2018 Consumer Confidence Report

Water System Name: **South Fork Estates Mutual Water Company** Report Date: 06/21/2019

We test the drinking water quality for many constituents as required by state and federal regulations. This report shows the results of our monitoring for the period of January 1 to December 31, 2018 and may include earlier monitoring data.

Este informe contiene información muy importante sobre su agua para beber. Favor de comunicarse South Fork Estates Mutual Water Company a Quail Run Drive, Three Rivers CA 93277 para asistirlo en español.

Type of water source(s) in use: Well (Also referred to as groundwater)

Name & general location of source(s): Wells #1, #2, #3 in South Fork Estates, Three Rivers, Ca 93271

Drinking Water Source Assessment information: Copies of the summaries of the source water assessments for wells #1 and #2 (prepared by the Tulare County Health Services in December 2002) and for Well #3 (prepared for us in July 2014 by California Rural Water Association) are attached.

Time and place of regularly scheduled board meetings for public participation: A meeting for all owners is held on the last Saturday of February each year. Owners are notified by mail of the date, time and location. The Board of Directors meets quarterly or as needed. The date, time, and location may be obtained from any board member.

For more information, contact: Patty Pliskin Phone: (559) 561-4709

TERMS USED IN THIS REPORT

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs (or MCLGs) as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (U.S. EPA).

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Primary Drinking Water Standards (PDWS): MCLs and MRDLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Secondary Drinking Water Standards (SDWS): MCLs for contaminants that affect taste, odor, or appearance of the drinking water. Contaminants with SDWSs do not affect the health at the MCL levels.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Regulatory Action Level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

Variances and Exemptions: Permissions from the State Water Resources Control Board (State Board) to exceed an MCL or not comply with a treatment technique under certain conditions.

Level 1 Assessment: A Level 1 assessment is a study of the water system to identify potential problems and determine (if possible) why total coliform bacteria have been found in our water system.

Level 2 Assessment: A Level 2 assessment is a very detailed study of the water system to identify potential problems and determine (if possible) why an *E. coli* MCL violation has occurred and/or why total coliform bacteria have been found in our water system on multiple occasions.

ND: not detectable at testing limit
ppm: parts per million or milligrams per liter (mg/L)
ppb: parts per billion or micrograms per liter (µg/L)
ppt: parts per trillion or nanograms per liter (ng/L)
ppq: parts per quadrillion or picogram per liter (pg/L)
pCi/L: picocuries per liter (a measure of radiation)

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

- *Microbial contaminants*, such as viruses and bacteria, that may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
- *Inorganic contaminants*, such as salts and metals, that can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- *Pesticides and herbicides*, that may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
- *Organic chemical contaminants*, including synthetic and volatile organic chemicals, that are byproducts of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, agricultural application, and septic systems.
- *Radioactive contaminants*, that can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, the U.S. EPA and the State Board prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. The U.S. Food and Drug Administration regulations and California law also establish limits for contaminants in bottled water that provide the same protection for public health.

Tables 1, 2, 3, 4, 5, and 6 list all of the drinking water contaminants that were detected during the most recent sampling for the constituent. The presence of these contaminants in the water does not necessarily indicate that the water poses a health risk. The State Board allows us to monitor for certain contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of the data, though representative of the water quality, are more than one year old. Any violation of an AL, MCL, MRDL, or TT is asterisked. Additional information regarding the violation is provided later in this report.

The State allows us to monitor for some contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of our data, though representative, are more than one year old.

TABLE 1 – SAMPLING RESULTS SHOWING THE DETECTION OF COLIFORM BACTERIA

Microbiological Contaminants (complete if bacteria detected)	**Highest No. of Detections**	**No. of Months in Violation**	**MCL**	**MCLG**	**Typical Source of Bacteria**
Total Coliform Bacteria (state Total Coliform Rule)	(In a month) 3*	1	1 positive monthly sample	0	Naturally present in the environment
Fecal Coliform or *E. coli* (state Total Coliform Rule)	(In the year) 0	0	A routine sample and a repeat sample are total coliform positive, and one of these is also fecal coliform or *E. coli* positive		Human and animal fecal waste
E. coli (federal Revised Total Coliform Rule)	(In the year) 0	0	(a)	0	Human and animal fecal waste

(a) Routine and repeat samples are total coliform-positive and either is *E. coli*-positive or system fails to take repeat samples following *E. coli*-positive routine sample or system fails to analyze total coliform-positive repeat sample for *E. coli*.

