. Mr. Stephen Busch from our office was also present. The purpose of the visit, in part, was to discuss the city's Cross Connection Control Program (CCCP).

The city of Flint has made significant progress in recent years regarding the implementation of the city's approved CCCP. This effort has included identification of accounts, inspection and re-inspection of accounts at the approved frequencies, and ensuring the testing of backflow prevention assemblies in accordance with approved frequencies. However, the city's most recent report of annual CCCP activities for 2014 indicates a significant decrease in these activities below minimum requirements, and this deficiency must be addressed.

Our office fully recognizes the recent staffing loss of the city's previous plumbing inspector and the importance of these plumbing inspection services in providing public health protection, but these activities should not be borne at the cost of the city's CCCP and the protections it provides. Given the bacterial detections that occurred in the city's water distribution system in August and September 2014, along with customer complaints regarding aesthetic water quality, the need for protection through cross connection control are very evident.

We also realize that implementing a CCCP for a community water system of this magnitude requires a significant commitment of time and personnel. We encourage the city to review CCCP staffing needs and authorize the workforce necessary to comply with the city's approved CCCP requirements.

Mr. Howard Kroft

2

May 11, 2015

Should you require further information, please contact me at the telephone number below; via e-mail at prysbym@michigan.gov; or Department of Environmental Quality, P.O. Box 30242, Lansing, Michigan 48909.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael F. Prysby". The signature is fluid and cursive, with the first name "Michael" being more prominent and the last name "Prysby" following in a similar style.

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

mfp/jlr

cc: Mr. Glen Thomas, City of Flint
Mr. Stephen Busch, P.E.



RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING



DAN WYANT
DIRECTOR

February 27, 2015

Mr. Gerald Ambrose, Emergency Manager
City of Flint
1101 South Saginaw Street
Flint, Michigan 48502

Dear Mr. Early:

SUBJECT: S2 Grant Program
City of Flint
S2 Grant Project No. 9204-01

We are pleased to inform you that your final disbursement request (No. 7), in the amount of \$66,650.62 was paid on February 13, 2014. The project plan was approved on December 13, 2013. The plans and specifications were approved on November 19, 2014. The State Revolving Fund (SRF) loan for Project No. 5439-01 was verified as self-funded via a construction start date of December 3, 2015. The subject S2 Grant project is now administratively complete.

Based on available grant funds, the final S2 Grant amount and local match are \$717,531.49 and \$79,725.51, respectively. The total final project cost is \$797,257. For your files, I am enclosing the S2 Final Project Cost Summary from our database, which reflects and confirms the amounts on your final disbursement request.

Please note that the Michigan Financial Authority (MFA) or the Michigan Department of Environmental Quality (DEQ) may conduct an audit or other review of your project to determine whether Strategic Water Quality Initiatives Fund program requirements have been met. You will be notified in advance of any on-site review. Please retain all project records, whether in written or computerized form, for three years from the date of this letter. If requested, you must provide such records to the MFA, the DEQ, or their agents for inspection.

We are pleased that we could assist you in your effort to protect and preserve the water quality of our state.

If you have any questions, please call the project manager, Mr. Kurt Swendsen at 517-284-5418, or you may contact us by mail at DEQ, P.O. Box 30241, Lansing, Michigan 48909-7741.

Sincerely,

Sonya T. Butler, Chief
Revolving Loan Section
Office of Drinking Water and Municipal Assistance
517-284-5433

Attachment

cc: Mr. Daughtery Johnson, City of Flint
Mr. Jeff Markstrom, Rowe, Inc., Flint
Ms. Nichole Dorr, MFA
Mr. Chuck Bennett, DEQ-Water Resources Division, Lansing District Office
Ms. Debbie Martinson, DEQ

S2 Final Project Cost Summary

Project Number 9204-01

Grantee	City of Flint		Location	City of Flint	
Budget Item		Requested Costs	Approved Costs	Allowable %	Approved Final Costs
1	Planning Costs	\$797,257.21	\$797,257.21	100.0000%	\$797,257.21
			Eligible Cost Subtotal		\$797,257.21
			Less 10% Local Match		\$79,725.72
			Total Approved Project Cost		\$717,531.49

