STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH

IN RE: **Hart Flat Bear Mutual Water Company Water System**
Water System No. 1500556

TO: Mr. Kevin Coghlin, Board President
Hart Flat Bear Mutual Water Company
27027 Deer Creek Way
Keene, CA 93531

BY REGISTERED MAIL

CITATION FOR NONCOMPLIANCE -- Water System No. 1500556
TOTAL COLIFORM MCL VIOLATION – March 2013
Citation No. 03-19-13C-038

Issued on May 14, 2013

STATEMENT OF FACTS

Har Flat Bear Mutual Water Company Water System (hereinafter Water System) is classified as a community water system and serves a population of approximately forty three (43) persons through twenty one (21) service connections. The Water System has one (1) active source of supply, Well 01 (PS Code: 1500556-001), a 40,000-gallon storage tank and the distribution system. No treatment is provided to the well water. The Water System operates under the authority of a domestic water supply permit (No.. 556) issued on November 7, 1988, by the Kern County Environmental Health Services Department.

The Southern California Drinking Water Field Operations Branch, Division of Drinking Water and Environmental Management, California Department of Public

Health (hereinafter "Department") is responsible for enforcing the Safe Drinking Water Act and regulations promulgated pursuant thereto.

- The Water System is required to collect one (1) routine bacteriological sample per month. Please refer to the Water System's approved Bacteriological Sample Siting Plan (BSSP) or Table 64423-A.
- One (1) routine bacteriological quality sample collected on February 18, 2013, from the distribution system, tested positive for total coliform bacteria.
- All three (3) repeat samples collected on February 25, 2013, from the distribution system tested negative for total coliform bacteria.
- One (1) repeat sample collected on February 25, 2013, from Well 01 (also counted towards the Ground Water Rule's trigger source sampling requirement) tested negative for total coliform bacteria.
- **Repeat samples were not collected within 24 hours of being notified of the total coliform positive result [Section 64424(a), *Authorities*].**
- Due to total coliform positive samples in February 2013, the Water System was required to collect five routine bacteriological samples in March 2013.
- Three (3) out of five (5) routine bacteriological samples collected on March 25, 2013, from the distribution system tested positive for total coliform bacteria.
- One (1) bacteriological sample collected on March 29, 2013, from Well 01 (counted towards the Ground Water Rule's trigger source sampling requirement) tested negative for total coliform bacteria.
- One (1) special bacteriological sample collected on March 29, 2013, from the 40,000-gallon storage tank tested negative for total coliform bacteria.

- **Hart Flat Bear Mutual Water Company Water System failed the total coliform MCL for March 2013 [Section 64426.1(b)(2), *Authorities*].**
- None of the total coliform positive samples collected in February and March 2013 showed the presence of fecal coliform or Escherichia coli (*E.coli*) bacteria.
- All five (5) routine bacteriological samples collected the following month, on April 15, 2013, from the distribution system tested negative for total coliform bacteria.
- On March 28, 2013, Tami Welker of skOO'kum h_2o Monitoring, Inc., the Water System's contract sampler, notified the Department that the Water System failed the total coliform MCL for March 2013.
- On April 4, 2013, a public notice and Proof of Notification were emailed to the Water System for the March 2013 total coliform MCL failure.
- On April 25, 2013, the Department received signed and dated copies of the public notice and Proof of Notification from the Water System. According to these documents, public notification was completed on April 18, 2013.
- On April 25, 2013, an investigation report was emailed to the Water System for the March 2013 total coliform MCL failure.
- On April 22, 2013, the Department received a completed copy of the investigation report. The investigation report was completed by skOO'kum h_2o Monitoring, Inc., on behalf of the Water System.
- The investigation report indicates the possible cause of contamination was undetermined. Based on review of the total coliform positive samples, problems in the distribution system may be the cause of contamination. The investigation report indicates that the Water System plans to conduct a cross-connection control survey and implement a cross-connection control program.