TABLE 2 – SAMPLING RESULTS SHOWING THE DETECTION OF LEAD AND COPPER

Lead and Copper (complete if lead or copper detected in the last sample set)	**Sample Date**	**No. of Samples Collected**	**90th Percentile Level Detected**	**No. Sites Exceeding AL**	**AL**	**PHG**	**No. of Schools Requesting Lead Sampling**	**Typical Source of Contaminant**
Lead (ppb)	09/23/2016	5	2.85	0	15	0.2	Not Applicable	Internal corrosion of household water plumbing systems; discharges from industrial manufacturers; erosion of natural deposits
Copper (ppm)	09/23.2016	5	0.145	0	1.3	0.3	Not applicable	Internal corrosion of household plumbing

								systems; erosion of natural deposits; leaching from wood preservatives

TABLE 3 – SAMPLING RESULTS FOR SODIUM AND HARDNESS

Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**	**MCL**	**PHG (MCLG)**	**Typical Source of Contaminant**
Sodium (ppm)	10/09/2018	22	19-23	None	None	Salt present in the water and is generally naturally occurring
Hardness (ppm)	10/09/2018	263	250-280	None	None	Sum of polyvalent cations present in the water, generally magnesium and calcium, and are usually naturally occurring

TABLE 4 – DETECTION OF CONTAMINANTS WITH A PRIMARY DRINKING WATER STANDARD

Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**	**MCL [MRDL]**	**PHG (MCLG) [MRDLG]**	**Typical Source of Contaminant**
Turbidity	10/09/2018	0.08333	0.0 - 0.15	TT	N/A	Soil Runoff. Turbidity has no health effects. However, high levels of turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.
Gross Alpha Particle Activity (pCi/L)	10/09/2018	4.03	ND – 12.1	15 pCi/L	(0)	Erosion of natural deposits. Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Combined Radium 226 & 228 (pCi/L)	Multiple sample dates between Feb – Oct 2016	0.48	0.0636-2.36	5 pCi/L	(0)	Erosion of natural deposits. Some people who drink water containing radium 226 or 228 in excess of the MCL over many years may have an increased risk of getting cancer.
Arsenic (ug/L)	10/09/2018	2.57	2.3 – 2.8	10	0.004	Erosion of natural deposits; runoff from orchards; glass and electronics production wastes. Some people who drink water containing arsenic in excess of the MCL over many years may experience skin damage or circulatory system problems, and may have an increased risk of getting cancer.
Barium (mg/L)	10/09/2018	1.67	None detected – 2.50	4	1	Discharge of oil drilling wastes and from metal refineries; erosion of natural deposits. Some people who drink water containing barium in excess of

						the MCL over many years may experience an increase in blood pressure.
Fluoride (F) (mg/L)	10/09/2018	0.15	0.14-0.16	2.0	1	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories. Some people who drink water containing fluoride in excess of the federal MCL of 4 mg/L over many years may get bone disease, including pain and tenderness of the bones. Children who drink water containing fluoride in excess of the state MCL of 2 mg/L may get mottled teeth.
Nitrate (as N) (mg/L)	02/20/2018 05/21/2018 08/21/2018 10/09/2018	4.59	0.70 -7.0	10	10	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits. Infants below the age of six months who drink water containing nitrate in excess of the MCL may quickly become seriously ill and, if untreated, may die because high nitrate levels can interfere with the capacity of the infant's blood to carry oxygen. Symptoms include shortness of breath and blueness of the skin. High nitrate levels may also affect the oxygen-carrying ability of the blood of pregnant women.
Uranium (pCi/L)	10/23/2015	3.7	2.4-5.9	20	0.43	Erosion of natural deposits. Some people who drink water containing uranium in excess of the MCL over many years may have kidney problems or an increased risk of getting cancer.
Uranium (pCi/L) Well #3	Multiple dates Feb-Sept. 2016	6.14	3.9-8.4	20	0.43	Erosion of natural deposits. Some people who drink water containing uranium in excess of the MCL over many years may have kidney problems or an increased risk of getting cancer.
Chlorine (mg/L)	10/09/2018	20.3	19-23	[MDRL= 4.0 (as Cl_2)]	[MRDLG= 4 (as Cl_2)]	Drinking water disinfectant added for treatment. Some people who use water containing chlorine well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chlorine well in excess of the MRDL could experience stomach discomfort.