Line Items Final

Planning Costs

Project Number 9204-01

Item	Desc. or Invoice Number	Requested	Ineligible	Approved	Reason	Cost Type
1	Rowe invoices 67422 - 69146	\$65,568.17	\$0.00	\$65,568.17	DR1, 5 invoices	Incurred
2	invoices 0069223	\$249,360.00	\$0.00	\$249,360.00	DR2	Incurred
3	invoice 70243	\$49,906.40	\$0.00	\$49,906.40	DR3	Incurred
4	invoices 70514, 70686	\$83,150.90	\$0.00	\$83,150.90	DR4	Incurred
5	invoices 70863, 71040, 71215	\$153,141.87	\$0.00	\$153,141.87	DR5	Incurred
6	invoices 71393, 71545, 71719	\$122,073.63	\$0.00	\$122,073.63	DR6	Incurred
7	invoices 72977, 72570, 72787	\$74,056.24	\$0.00	\$74,056.24	DR7	Incurred
Total:		\$797,257.21	\$0.00	\$797,257.21		



Dayne Walling
Mayor

City of Flint

Utilities Division



Gerald Ambrose
Emergency Manager

February 9, 2015

Mr. Kurt Swendsen
Michigan Department of Environmental Quality
Constitution Hall
525 W. Allegan
Lansing, MI 48933

Re: City of Flint SRF Project Construction Phase
Project Status Report

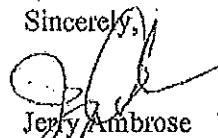
Dear Mr. Swendsen:

The City of Flint is writing this letter to inform the MDEQ that the construction phase of the SRF project is underway. As you are aware, the City of Flint will be self-funding the construction project and will be performing most of the construction activities with our own utility crews. The following is a summary of the project as we stand today:

- Construction activities began on December 3, 2014
- To date our crews have been concentrating on rehabilitation of the sanitary manholes along Gilkey Creek, Swartz Creek, Carman Creek and Thread Creek which are tributaries of the Flint River. We have signed a contract with Liquiforce to perform the sewer lining items that the City of Flint staff is not able to self-perform.
- The City of Flint has allocated 2 crews consisting of 8 staff. The project is being managed by Rob Smith, our Sewer Systems Supervisor.
- Based on our understanding of the project, we anticipate construction activities to continue through the 2015 construction season with a completion date of November 2015.
- We have kept our consultant, ROWE Professional Services Company, apprised of our progress.

We trust that this letter addresses the concerns of the MDEQ relating to the progress of the SRF construction phase. If you have any questions or require additional information, please contact Daugherty Johnson, Utilities Administrator at djohnson@cityofflint.com.

Sincerely,


Jerry Ambrose
Emergency Manager

Cc: Daugherty Johnson, City of Flint
Jeff Markstrom, ROWE

Swendsen, Kurt (DEQ)

From: Daugherty Johnson <djohnson@cityofflint.com>
Sent: Thursday, February 19, 2015 11:21 AM
To: Swendsen, Kurt (DEQ)
Cc: Robert Smith; Jeff Markstrom
Subject: City of Flint SRF project progress
Attachments: SRF progress letter Feb 2015.pdf

Hell Kurt. I have attached a letter detailing our progress on our self funded SRF project. If you have any questions please call me at (810) 577-8906 or email. We will also send a hard copy of the letter.

Thank you
 Daugherty Johnson
 Utilities Administrator
 City of Flint

From:
 Sent:
 To:
 Cc:
 Subject:
 Attachments:

Hell Kurt
 questions

From:
 Sent:
 To:
 Cc:
 Subject:
 Attachments:

From:
 Sent:
 To:
 Cc:
 Subject:
 Attachments:

From:
 Sent:

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, May 01, 2015 12:17 PM
To: Prysby, Mike (DEQ); gthomas@cityofflint.com
Subject: RE: Premise plumbing
Attachments: Final Genesee supplemental questionnaire 2-23-15.docx

Glen,

The attached questionnaire that would be utilized by the Local Health Department and Department of Health and Human Services provides additional detail of what to be on the lookout for (See Questions 12 and 13). As we indicated almost every service connection could potentially have some element associated with what is listed in this questionnaire, but we are just looking for a rough list of those with more non-typical appurtenances such as spas, grocery stores with spray/mist system, garden/nurseries with mist irrigation, etc., and those that Mike provided. Thanks.