- To help clear bacteriological contamination from the distribution system, the Water System performed emergency chlorination and flushing of the distribution system towards the end of March 2013.
- **It is noted that the Water System also experienced bacteriological contamination in October 2012 and November 2012. Due to history of total coliform positive samples, the Water System will be required to prepare an emergency chlorination plan.**
- Results of all bacteriological samples collected from January 2012 to April 2013 are summarized in **Attachment A.**

AUTHORITIES

Section 116577 of the CHSC, states in relevant part:
"(a) Each public water system shall reimburse the department for the actual costs incurred by the department for any of the following enforcement activities related to that water system:
(1) Preparing, issuing, and monitoring compliance with, an order or citation.
(2) Preparing, and issuing public notification

(b) The department shall submit an invoice for these enforcement costs to the public water system that requires payment prior to September 1 of the fiscal year following the fiscal year in which the costs were incurred. The invoice shall indicate the total hours expended, the reasons for the expenditure, and the hourly cost rate of the department. The costs set forth in the invoice shall not exceed the total actual costs to the department of the enforcement activities specified in this section."...

Section 116650 of the California Health and Safety Code (hereinafter CHSC), states in relevant part:
"(a) If the department determines that a public water system is in violation of this chapter or any regulation, permit, standard, or order issued or adopted thereunder, the department may issue a citation to the public water system. The citation shall be served upon the public water system personally or by registered mail.
(b) Each citation shall be in writing and shall describe with particularity the nature of the violation, including a reference to the statutory provision, standard, order, or regulation alleged to have been violated.
(c) For continuing violations, the citation shall fix the earliest feasible time for elimination or correction of the condition constituting the violation where appropriate. If the public water system fails to correct a violation within the time specified in the citation, the department may assess a civil penalty as specified in subdivision (e).
(d) For a noncontinuing violation of primary drinking standards, the department may assess in the citation a civil penalty as specified in subdivision (e).
(e) Citations issued pursuant to this section shall be classified according to the nature of the violation or the failure to comply. The department shall specify the classification in the citation and may assess civil penalties for each classification as follows:
(1) For violation of a primary drinking standard, an amount not to exceed one thousand dollars ($1,000) per day for each day that the violation occurred, including each day that the violation continues beyond the date specified for correction in the citation or order.

(2) For failure to comply with any citation or order issued for violation of a secondary drinking water standard that the director determines may have a direct or immediate relationship to the welfare of the users, an amount not to exceed one thousand dollars ($1,000) for each day that the violation continues beyond the date specified for correction in the citation or order.

(3) For failure to comply with any citation or order issued for noncompliance with any department regulation or order, other than a primary or secondary drinking water standard, an amount not to exceed two hundred dollars ($200) per day for each day the violation continues beyond the date specified for correction in the citation."

Section 116655 of the CHSC, states in relevant part:

"(a) Whenever the department determines that any person has violated or is violating this chapter, or any permit, regulation, or standard issued or adopted pursuant to this chapter, the director may issue an order doing any of the following:

(1) Directing compliance forthwith.

(2) Directing compliance in accordance with a time schedule set by the department.

(3) Directing that appropriate preventative action be taken in the case of a threatened violation.

(b) An order issued pursuant to this section may include, but shall not be limited to, any or all of the following requirements:

(2) That purification or treatment works be installed."

California Code of Regulations (hereinafter, CCR), Title 22, Section 64423, Table 64423-A establishes the minimum routine sampling requirements, and states in relevant part:

Monthly Population Served	*Service Connections*	*Minimum Number of Samples*
25 to 1000	15 to 400	1 per month
1,001 to 2,500	401 to 890	2 per month
2,501 to 3,300	891 to 1,180	3 per month
3,301 to 4,100	1,181 to 1,460	4 per month
4,101 to 4,900	1,461 to 1,750	5 per month
4,901 to 5,800	1,751 to 2,100	6 per month
5,801 to 6,700	2,101 to 2,400	7 per month
6,701 to 7,600	2,401 to 2,700	2 per week
7,601 to 12,900	2,701 to 4,600	3 per week
12,901 to 17,200	4,601 to 6,100	4 per week
17,201 to 21,500	6,101 to 7,700	5 per week
21,501 to 25,000	7,701 to 8,900	6 per week
25,001 to 33,000	8,901 to 11,800	8 per week
33,001 to 41,000	11,801 to 14,600	10 per week
41,001 to 50,000	14,601 to 17,900	12 per week
50,001 to 59,000	17,901 to 21,100	15 per week

CCR, Title 22, Section 64424 establishes the repeat sampling requirements, and states in relevant part:

"(a) If a routine sample is total coliform-positive, the water supplier shall collect a repeat sample set as described in paragraph (a)(1) within 24 hours of being notified of the positive result. The repeat samples shall all be collected within the same 24 hour time period. A single service connection system may request that the Department allow the collection of the repeat sample set over a four-day period.