TABLE 5 – DETECTION OF CONTAMINANTS WITH A <u>SECONDARY</u> DRINKING WATER STANDARD

Chemical or Constituent (and reporting units)	Sample Date	Level Detected	Range of Detections	SMCL	PHG (MCLG)	Typical Source of Contaminant
Zinc (mg/l)	10/09/2018	0.83	0.66-1.20	5.0	None	Runoff/leaching from natural deposits; industrial wastes
Total Dissolved Solids (mg/l)	10/09/2018	380	360-390	1,000	None	Runoff/leaching from natural deposits
Specific Conductance (µS/cm)	03/11/2016	580	550-600	1600	None	Substances that form ions when in water; seawater influence.
Sulfate (mg/l)	10/09/2018	23.67	17-35	500	None	Runoff/leaching from natural deposits; industrial wastes

Additional General Information on Drinking Water (as of 6/18/10:11AM)

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the U.S. EPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. U.S. EPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

Lead-Specific Information: 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. South Fork Estates Mutual Water Company 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. [***OPTIONAL:*** If you do so, you may wish to collect the flushed water and reuse it for another beneficial purpose, such as watering plants.] 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 (1-800-426-4791) or at http://www.epa.gov/lead.

Nitrate in drinking water at levels above 10 mg/L is a health risk for infants of less than six months of age. Such nitrate levels in drinking water can interfere with the capacity of the infant's blood to carry oxygen, resulting in serious illness; symptoms include shortness of breath and blueness of the skin. Nitrate levels above 10 mg/L may also affect the ability of the blood to carry oxygen in other individuals, such as pregnant women and those with specific enzyme deficiencies. If you are caring for an infant, or you are pregnant, you should ask advice from your health care provider.

Summary Information for Violation of a MCL, MRDL, AL, TT, or Monitoring and Reporting Requirement

PLEASE NOTE: This Consumer Confidence Report (CCR) reflects changes in drinking water regulatory requirements during 2016. All water systems are required to comply with the state Total Coliform Rule and effective April 1, 2016, all water systems are also required to comply with the federal Revised Total Coliform Rule. The new federal rule maintains the purpose to protect public health by ensuring the integrity of the drinking water distribution system and monitoring for the presence of microbials (i.e., total coliform and E. coli *bacteria). The U.S. EPA anticipates greater public health protection as the new rule requires water systems that are vulnerable to microbial contamination to identify and fix problems. Water systems that exceed a*

specified frequency of total coliform occurrences are required to conduct an assessment to determine if any sanitary defects exist. If found, these must be corrected by the water system.

District 24 (Tulare) of the Division of Drinking Water (DDW) of the California State Water Resources Control Board (SWRCB) is the regulator of our water system. They administer both state and federal regulations pertaining to our system.

