ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Disinfecting A Private Well

The following information provides a step-by-step outline for disinfection of a **private** drinking water well. It is possible that some home water supplies may be prone to bacterial contamination and thus require permanent disinfection. This is also briefly discussed.

ACTIONS PRIOR TO DISINFECTION

Well Inspection. Carefully inspect the well to identify potential pathways that may have allowed bacteria to enter the well. See the DES fact sheets concerning Dug Well Design (WD-DWGB-1-4) or Bedrock Well Design (WD-DWGB-1-2), which identify good well construction. (Fact sheets are available online at http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm.) If there are structural deficiencies in the well that are not addressed, **the bacteria contamination will reoccur**. The vast majority of bacterial occurrences in wells can be linked to easily corrected construction flaws rather than disaster conditions.

Flushing the System. The second step prior to disinfecting is to flush the well and the home's plumbing system. Chlorine is not able to kill bacteria entrapped within mud, rust or other solids. In order to remove bacteria, all components of the system must be flushed to a clean condition. Flush this water through outdoor faucets to avoid overloading your septic tank or leach field. Also, bypass any treatment devices until you have discussed proper disinfection with the treatment device installer or manufacturer.

Cleaning/Flushing Dug Wells. Slide open the cover, look for poor construction and repair as necessary, scrub the walls with a long handled brush and wash down using a garden hose. If a "mud sucker construction pump" is available, pump the dirty water out of the well. If only the regular installed pumping system is available, pump the dirty water out of the well using outside faucets. During this flushing process, do not use water in the home in order to minimize the amount of dirty water entering the rest of the plumbing system. Flush the well until the water runs clear. Be careful not to overheat the pump.

Cleaning/Flushing Bedrock Wells. It is not possible for a homeowner to physically clean the side walls of a bedrock well. However, the cascading water caused by the drawdown in the well will significantly flush the inside of the well. Flush the well by pumping water to the outdoors, away from your septic system, plants, and streams or ponds, until all discoloration has ended. If the pumped water becomes mixed with air, turn off the pump to avoid overheating and damaging the pump. Pumping can continue later.

Flushing Pressure Tanks. Mineral sediments commonly occur in the pressure tank and/or hot water tank of the plumbing system. To clean the pressure tank, first run the well until the water coming out of the faucets is clear for a sustained period. Then using the manual off/on switch and automatic pressure switch, create flow in and out of the pressure tank to loosen any sediments that have settled to the bottom of the tank. The tank can be drained by shutting off power to the well pump and opening the boiler drain on the tank tee. For cleaning the hot water tank, connect a garden hose to the faucet at the bottom of the tank and flush the water to the outdoors until it runs clean.

Flushing Plumbing. The plumbing system can be cleaned by creating high flow velocity in the plumbing. This can be accomplished by targeting each leg of the plumbing system separately. The best results are achieved by opening multiple faucets to create the highest flow rates possible. The velocity of flow (i.e., high flow), rather than the flow duration, is the most critical factor in flushing the plumbing. Whenever possible, flush the water to the outdoors, away from your septic system, plants and streams and ponds. Remove faucet aerators before flushing.

ESTIMATING THE VOLUME OF WATER NEEDING DISINFECTION

To determine the amount of chlorine to use, it is necessary to first estimate the total volume of water to be disinfected. This would include the water in the well, in surrounding soils and in the home's plumbing system.

The volume of water in a cylindrical shape can be determined by using the formula below:

$$\textbf{Volume (in gallons)} = 3.14 \times R^2 \times H \times 7.48$$

Where:
R = radius (in feet) of the well (the radius is **half** the diameter of the well)
H = water depth (in feet) from water surface to bottom of the well

Shown below are volumes for various size cylinders. Bedrock wells are typically 6 inches in diameter and dug wells are typically 3 feet in diameter.