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

From: Prysby, Mike (DEQ)
Sent: Friday, May 01, 2015 9:56 AM
To: gthomas@cityofflint.com
Cc: Busch, Stephen (DEQ)
Subject: Premise plumbing

Glen,

Based upon our discussion during our April 29th, 2015 site visit, approximately 40-45 commercial/industrial customers were identified as a potential candidate for needing a premise plumbing Water Safety Plan (WSP). Attached is a list of mechanical components within building premise plumbing to assist you in confirming this and/or identifying additional customers that could serve as WSP candidates. Please send us your completed list at your earliest convenience. Thanks.

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

**Legionellosis Questionnaire
Genesee County, 2014-2015**

Interviewer Identification

Date of Interview: _____ Interviewer's Name: _____
Health Dept.: _____ Phone Number: _____ E-mail: _____

What was the patient's outcome? ☐ RECOVERED ☐ STILL ILL ☐ DIED ☐ UNK

Patient Contact Information

Name: _____ Age: _____ Sex: ☐ M ☐ F
Street address: _____ City: _____
State: _____ Zip: _____ County: _____
Daytime Phone: _____ Evening Phone: _____

Surrogate Contact Information <List surrogate contact information if patient is too unwell or has died>

Name: _____
Daytime Phone: _____ Evening Phone: _____
Relationship to Patient: _____

Hello, my name is _____ and I'm calling from _____ (health department). We are investigating a cluster of respiratory illnesses in Genesee County. At this point, the source of these illnesses is still under investigation. We are hoping this interview will provide further information and answers about the illnesses. I'd like to ask you a few questions about your home and your exposures during the 2 weeks before you got sick. You do not have to answer any of the questions, but any assistance you can provide is appreciated. Do you have about 30 minutes to talk? If not now, when would be a good time for me to call back? _____

<If the case is from more than 1 month prior, the following text may be used: >

It might be helpful for you to collect documents such as a calendar, receipts, credit card or bank statements to jog your memory about your activities and where you were in the 2 weeks prior to getting sick. The only information we would ask you to share from these are dates and locations. Would you like me to call you back after you have time to collect these materials? When would be a convenient day and time for me to call you back? _____

I have that your first symptom started on <insert onset date> _____. Is this correct?

☐ Yes ☐ No ☐ Not sure

If no, what was the first date you started feeling sick? ____/____/____

List dates of exposure period: from ____/____/____ to ____/____/____ <The exposure period includes the 2 weeks before the date of illness onset>

Illness Information

1.) During your illness, did you have any of the following symptoms?

	Check one:		
	YES	NO	UNK
Diagnosis of pneumonia			
Fever If yes, highest temp: _____			
Chills			
Cough			
Nausea			
Vomiting			
Diarrhea			
Aches or muscle pains			
Chest pain			
Shortness of breath			
Sore throat			
Headaches			
Other symptoms (<i>specify</i>): _____			

Exposure Information

2.) How long have you lived at your current residence? _____

<If they have moved since the listed exposure period, indicate that you are asking about the house they lived in prior to becoming sick>

a.) If you moved after the exposure period/illness, what was your previous residence address? _____

3.) Where did you get your tap (drinking and other household use) water from between ____/____/____ and ____/____/____? *<Exposure period from above>*

- ☐ 1. City of Flint Water
☐ 2. City of Flint Township Water
☐ 3. Other municipal water system
☐ 4. Private well
☐ 5. Unknown
☐ 6. Other _____

4.) During the last year, has the water pressure at your residence changed? ☐ Yes ☐ No ☐ Not Sure

a.) If yes, did the water pressure: ☐ Increase ☐ Decrease

b.) If yes, when did the water pressure change occur? _____

5.) During the last year, has the water quality (appearance, taste, smell) at your residence changed?

☐ Yes ☐ No ☐ Not Sure

a.) If yes, please describe the change in the water quality: _____

b.) If yes, when did the water quality change occur? _____

6.) Prior to your illness, did you make any recent plumbing changes or repairs at your residence?

☐ Yes ☐ No ☐ Not sure

a.) If yes, please describe the changes/repairs and give the dates the work was done.

7.) Prior to your illness, were there any water main breaks or other water line issues that affected the water at your residence, including boil water advisories? ☐ Yes ☐ No ☐ Not sure

a.) If yes, please describe the water main/line issues or boil water advisories and give the dates they occurred.