VIOLATION OF A MCL, MRDL, AL, TT, OR MONITORING AND REPORTING REQUIREMENT				
Violation	**Explanation**	**Duration**	**Actions Taken to Correct the Violation**	**Health Effects Language**
During 2018 our water system incurred one violation, which was for exceeding the Total Coliform Maximum Level. As a result, we received a citation from the SWRCB, DDW. This is: **Citation No. 03-24-18-036 issued March 21, 2018**	The MCL for Total Coliform for a water system of our size is that in any month, no more than one sample of the samples we are required to take in accordance with state or federal regulations (regulatory samples), is total coliform-positive. In February 2018, three of six regulatory samples from our water system were total coliform-positive, which is a violation of the MCL. Note that our system routinely takes samples not required by regulation. These we refer to as "other" or "non-regulatory" samples.	The regulatory samples were taken on February 20 and 22. On February 26, District 24 of the SWRCB directed that we distribute a Boil Water Order (BWO) to all users of water from our system which was done on the same day. As outlined in more detail in the following section, we took several actions to remove and prevent reentry of coliform bacteria into our system. Additional samples were taken to ensure contamination was no longer present. The BWO was lifted effective April 17, 2018.	The citation issued for this violation directed us to take five actions (directives). We have complied with 4 of the 5 directives and the 5th is pending compliance. The following section of this report has a detailed discussion of the directives and actions taken.	Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially harmful, waterborne pathogens may be present or that a potential pathway exists through which contamination may enter the drinking water distribution system. We found coliforms indicating the need to look for potential problems in water treatment or distribution. When this occurs, we are required to conduct an assessment to identify problems and to correct any problems that were found during these assessments.

Actions Taken to Correct this Violation

As a result of this violation we were required to take five actions (referred to as "directives"). We have completed Directives 2 (Notification of persons served by our system of the violation); 3 (Submission of a Compliance Certification Form that the notification required by directive 2 was completed); and 4 (Complete and return a "Notification of Receipt" form to the State Water Board).

Directive 1 (Do not exceed the MCL for total coliform bacteria in all future reporting periods); is an open commitment with no time limit. Actions taken during the period of the BWO and afterward to help prevent a reoccurrence include the following:

On February 27-28, using chlorine, we disinfected the water system including all tanks and mains. Allowing for suitable contact time for the chlorine, we flushed the system to remove the chlorine, and to remove any sand or debris that might have accumulated in the mains and that could harbor coliform bacteria. We inspected the water system for possible sources of contamination. During the first week of April we replaced two major valves in the booster pump lines that may have allowed contaminants into our system. In May we replaced two vacuum/air release valves in our mains that may also have allowed contaminants into the system. As part of the repair in May, we added a flushing port at the end of a 75 foot dead-end section of the main, permitting the removal of stagnant water that had accumulated in that section of pipe.

We continue to monitor our system for potential sources of contamination and periodically, as a precaution, disinfect our system using chlorine, and after disinfection, flush our system to remove sand and debris from the mains.

In order to more closely monitor the quality of the water in our system and more quickly evaluate our situation if a sample test is total coliform-positive, we have increased the number of non-regulatory samples we take every month. A water system of our size is required to take one sample each month from sample points representative of our system. We use three sample points, and in accordance with the sample plan approved by District 24, SWRCB, we rotate those points on a set schedule every month. At the time we take the monthly required sample, we voluntarily take additional "other" samples from two other sample points to ensure we are monitoring all parts of our water system. We also periodically take non-regulatory samples from our wells to ensure bacteria have not entered any of our water sources.

Directive 5 (Submit a plan and time schedule for the installation of continuous chlorination equipment in the water system.) has not been completed. Continuous Chlorination is discussed in a separate section at the end of this report.

Summary Information for Federal Revised Total Coliform Rule

Level 1 and Level 2 Assessment Requirements

Level 1 or Level 2 Assessment Requirement not Due to an *E. coli* MCL Violation

Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially harmful, waterborne pathogens may be present or that a potential pathway exists through which contamination may enter the drinking water distribution system. We found coliforms indicating the need to look for potential problems in water treatment or distribution. When this occurs, we are required to conduct assessment(s) to identify problems and to correct any problems that were found during these assessments.

During the 2018, no Level 1 assessment was required of our system.