Approximate Water Volume in Wells
(in US Gallons, rounded to the nearest gallon)

	Diameter of Well (feet)				
Water Depth in Well (feet)	**0.5**	**1**	**2**	**3**	**4**
2.5*	4	15	59	132	235
5	7	29	117	264	470
10	15	59	235	528	939
20	29	117	470	1,057	1,879
100	147	587	2,349	--	--
500	734	2,936	--	--	--

* To achieve minimal filtration of rainfall, the soil backfill around a well should be at least 5 feet above the seasonal high water table.

Water also exists outside of the well hole in the soil and crushed stone or rock fractures surrounding the well. Depending on the well type and depth, this amount of water can be large. For dug wells, we suggest doubling the volume of water determined inside the well casing when considering the amount of well water needing disinfection. Your estimate of the amount of extra water outside the well's "footprint" is a judgment call.

WHAT CHEMICALS TO USE TO DISINFECT

Chlorine is the standard chemical used to disinfect all components of a water system **except treatment devices**. (To disinfect treatment devices, call your water conditioning installer or manufacturer.) Chlorine comes in two common forms: 5.25 to 6 percent sodium hypochlorite, a liquid; and 70 percent calcium hypochlorite, a solid. The liquid form is ordinary household chlorine bleach; read the small print on the label to ensure that it is **only sodium hypochlorite**. The solid calcium hypochlorite is available in granular form through a water well industry retail supplier or through a licensed water well contractor or pump professional. Do not use bleaches made for synthetic fabrics or those with added fragrances to disinfect a well.

CONCENTRATION OF CHLORINE TO USE

Liquid Chlorine

The chlorine concentration used to disinfect a well can be varied based on the bacterial contamination level expected. If the well is believed to be reasonably clean (e.g., no inundation by muddy surface water, no dead

animals), then 5 to 10 parts per million (ppm) is a good disinfecting concentration. If more contamination is expected, then a 50 ppm concentration or higher should be used. In the table below are amounts of chlorine to achieve the desired concentration of chlorine in water. **Chlorine can be hazardous; wear suitable clothing, gloves and eye protection**.

Desired Chlorine and Water Concentration	5.25 to 6% Chlorine Bleach	Water Volume (gallons)
1 ppm*	1 gallon of 5.25%	50,000
5 ppm	1 gallon of 5.25%	10,000
10 ppm	1 gallon of 5.25%	5,000
50 ppm	1 gallon of 5.25%	1,000

* Parts per million, also equal to milligrams per Liter.

For example, assume a well is 800 feet deep, 6 inches in diameter and the water level is at 50 feet. Therefore, the total water depth is 750 feet. Your calculations of the amount of water to be disinfected are given below:

Water volume of the well	= 1,100 gallons
Water volume in rock/soils surrounding the well	= 2,200 " (assume twice as much volume)
Water volume in home plumbing and pressure tank	= 50 "
Total volume to disinfect	= 3,350 gallons

Now choose the concentration of chlorine to be used, based on the assumed contamination level. Since the well has been flushed to a high state of cleanliness, use 10 ppm of hypochlorite for the disinfection solution. Referring to the chart above, we see that 1 gallon of bleach will disinfect 5,000 gallons to a 10 ppm concentration.

Since we have approximately 3,350 gallons of water to disinfect at a desired concentration of 10 ppm, we will not need a full gallon of bleach. Between 2.5 and 3 quarts of bleach are needed to disinfect 3,350 gallons to a 10 ppm concentration.

In bedrock wells remember there may be other homes down hill of your property also using the same rock fractures. Please start with a low concentration of chlorine, going to higher amounts if your first disinfection is not successful. Please respect your neighbors.