I'd like to ask you some questions about what you did during the 2 weeks before you got sick.

The time period I'm asking about is between ____/____/____ and ____/____/____. <Exposure period>

During this 2 week period, did you:

8.) Work or volunteer, either full or part time? ☐ Yes ☐ No ☐ Not sure

a.) If yes, complete the following table:

Job description	Company	Location	Any exposure to misty water?

9.) Spend any time in a hospital, doctor's office, clinic, or dentist office as a patient, visitor, employee, or volunteer? ☐ Yes ☐ No ☐ Not sure

a.) If yes, check all that apply:

Exposure	Date(s)	Reason for Visit	Name & City of Hospital/ Office/ Clinic	Name of Doctor
Inpatient ☐	Admission _____ Discharge _____			
Outpatient ☐				
Visitor ☐				
Employee ☐				
Volunteer ☐				

10.) Visit, reside, or work in a long term care facility, nursing home, assisted living facility, or senior living facility? ☐ Yes ☐ No ☐ Not sure

a.) If yes, complete the following table:

Exposure	Date(s)	Name & City of Facility
Resident ☐		
Visitor ☐		
Employee ☐		

11.) In the 2 weeks before you before you got sick (____/____/____ to ____/____/____), did you spend any nights away from home (excluding healthcare settings)? ☐ Yes ☐ No ☐ Not sure

a.) If yes, complete the following table: <prompts: hotel, campground, cabin, cruise, second home, with family, etc.>

Accommodation Type/Name	Address Street, City, State	Floor/Room No.	Dates of Stay	
			Arrival	Departure

12.) In the 2 weeks before you before you got sick (____/____/____ to ____/____/____), did you visit any of the following community venues?

Venue	Check one:			Date(s)	Name of Venue	Address
	YES	NO	UNK			
Hotel (<i>without</i> staying overnight – e.g. dinner, wedding)						
Auditorium						
Barbershop or Hair salon						
Car wash						
Casino						
Church or Place of worship						
Gym or Work out facility						
Grocery store						
Home improvement store						
Spa or Nail salon						
Mall or Department store						
Movie theater						
Other (<i>specify</i>)						

13.) In the 2 weeks before you before you got sick (____/____/____ to ____/____/____), did you have exposure to any of the following water sources, either **at home** or while **away from home**?

Exposures at home	Check one:			Dates (s)	Description: Name (or Type)/Location
	YES	NO	UNK		
Shower					
Use a detachable shower head or hose					
Hot tub, whirlpool spa, Jacuzzi tub					
Sat NEAR a working hot tub or whirlpool spa but did not get in					
Steam room or wet sauna					
Humidifier (whole house or portable)					If yes, specify type: If yes, what type of water is used in device? ☐ Bottled ☐ Tap ☐ Other: _____
Respiratory therapy machine (e.g. nebulizer, CPAP, BiPAP, etc.)					If yes, specify type: If yes, what type of water is used in device? ☐ Bottled ☐ Tap ☐ Other: _____
Other (specify)					

Exposures away from home	YES	NO	UNK	Dates (s)	Description: Name (or Type)/Location
Shower at gym, work, other location					
Use a detachable shower head or hose					
Hot tub, whirlpool spa, Jacuzzi tub					
Sat NEAR a working hot tub or whirlpool spa but did not get in					
Humidifier (whole house or portable)					If yes, specify type: If yes, what type of water is used in device? ☐ Bottled ☐ Tap ☐ Other: _____
Pool/splash pad/waterpark					
Recreational or cooling misters					
Steam room or wet sauna					
Decorative fountain					
Outdoor watering hose or sprinkler					
Beach, lake, pond, river, creek, etc.					
Other (specify)					

Medical History

Now I'm going to ask a few questions about your medical history and health behaviors.

14.) Have you ever been told by a healthcare provider that you had any of the following conditions:

Condition	Check one:			Comments
	YES	NO	UNK	
Chronic kidney disease				
Weakened immune system (due to cancer, chemotherapy, radiation therapy, immunosuppressive meds, HIV, organ transplant, etc.)				
Diabetes				
Chronic lung disease (COPD, emphysema)				
Asthma or chronic bronchitis				
Heart disease or congestive heart failure				
Liver disease				
Other conditions (<i>specify</i>)				

15.) Health behaviors:

	Check one:		Quantity per day (packs or drinks)	Duration (years)
	YES	NO		
Are you currently a smoker?				
Are you a former smoker?				
Do you drink alcohol?				