(1) For a water supplier that normally collects more than one routine sample a month, a repeat sample set shall be at least three samples for each total coliform-positive sample. For a water supplier that normally collects one or fewer samples per month, a repeat sample set shall be at least four samples for each total coliform-positive sample.

(2) If the water supplier is unable to collect the samples within the 24-hour time period specified in subsection (a) or deliver the samples to the laboratory within the 24 hours after collection because of circumstances beyond its control, the water supplier shall notify the Department within 24 hours. The Department will then determine how much time the supplier will have to collect the repeat samples.

(b) When collecting the repeat sample set, the water supplier shall collect at least one repeat sample from the sampling tap where the original total coliform-positive sample was taken. Other repeat samples shall be collected within five service connections upstream or downstream unless there is no upstream and/or downstream service connection.

(c) If one or more samples in the repeat sample set is total-coliform positive, the water supplier shall collect and have analyzed an additional set of repeat samples as specified in subsections (a) and (b). The supplier shall repeat this process until either no coliforms are detected in one complete repeat sample set or the supplier determines that the MCL for total coliforms specified in 64426.1 has been exceeded and notifies the Department.

(d) If a public water system for which fewer than five routine samples/month are collected has one or more total coliform-positive samples, the water supplier shall collect at least five routine samples the following month. If the supplier stops supplying water during the month after the total-coliform positive(s), at least five samples shall be collected during the first month the system resumes operation. A water supplier may request the Department waive the requirement to collect at least five routine samples the following month, but a waiver will not be granted solely on the basis that all repeat samples are total coliform-negative. To request a waiver, one of the following conditions shall be met:

(1) The Department conducts site visit before the end of the next month the system provides water to the public to determine whether additional monitoring and/or corrective action is necessary to protect public health.

(2) The Department determines why the sample was total coliform-positive and establishes that the system has corrected the problem or will correct the problem before the end of the next month the system serves water to the public. If a waiver is granted, a system shall collect at least one routine sample before the end of the next month it serves water to the public and use it to determine compliance with 64426.1."

CCR, Title 22, Section 64426.1 establishes the total coliform maximum contaminant level and states in relevant part:

"(a) Results of all samples collected in a calendar month pursuant to Sections 64423, 64424, and 64425 that are not invalidated by the Department or the laboratory shall be included in determining compliance with the total coliform MCL. Special purpose samples such as those listed in 64421(b) and samples collected by the water supplier during special investigations shall not be used to determine compliance with the total coliform MCL.

(b) A public water system is in violation of the total coliform MCL when any of the following occurs:

(1) For a public water system which collects at least 40 samples per month, more than 5.0 percent of the samples collected during any month are total coliform-positive; or

(2) For a public water system with collects fewer than 40 samples per month, more than one sample collected during any month is total coliform-positive; or

(3) Any repeat sample is fecal coliform-positive or E. coli-positive; or

(4) Any repeat sample following a fecal coliform-positive or E. coli-positive routine sample is total coliform-positive.

(c) If a public water system is not in compliance with paragraphs (b)(1) through (4), during any month in which it supplies water to the public, the water supplier shall notify the Department by the end of the business day on which this is determined, unless the determination occurs after the Department office is closed, in which case the supplier shall notify the Department within 24 hours of the determination. The water supplier shall also notify the consumers served by the water system. A Tier 2 Public Notice shall be given for violations of paragraphs (b)(1) or (2), pursuant to section 64463.4. A Tier 1 Public Notice shall be given for violations of paragraphs (b)(3) or (4), pursuant to section 64463.1."

DETERMINATIONS

Based upon the above Statement of Facts and Authorities, the Department determines that the Water System has violated the following:

1. CCR, Title 22, Section 64426.1(b)(2): Specifically, the Water System violated the total coliform MCL for March 2013 when more than one sample collected from the Water System, tested positive for total coliform bacteria.

2. CCR, Title 22, Section 64424(a): Specifically, during the month of February 2013, the Water System failed to collect repeat samples within 24 hours of being notified of the routine total coliform positive result.