Solid Chlorine
Solid chlorine can be used in place of liquid chlorine. Using the example above and the equivalents provided below, approximately 6.5 ounces of solid chlorine will disinfect 3,350 gallons to a 10 ppm concentration. **However, solid chlorine can be dangerous. Extra care should be given in its handling.**

Equivalent Volume of Sodium Hypochlorite to Weight of Calcium Hypochlorite

Required 5.25% - 6% Sodium Hypochlorite (Liquid)	Equivalent 70% Calcium Hypochlorite (Solid)
1 quart	2.2 oz by weight
1 gallon	8.9 oz

DISINFECTING WELLS
For dug wells, access the well by removing the cover. Follow the steps below

For bedrock wells, access the well by removing or opening the well cap. Some well caps have a 1-inch removal plug at the top of the cap. This plug can be removed to gain access to the interior of the well. Otherwise remove the entire cap. With bedrock wells, it may be difficult to disperse the chlorine throughout the entire well depth. When liquid chlorine is used, add water to the top of the well as described below to force the liquid chlorine deeper into the hole. Typically a garden hose can be used for mixing the chlorine in the well. This method is often used for shallow bedrock wells, less than 100 feet.

Solid chlorine pellets can also be used, particularly in deeper wells. The advantage of chlorine pellets is that they sink to the bottom of the well, fully dispersing the chlorine through the overall well depth. Wash chlorine pellets off wires and pipe fixtures of the well interior.

Pour the proper volume of chlorine into the well. Mix by running a hose stream from an outdoor faucet back into the well. Wash the upper portion of the well with the chlorinated water. Circulate the chlorine water solution through the pressure tank and home plumbing system. Confirm the chlorinated water has reached all taps by smelling the water flowing from the taps or by using a test kit. Chlorine test kits may be borrowed from neighbors who have backyard swimming pools or can be purchased at hardware stores.

Let chlorinated water remain in the pipes and the well overnight. Some water usage can occur but avoid high volume demands that would dilute the chlorine strength. **Do not drink water with high chlorine levels**.

HOW TO TIME THE ADDITION OF CHLORINE

As a typical rule of thumb, the chlorine should be in contact with the water system components overnight. The more contact time, the more likely it is that bacteria will be removed. Chlorine is normally added to a water system in the early evening. This allows the chlorine ample contact time with the well before being flushed out.

Flushing out Chlorine

The next morning, flush the chlorine-laden water into the woods or on top of the soil. Do not run the chlorine solution into a stream or pond as it is harmful to aquatic organisms. Do not run chlorinated water into leach fields or onto grass or other plants. Continue until the chlorine smell has dissipated or the concentration is less than 1.0 mg/L. Remember that bacteria testing cannot begin until all chlorine is removed from the well. Chlorine will dissipate on its own with time.

WATER QUALITY TESTING

Once all chlorine is purged from the well, a bacteria test can be taken. Any chlorine remaining in the well or in the sample bottle will negate the lab test, thus requiring collection of another sample. Therefore, **all chlorine must be purged from the well before a bacteria test can be taken**.

If the bacteria test shows an absence of total coliform bacteria, the well should be useable for drinking water. However, if the test result indicates the presence of bacteria, it is recommended to take additional samples to test for bacteria until the results are consistently bacteria-free. If bacteria are present or reoccur upon additional sampling, it may mean that the disinfection needs to be repeated, or it may mean that new bacteria have entered the well from an unrecognized source that caused the previous bacteria contamination.

Permanent Disinfection

If bacteria persist in the well, a permanent disinfection system should be installed. Such a system could be a chlorine feed by a chemical feed pump or an ultraviolet (UV) system, as discussed in the fact sheet "Ultraviolet Water Disinfection" (DWGB-4-5). A disinfection system should be preceded by a fine mesh particle filter to ensure the disinfectant is not overwhelmed by irregular contaminant levels. If there has been no meaningful bacterial testing on the well in recent years, it may be possible that the well did not originally have reliable bacteria quality.

FOR MORE INFORMATION

Please contact the Drinking Water and Groundwater Bureau at (603) 271-2513 or dwgbinfo@des.nh.gov or visit http://des.nh.gov/organization/divisions/water/dwgb/index.htm. All of the bureau's fact sheets are available at: http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm.

Note: This fact sheet is accurate as of May 2012. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.