During 2018, one (1) Level 2 assessment was required and was completed for our water system by District 24, DDW. The assessment was required as a result of the same incident described in the violation cited above: Having two or more positive samples for total coliform bacteria in one month (February 2018).

We were required to take two (2) corrective actions and have completed one (1) of those actions.

The first required action was to "conduct a cross connection control survey completed by a specialist." This was accomplished during 2018,

The second requirement was the implementation of continuous chlorination. This requirement is the same as the directive cited in the above violation and is discussed in more detail in a separate section at the end of this report.

SOURCE WATER ASSESSMENT SUMMARY INFORMATION

For Use with Annual Consumer Confidence Reports

SOURCE WATER ASSESSMENT SUMMARY INFORMATION

Source water assessments were conducted for wells #1 and #2 in December 2002 by the Tulare County Environmental Health Department. The findings were identical.

A source water assessment for well #3 was conducted by the California Rural Water Association in July 2014 when the well was added to our water system.

The Vulnerability Findings of each report are printed below. A copy of each full report can be obtained by contacting:

South Fork Estates Mutual Water Company
P.O. Box 597
Three Rivers, CA 93271

Vulnerability Summary [Well #1]

California Drinking Water Source Assessment and Protection (DWSAP) Program

District Name LPA Tulare County **District No.** 84 Tulare
System Name SOUTH FORK ESTATES **System No.** 5403113
Source Name WELL 01 001 **Source No.** 5403113-001

Completed by LPA Tulare County **Date** December 2002

A source water assessment was conducted for the **WELL 01**
of the **SOUTH FORK ESTATES** water system in **December 2002**

According to DHS records, this Source is Groundwater. This Assessment was done using the Default Groundwater System Method.

The source is considered most vulnerable to the following activities associated with contaminants detected in the water supply:

Historic gas stations

The source is considered most vulnerable to the following activities not associated with any detected contaminants:

Mining operations - Historic

Discussion of Vulnerability

The activities to which the South Fork Estates water system is most vulnerable include historic gas stations with known contaminant plumes, septic systems, and grazing animals. The leaking underground storage tanks have been removed and there has been remediation at the sites.
It is important that septic systems be kept in good repair and pumped regularly. It is also necessary to keep the well site clean and free of weeds and debris to prevent contamination. The cement surface seal needs to be checked for cracks and immediately repaired or sealed.

Vulnerability Summary [Well #2]

California Drinking Water Source Assessment and Protection (DWSAP) Program

District Name LPA Tulare County **District No.** 84 **County** Tulare
System Name SOUTH FORK ESTATES **System No.** 5403113
Source Name WELL02 **SOURCE No.** 002 **PS Code** 5403113-002

Completed by LPA Tulare County **Date** December 2002

According to DHS records, this Source is Groundwater. This Assessment was done using the Default Groundwater System Method.

A source water assessment was conducted for the **WELL 02** of the **SOUTH FORK ESTATES** water system in **December 2002**

The source is considered most vulnerable to the following activities associated with contaminants detected in the water supply: Historic gas stations

The source is considered most vulnerable to the following activities not associated with any detected contaminants:
Mining operations – Historic

Discussion of Vulnerability

The activities to which the South Fork Estates water system is most vulnerable include historic gas stations with known contaminant plumes, septic systems, and grazing animals. The leaking underground storage tanks have been removed and there has been remediation at the sites.

It is important that septic systems be kept in good repair and pumped regularly. It is also necessary to keep the well site clean and free of weeds and debris to prevent contamination. The cement surface seal needs to be checked for cracks and immediately repaired or sealed.

Vulnerability Summary [Well #3]

Drinking Water Source Assessment and Protection (DWSAP) Program

Assessment by California Rural Water Association **ID.** VB **County** Tulare

System Name SOUTH FORK ESTATES MUTUAL WATER CO **System No.** 5403113

Source Name WELL 03 **Source No.** 5403113-003 **PS Code** 5403113-003

Completed by Cian Reger **Date** July 2014

THE FOLLOWING INFORMATION MUST BE INCLUDED IN THE SYSTEM CONSUMER CONFIDENCE REPORT
A source water assessment was conducted for the **WELL 03** of the **SOUTH FORK ESTATES MUTUAL WATER CO** water system in **July 2014**.