The above violations are classified as non-continuing violations.

DIRECTIVES

Hart Flat Bear Mutual Water Company is hereby directed to take the following actions:

1. Cease and desist from failing to comply with Section 116555(a) of the California Health and Safety Code (CHSC) and Sections 64424(a) and 64426.1 (b)(2) of Title 22, California Code of Regulations.

2. In the future, the Water System shall collect the required number of four (4) repeat samples within 24 hours of receipt of notification from its contract laboratory.

3. **By June 30, 2013, the Water System shall submit an Emergency Chlorination Plan (ECP) to the Department.** Guidance for preparing an ECP is provided under **Attachment B**.

4. By **June 30, 2013,** the Water System shall provide information to the Department about implementation of a cross-connection control program (required under Title 17, CCR). Information about the existing backflow prevention assemblies and findings of last cross-connection control survey shall be also included in the response.

5. Notify the Department within five business days of the date of service of this Citation if the deadlines established by this Citation will not be met and explain, in writing, the reason(s) for delay(s).

6. The Water System shall reimburse the Department, in accordance with an invoice that shall be provided to the Water System, the costs for enforcement activities, and such reimbursement shall be made prior to September 1 (or by a different date if specified by the Department) of the fiscal year following the fiscal year in which such costs are incurred as described in CHSC Section 116577(a)(1-2) and 116577(b).

FURTHER ENFORCEMENT ACTIONS

Section 116270, Division 104, Part 12, Chapter 4 of the CHSC authorizes the Department to: issue additional citations with assessment of penalties if the public water system continues to fail to correct a violation identified in a citation; take action to suspend or revoke a permit that has been issued to a public water system if the system has violated applicable law or regulations or has failed to comply with orders of the Department; and petition the superior court to take various enforcement measures against a public water system that has failed to comply with orders of the Department. The Department does not waive any further enforcement action by issuance of this citation.

PARTIES BOUND

This citation shall apply to and be binding upon Hart Flat Bear Mutual Water Company, its officers, directors, agents, employees, contractors, successors, and assignees.

SEVERABILITY

The directives of this citation are severable, and Hart Flat Bear Mutual Water Company shall comply with each and every provision thereof, notwithstanding the effectiveness of any other provision.

CIVIL PENALTY

Section 116650, subsection (d) and (e) of the CHSC allow for the assessment of a civil penalty for the failure to comply with the requirements of the Safe Drinking Water Act. Failure to comply with any Directive of this Citation may result in the Department imposing an administrative penalty of not less than $200 (two hundred

dollars) for each day that the violation continues beyond the date set for correction in this Citation.

The Department does not waive any further enforcement action by issuance of this citation, and expressly reserves the right to issue a citation with penalties for the violations on which the Directives of this citation are based.

May 14, 2013
Date

Jaswinder Dhaliwal
Jaswinder S. Dhaliwal, P.E.
Senior Sanitary Engineer
Tehachapi District
SOUTHERN CALIFORNIA BRANCH
DRINKING WATER FIELD OPERATIONS

Attachment
Attachment A: Bacteriological Summary January 2012 through April 2013
Attachment B: Guidance for Preparing an Emergency Chlorination Plan

cc: Kern County Environmental Health Services Department (w/o attachment)
Dan Sackett, skOO'kum h_2o Monitoring, Inc.