16.) Do you know anyone else with similar symptoms? ☐ Yes ☐ No ☐ Not sure

a.) If yes, complete the following table:

Name	Phone	State of Residence	Details of Shared Exposure

Additional Comments _____

Thank you so much for taking the time to answer these questions. Do you have any questions that I can help answer? If you have any questions or remember any further details later, please contact the _____ (health department) at phone: _____.

Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Tuesday, March 17, 2015 2:02 PM
To: Howard Croft (hcroft@cityofflint.com); Brent Wright (bwright@cityofflint.com); mglasgow@cityofflint.com; Daugherty Johnson (djohnson@cityofflint.com)
Cc: Gerald Ambrose (gambrose@cityofflint.com); 'nhenderson@cityofflint.com'; prysbym@michigan.gov
Subject: Water Quality Optimization Strategy

Howard,

As Mike Prysby and I mentioned during our phone call earlier today, the City should be taking action to optimize water quality in the City's distribution system which will in turn provide the City's water customers with water quality that helps limit the potential for legionella occurrence in premise plumbing. It is recognized that contraction of Legionnaires' Disease is not from ingestion of potable water and not regulated under Safe Drinking Water Act requirements. Further, there is currently no direct evidence of legionella in the City's public water system. However, actions by the City of Flint water system can help minimize the potential for an outbreak in customer plumbing systems.

These actions include the following:

- Water main pigging and flushing to remove biofilm, tuberculation, and sediment throughout the distribution system. Failure to remove such material will limit the effectiveness of any disinfectant. Pigging is the preferred process and equipment can be obtained at minimal cost. As the growth range for legionella starts at 68 degrees F, conducting this work as soon as possible in the spring and early summer with cooler temperatures would help reduce the potential for formation under warmer water conditions.
- Maintain pH levels of 7.2-7.8 in finished water and distribution system when possible to maximize the disinfection and oxidation potential of the hypochlorous acid residual (versus the less potent hypochlorite ion). Any optimized corrosion control plan practices regarding pH levels must be taken into consideration.
- Maintain a minimum free chlorine residual of 0.5 mg/L throughout the distribution system when possible. Continuous residual at this level has been shown to be effective in control of legionella. (This will need to be balanced with requirements to limit TTHM formation and comply with the TTHM standard.)
- Continuous operation and optimization of the ozone treatment equipment to treat raw source water. Ozone is highly effective in the destruction of legionella bacteria.
- Conduct routine monitoring for legionella bacteria at the water treatment plant tap and at locations in the distribution system. Note: sample locations must take water directly off the main and not be from premise plumbing systems. Distribution locations could include storage tank inlets or pumping stations. Monitoring at the WTP plant tap would demonstrate removal of any legionella present in raw source water. A private laboratory that specializes in water sample analysis for legionella would need to be used.
- Optimize water treatment plant operation for pathogen reduction under surface water treatment rule requirements. Optimizing the removal for similar pathogens can help reduce the potential for legionella.

A conference call with City staff would probably be best to facilitate further discussions of these actions in more detail. Mike and I can make ourselves available this week to discuss and answer any questions.

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

Rennaker, Joanne (DEQ)

From: Prysby, Mike (DEQ)
Sent: Friday, February 20, 2015 8:41 AM
To: 'bwright@cityofflint.com'
Subject: call

Brent,

Are we having a conference call today? I am available, give me a time for the call and I will make my-self available.

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

Rennaker, Joanne (DEQ)

From: Prysby, Mike (DEQ)
Sent: Friday, April 03, 2015 11:55 AM
To: Michael Glasgow; 'bwright@cityofflint.com'
Subject: Flint MORs

Mike, Brent

I was looking at Flint's MORs and I just noticed that ozone treatment parameters (ozone dosage and residuals) are not included. Ozone treatment parameters need to be included in the MOR. Please include this in future MORs. Also, if you can resurrect the ozone treatment parameters from previous months of operation (since going to the Flint River).....we would like that information to include in the previous MORs. Thanks.

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