The source is considered most vulnerable to the following activities not associated with any detected contaminants:
Other Animal operations
Septic systems - low density [<1/acre]

Discussion of Vulnerability

The system is most vulnerable to other animal operations and low density septic systems.

DISCUSSION OF CONTINUOUS CHLORINATION

As indicated above, one of the directives resulting from the Violation of the MCL for total coliform which is also one of the two findings from the Level 2 assessment, is a requirement from the DDW for our water company to plan for and implement continuous chlorination.

South Fork Estates Mutual Water Company takes these findings and directives seriously. We have not yet implemented this requirement because of concerns that, due to the design of our water system, if continuous chlorination is installed, we will have a significant potential for the formation of "Disinfection By-Products" (DBPs) within the system. As discussed below, the design of the water flow into and out of both our 10,000 gallon holding tank and our 100,000 gallon storage tank inhibits the circulation and turnover of water in each tank. The result is "aging" water.

The following quotes are taken from American Water Works Association (AWWA) manuals ""Water Distribution" (2016 edition) and "Water Operator Field Guide" (second edition).

DBPs "…are formed when chlorine is added to water that contains the necessary types and amounts of natural organic matter…." "At high concentrations, many disinfection by-products are considered a danger to human health."

"The water age – the amount of time that water resides in the distribution system or storage tanks before being consumed – is of critical importance. Longer water age usually leads to increased formation of DBPs."

"As temperature increases, DBP formation may increase. Warmer water favors the formation of DBPs, as does summer heat, which bakes the system storage tanks."

THE DESIGN OF OUR WATER SYSTEM: Our water system was designed and constructed around 1991. It consists of three wells (2 drilled in 1982 and one added in 2012) in close proximity to each other. Co-located with the wells is a "pumping station" consisting of a 10,000 gallon "holding" tank and two booster pumps. (All water quantities mentioned in this discussion are estimates.) The wells and pumping station are at the lowest elevation in our service area.

A 100,000 gallon "storage" tank is located at the highest elevation of our system.

Connecting the pumping station and the storage tank is a single primary main consisting of 1150 feet of 6-inch steel pipe at the lowest elevation, and 3,585 feet of 8-inch PVC pipe from the end of the steel pipe to the storage tank. Total capacity of the primary main is approximately 11,045 gallons. Water flow in the primary main will be either toward the storage tank (when a booster pump is on) or away from the storage tank (when the booster pumps are off and water is being consumed).

Connected to this primary main are two 6-inch lateral mains (total length of 1,800 feet = capacity of 2,655 gallons) that provide water to service connections (lots) on side roads. Under normal operating conditions, water flow in the lateral mains is always away from the primary main. For the purpose of this discussion, the lateral mains should be considered as large service connections. About half of our current active connections take water from the two lateral mains and the other half take water directly from the primary main.

WATER FLOW THROUGH OUR SYSTEM: Water flow depends on the operation of pumps, which are controlled by sensors inside each tank. Starting with both tanks full, as water is consumed by users of our system, water flows out of the storage tank and the water level in the storage tank drops. When about 4,000 gallons has been drawn from the tank, a booster pump at the pumping station is activated and starts pumping water from the holding tank into the primary main. As water enters at the "bottom" of the primary main, water is pushed back into the storage tank and the water level in the storage tank rises. When 4,000 gallons has reentered the storage tank, the booster pump shuts off.

The pumping capacity of a booster pump is in the range of 80 to 85 gallons per minute (gpm), about 3 times the current peak daily consumption rate for our water system during a year. Under normal operating conditions, once a booster pump comes on, water will always start flowing back into the storage tank. The only water from the storage tank ("storage tank water") that will be consumed will be by service connections located on that area of the primary main (the highest elevations of the main) and only when the storage tank water has reached each service connection.