JSD//lm

ATTACHMENT A

Hart Flat Bear Mutual Water

1500556 *Distribution System Freq: 1/M*

Sample Date	*Time*	*Location*	*T Coli*	*E Coli*	*F Coli*	*Type*	*Cl2*	*Violation*	*Comment*
1/17/2012	10:00	1ROU	A	A		Routine			
2/13/2012	8:45	1ROU	A	A		Routine			
3/8/2012	12:58	1ROU	A	A		Routine			
3/13/2012	11:15	1ROU	A	A		Routine			
4/17/2012	10:00	1ROU	A	A		Routine			
5/23/2012	9:00	1ROU	A	A		Routine			
6/26/2012		1ROU	A	A		Routine			
7/19/2012	12:15	1ROU	A	A		Routine			
8/23/2012	13:20	1ROU	A	A		Routine			
9/20/2012	13:00	1ROU	A	A		Routine			
10/23/2012	9:15	1ROU	P	A		Routine			
10/29/2012	13:05	1REP1	A	A		Repeat			
10/29/2012	13:20	1REP2	A	A		Repeat			
10/29/2012	13:30	1REP3	A	A		Repeat			
11/28/2012	10:45	1ROU	A	A		Routine			
11/28/2012	10:55	2ROU	A	A		Routine			
11/28/2012	11:10	3ROU	A	A		Routine			
11/28/2012	11:25	4ROU	P	A		Routine			
11/28/2012	11:35	5ROU	A	A		Routine			
11/30/2012	10:45	1REP1	A	A		Repeat			
11/30/2012	10:55	1REP2	A	A		Repeat			
11/30/2012	11:05	1REP3	A	A		Repeat			
12/20/2012	12:10	1ROU	A	A		Routine			
12/20/2012	12:20	2ROU	A	A		Routine			
12/20/2012	12:30	3ROU	A	A		Routine			
12/20/2012	12:40	4ROU	A	A		Routine			
12/20/2012	12:50	5ROU	A	A		Routine			
1/17/2013	10:15	1ROU	A	A		Routine			
2/18/2013	11:00	1ROU	P	A		Routine			
2/25/2013	12:08	1REP1	A	A		Repeat			
2/25/2013	12:14	1REP2	A	A		Repeat			
2/25/2013	12:23	1REP3	A	A		Repeat			
3/25/2013	5:15	29451 Hart Oaks	P	A		Routine			
3/25/2013	5:25	29618 Hart Oaks	P	A		Routine		MCL	Cit # 03-18-13C-038 issued.
3/25/2013	5:35	29501 Hart Oaks	P	A		Routine			
3/25/2013	5:45	29900 Hart Oaks	A	A		Routine			

Sample Date	*Time*	*Location*	*T Coli*	*E Coli*	*F Coli*	*Type*	*Cl2*	*Violation*	*Comment*
3/25/2013	6:00	29757 Hart Oaks	A	A		Routine			
3/29/2013	8:10	Storage Tank	A	A		Other			
4/8/2013	7:30	29757 Hart Oak D	A	A		Other			
4/8/2013	7:40	29900 Hart Oak D	A	A		Other			
4/8/2013	7:50	29501 Hart Oak D	A	A		Other			
4/8/2013	8:00	29618 Hart Oak D	A	A		Other			
4/8/2013	8:10	29451 Hart Oak D	A	A		Other			
4/15/2013	8:10	29900 Hart Oak D	A	A		Routine			
4/15/2013	17:40	29451 Hart Oak D	A	A		Routine			
4/15/2013	17:50	29618 Hart Oak D	A	A		Routine			
4/15/2013	18:00	29501 Hart Oak D	A	A		Routine			
4/15/2013	18:20	29757 Hart Oak D	A	A		Routine			

Hart Flat Bear Mutual Water

1500556

Source Monitoring Freq:

Sample Date	*Time*	*Source*	*T Coli*	*E Coli*	*F Coli*	*Violation*	*Comment*
10/29/2012	13:40	WELL #1	A	A			
11/30/2012	11:15	WELL #1	A	A			
2/25/2013	12:00	WELL #1 Repeat	A	A			
3/29/2013	8:30	WELL #1 Repeat	A	A			

ATTACHMENT B

State of California—Health and Human Services Agency
California Department of Public Health

RON CHAPMAN, MD, MPH
Director

EDMUND G. BROWN JR.
Governor

Emergency Chlorination Plan Guidance (April 2011) for Public Water Systems

The purpose of this Emergency Chlorination Plan (ECP) is to assist utilities implement emergency chlorination. The guidance provided below is designed to facilitate the installation of emergency chlorination equipment and to assist in the setting of chemical dosage in order to maintain acceptable free chlorine residual needed to insure public health protection immediately after a disaster. Items which should be obtained prior to the onset of a disaster include the following equipment:

1. Emergency chlorination units.
2. Chlorine residual test kits (preferably DPD)
3. Granular Calcium Hypochlorite, 65% available chlorine, (liquid sodium hypochlorite has a relatively short shelf life so it is advisable that it not be purchased in advance). Chemicals used for emergency chlorination must be approved under ANSI/NSF[1] Standard 60 (direct additives).