WATER FLOW AT THE HOLDING TANK/PUMPING STATION: When a booster pump is activated, water is pumped from the holding tank into the primary main and the water level in the holding tank drops. After about 800 gallons has been removed from the holding tank, the pumps in each well are activated and start pumping water into the holding tank. When both tanks are full, all pumps will be off.

[Note 1: Only one of the two booster pumps operates at any time. Two pumps allow us to take one pump off-line for maintenance or other reasons without affecting our water system. Note 2: Our wells produce more water in the winter (the rainy season) than in the summer. Occasionally in summer, our wells produce less water than the capacity of a booster pump (80-85 gpm). When that happens the booster pump will cycle on and off until the storage tank is full.]

The holding tank has two inlet ports from the three wells (two wells share one inlet port) and one outlet port to the booster pumps. All three ports are on the side of the tank and approximately a foot from the bottom of the tank. Since the inlet and outlet are at the same level, it is probable that when a booster pump and the well pumps are operating at the same time, much if not most of the water entering from the wells immediately exits to the booster pump and the primary main.

WATER FLOW AT THE STORAGE TANK: There is only one port at the storage tank, located on the side of the tank, approximately a foot from the bottom. It serves as the inlet/outlet to the primary main. The first 460 feet of 8-inch main (1,200 gallons capacity) below the tank has no service connections. The next 1,874 feet of 8-inch main (4,890 gal capacity) has 5 of our 33 active service connections. Note: The total capacity of these two segments of main is 6,080 gallons, far more than the 4,000 gallons that are drawn from the storage tank during a pumping cycle.

Assuming that each service connection uses an average of the total water consumption of the water system, (1 of our current 33 connections = 3%), these five connections would use no more than 15% of total consumption. Of the 4,000 gallons of water that enters the primary main from the storage tank, 1,200 gallons (the amount in the first 460 feet of primary main) cannot be used because there are no service connections. Of the remaining 2,800 gallons of "storage tank water," only that used by these five connections will be consumed. (This would be 15% of 2,800 gallons = 420 gallons.) Given the distance these service connections are from the storage tank, it is likely less "storage tank water" would be consumed than this estimate. (Note: 420 gallons is less than 0.5% of the total water estimated to be in the tank.)

WATER STRATIFICATION DUE TO TEMPERATURE. Neither of our two tanks are shaded and are in full sun much of each day. This is particularly true for our storage tank. For most of the year, especially during summer heat, water entering a tank from wells (as with the holding tank) and from buried main (as with the storage tank) probably will be colder than the water already in the tank. Assuming that heat rises (and cold falls), it would be fair to assume that water entering either tank, regardless of the height of the inlet, would tend to remain at the bottom (if entering at the bottom) or to rapidly move to the bottom if entering at a higher level of the tank.

POSSIBLE SOLUTIONS: There are three general suggestions we have been given for how to deal with possible DBPs. First is to reroute pipes so that water enters each tank from the top. One concern with this suggestion is that temperature stratification could result in the new (colder) water entering at the top and quickly moving to the bottom of the tank. In the storage tank, the "new water" would likely be mostly "old water" returning to the tank after a pumping cycle.

Second is to install mixers in the tank to circulate the water. A concern with that solution is that with the storage tank, if little "new water" enters the tank, we might just be mixing batches of water, each already with a high amount of DBPs.

Third is to increase the amount of water during each pumping cycle drawn from the storage tank from 4,000 gallons to 8,000 gallons or more. There are two concerns with that solution: It might take a large drawdown of stored water to be effective; and increasing the amount of water we take from the storage tank at any time affects the primary purpose of having a storage tank - namely, to have an adequate supply of water available in an emergency. During an era of drought, fire, electrical outages, equipment failure and operator error, this might not be a wise strategy.

IN SUMMARY: We take this issue seriously. There appears to be no easy solutions. We intend to identify and employ a competent professional who is familiar with SBP issues, to assess our system and identify feasible solutions. In the meantime, we will continue to attempt to identify and eliminate possible sources of contamination.