Installation Procedures

A utility should not wait until an emergency has occurred before it attempts to install its emergency chlorination equipment. It is advisable that all field maintenance staff be familiar with the installation procedures in order to quickly install the emergency chlorination equipment. The remainder of this plan addresses the use of hypochlorinators in the event of an emergency. For those utilities which use gas chlorination units, they should already be familiar with their operation if they are using this type of equipment.

The chlorination equipment purchased by the utility must be adequately sized for the proposed installation. The feed capacity of the hypochlorinator should allow the utility to does at a minimum of 5 parts per million free chlorine residual. After the emergency chlorination units have been physically connected to the wells and/or other sources in question, refer to the attached table or use the following procedures to calculate the appropriate settings. If you are unable to perform these calculations, contact a staff of the Drinking Water Program immediately.

The attached tables may be used to mix a solution of a known strength. Decide on a solution strength that you wish to use and find the amount of chlorine needed for a 100 gallon barrel from Table 1.

Table 2 can be used to determine the volume of solution to be added for different flow rates for each mg/L of chlorine dosage. It should be recognized that large capacity wells will need stronger solution strengths or the feed barrel will need to be filled too frequently. The volumes in table 2 are in gallons per day (gpd). If the feed pump capacity is given in gallons per hour, then the volume from Table 2 must be divided by 24 to give a gph value.

To determine the appropriate pump setting, the value from Table 2 must be divided by the feed pump capacity.

Example:

Feed Pump Capacity = 10 gph; Q = 1500 gpm; 7% solution; 5 mg/L dosage

From table 2 → Chlorine Volume = 30.9 gpd for each mg/L.

For 5 mg/L → 5 x (30.9) = 154.5 gpd

Since feed pump has a maximum capacity of 10 gph, the appropriate length of stroke setting is:

$$\frac{154.5 \times 24}{10 \text{ gph}} = 0.64$$

Outlined below are the equations to use if the Tables are not used:

1. A solution barrel of a known volume must be obtained. The barrel should be filled with a known volume of water. To this volume, a known weight of chemical should be added. The solution strength must be determined using the equation given below:

$$\% \text{ solution} = \frac{\text{Weight of chemical added to solution barrel (lbs)}}{\text{Weight of water in solution barrel (lbs)}} \times 100$$

(1 gallon of water weighs 8.34 lbs)

A 6% solution can be obtained by adding one half pound of chemical per gallon of water using a 100 gallon barrel. (see below):

50 / (100 x 8.34 lb/gal of water) x 100 = 5.99 or 6%

↓

used to get percentage

To calculate the pounds per hour of chemical that must be added to obtain a known chlorine concentration, the following equation must be used:

Equation #1:

lbs per hour of chemical = 8.34 x desired dosage in ppm x flow rate in gpm x 60 min/1,000,000

Assuming the desired dosage is 5 ppm that gives the following equation:

Equation #2: lbs per hour of chemical = 2.5×10^{-3} x flow rate in gpm

Next you must determine the required gallons per hour of chemical to be added. This must be obtained using the following equation:

Equation #3:

gallons per hour of chemical = lbs per hour / 8.34 / solution strength / 100 (from above)

Once this value has been obtained, then the next step is to review the maximum feed rate in gallons per day of the chemical feed pump. This is generally printed in a label attached to the pump and it may specify the discharge pressure this maximum rate applies to. Most chemical feed pumps have either a length of stroke setting or two settings for frequency of stroke and length of stroke. To determine what settings should be used, a review of the instrumentation on the pump must be conducted.

If two control settings are provided, then set the frequency control at 100% and provide adjustment only to the length of stroke adjustment. The equation to be used to determine at what setting the length of stroke should be, is given below:

Percent length of stroke = gallons per hour (obtained above) x 24 x 100 / the pump capacity in gpd

This numerical setting should be used when adjusting the pump. If both pump settings are to be changed from 100%, then the percent stroke equation is as follows:

Percent length of stroke = gallons per hour x 24 x 100 / stroke frequency / pump capacity in gpd

A check on the actual dosage can be performed by using the total gallons of solution pumped within a known operating period. That information can be used as follows:

$$\text{Actual Dosage} = \frac{\text{gallons of solution x solution strength}}{\text{gallons of water treated in MG}}$$

An easier way to use hypochlorination equipment is to have calibration or volumetric feed cylinders installed on the intake line to the pump. If these cylinders are available, then a known volume of solution can be pumped and the time it takes to pump that volume is used to determine gallons per hour at a known discharge pressure. The actual percent solution must still be known to conduct the other calculations.

Once a utility has implemented emergency chlorination of their system, it is important to conduct follow up distribution chlorine residual monitoring to determine the effectiveness of the chlorination process. In the event of an emergency, hypochlorination equipment should be used to dose the system at 2 ppm of free chlorine residual. Chlorine residual monitoring within the distribution system should take place to verify that an adequate residual is being obtained

at all locations within the distribution system. Any areas which have suppressed chlorine residuals should receive further investigation to determine whether or not there are other problems associated with the reduced residuals.

Flushing should be provided if possible, to draw the chlorinated water into the distribution system as soon as possible.

In addition to the chlorine residual monitoring, bacteriological sampling of the distribution system in all areas should be conducted. Chlorine residual monitoring in addition to bacteriological sampling should be used to further define areas of distribution system that need additional investigation. Chlorination of the system should continue until it has been verified that no structural problems exist within the distribution system and all bacteriological monitoring shows that there is no presence of pathogenic organisms.

TABLE 1

AMOUNT OF CHLORINE PER 100 GALLON BARREL*

Solution Strength / Type of Chlorine	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%
5% Sodium Hypochlorite**	60 gal	80 gal	100 gal								
12.5% Sodium Hypochlorite**	24 gal	32 gal	40 gal	48 gal	56 gal	64 gal	72 gal	80 gal	88 gal	96 gal	
65% Calcium Hypochlorite***	38 lbs	51 lbs	64 lbs	77 lbs	90 lbs	103 lbs	116 lbs	128 lbs	141 lbs	167 lbs	

* Add the quantity indicated to the 100 gallon barrel and then fill the remaining volume with water.

** The sodium hypochlorite must be ANSI/NSF[1] certified for potable drinking water and approved as direct additive (ANSI/NSF Standard 60).

1: American National Standard Institute (ANSI) or National Sanitation Foundation (NSF)

*** HTH, tablets or granular chlorine

Example: For 10% solution using 12.5% sodium hypochlorite, use 80 gallons of sodium hypochlorite and add 20 gallons of water.

Example: For 10% solution using 65% available Calcium Hypochlorite [$Ca(OCl)_2$], use 128 lbs of granular chlorine and add water to fill barrel and mix.

TABLE 2

CHLORINE VOLUME REQUIRED GALLONS PER DAY (GPD) PER MG/L OR PPM OF DESIRED CHLORINE DOSAGE*

Solution Strength	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%
Flow Rate											
50 gpm	2.4	1.8	1.4	1.2	1.03	0.9	0.8	0.7	0.7	0.6	0.6
75 gpm	3.6	2.7	2.0	1.8	1.5	1.4	1.2	1.0	1.0	0.9	0.8
100 gpm	4.8	3.6	2.9	2.4	2.0	1.8	1.6	1.4	1.3	1.2	1.1
300 gpm	14.4	10.8	8.6	7.2	6.2	5.4	4.8	4.3	3.9	3.6	3.3
500 gpm	24.0	18.0	14.4	12.0	10.3	9.0	8.0	7.2	6.6	6.0	5.5
800 gpm	38.4	28.8	23.0	19.2	16.5	14.4	12.8	11.5	10.5	9.6	8.9
1000 gpm	48.0	36.0	28.0	24.0	20.6	18.0	16.0	14.4	13.1	12.0	11.1
1500 gpm	72.0	54.0	21.5	36.0	30.9	27.0	24.0	21.6	19.6	18.0	16.6
2000 gpm	96.0	72.0	57.6	48.0	41.1	36.0	32.0	28.8	26.2	24.0	22.2

* Values in the Table are the flow rates in gallons of solution per day that be added for each mg/L of desired dosage.

Example: Well Discharge = 1,000 gpm

Solution Strength = 5%

Desired Dosage = 5 mg/L or 5 ppm

From Table 2, Need to add 28.8 gpd per mg/L (or ppm)

Therefore, 5 mg/L x 28.8 gpd/(mg/L) = 144 gpd.