ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Fluoride in Drinking Water

Fluoride occurs naturally in New Hampshire's bedrock. As such, it is frequently present in water samples taken from bedrock (artesian, drilled) wells. Fluoride is seen at high concentrations in bedrock wells in the Mt. Washington-Saco River Valley area, Wolfeboro through Franconia Notch and immediately west of Concord. In the remainder of New Hampshire, high fluoride concentrations occur more irregularly. Fluoride has no taste, color or odor and **thus the only way** to determine its concentration is by laboratory analysis.

In dug wells that are excavated into sand and gravel, the fluoride level is generally low (<0.2mg/L) and would not be expected to exceed 2 mg/L.

HEALTH AFFECTS

Fluoride in drinking water is beneficial at low concentrations, but can pose health concerns at higher concentrations. There are many sources of fluoride in the diet. Dentists apply fluoride to teeth; some municipal water systems add fluoride to their water supply's; many tooth pastes have fluoride as an additive; and some foods also have elevated fluoride such as fish and tea.

The Centers for Disease Control (CDC) have recommended 1.0 to 1.2 milligrams per liter (mg/L) of fluoride as the optimum beneficial concentration in drinking water for dental protection for the state of New Hampshire. Much additional information on fluoride is available from the CDC at www.cdc.gov/fluoridation.

At higher concentration however, there are health concerns. The US EPA has developed standards that limit the presence of fluoride in public drinking water supplies. These health standards are called maximum contaminant levels (MCLs). In addition, there are non-health related standards (that related to aesthetics) called secondary maximum contaminant level (SMCLs) which pertain to fluoride. These ranges of fluoride concentrations in drinking water are explained below.

Fluoride concentration of approximately 1.1 mg/L.

Fluoride has been shown to reduce tooth decay in children's teeth if they receive an adequate level. The optimal concentration, as recommended by CDC for New Hampshire, is approximately 1.1 mg/L. (1.1 mg/L is the same as saying 1.1 parts per million parts (ppm)). Below 0.5 mg/L there is little tooth decay protection. Above 1.5 mg/L, there is little additional tooth decay prevention benefit.

Fluoride concentration over 2.0 mg/L.

In the range of 2.0-4.0 mg/L of fluoride, staining of tooth enamel is possible. EPA categorizes staining as an aesthetic concern, and thus only requires that customers of public water systems be

notified of the elevated fluoride level. EPA does not require fluoride removal when the concentration exceeds 2.0 mg/L but is less than 4.0 mg/L. Approximately 5 percent of New Hampshire bedrock wells have fluoride that exceeds 2.0 mg/L. In the summer of 2006 the National Research Council of the National Academy of Sciences recommended that EPA reduce the 4.0 mg/L and requested that EPA determine what that new level should be. EPA will likely require a few years to make that new recommendation.

Fluoride concentration over 4.0 mg/L.
At concentrations above 4.0 mg/L, studies have shown the possibility of skeletal fluorosis, as well as the staining of teeth. In its most severe form, skeletal fluorosis is characterized by irregular bone deposits that may cause arthritis and crippling when occurring at joints. EPA recognizes skeletal fluorosis as a health concern, and thus requires that public water systems not only **notify** their customers, but also **treat** the water to lower the fluoride concentration. Less than 1 percent of New Hampshire bedrock wells have fluoride that exceeds exceed 4.0 mg/L.

Specific health questions concerning fluoride's effects should be directed to a physician or dentist. For general health information concerning fluoride, please call the Environmental Health Program of the Department of Environmental Services at (603) 271-4608.

TESTING YOUR WELL WATER

The cost of a fluoride test is $7 per sample at the Department of Environmental Services Laboratory. At least two tests are recommended since the concentration of dissolved minerals can vary due to such factors as rainfall, length of pumping, season of the year, etc.

METHODS TO REDUCE FLUORIDE IN YOUR WATER SUPPLY

There are three approaches that one could take to respond to excess fluoride in a private well as discussed below.

Town Water

In most cases the option of town water is not available or is too costly. Town water however, is normally desirable when compared to a cellar full of water treatment devices.

New Wells

If the new well option is selected, a dug well or point well (both are located in sand and gravel deposits) would have the best chance for avoiding elevated fluoride. However, in many areas of New Hampshire the soil type, depth and year round sustained water table are not favorable for such wells. A new bedrock well would not likely be free of fluoride if your present bedrock well has an elevated fluoride level. The likelihood of avoiding fluoride in a new bedrock well can be estimated by having your neighbors test their wells for fluoride, and the other factors identified in fact sheet WD-WSEB-2-1, and then reviewing all data.

Treatment

There are at least three treatment options to remove fluoride as discussed below. Only that water used for drinking and water used for cooking needs to be treated when fluoride concentrations exceed 2.0 - 4.0 mg/L. A treatment system producing 2-5 gallons of water per day should be adequate. This size device installs easily "under-the-sink" and has a budget cost of approximately $1,000 (2007).

Reverse Osmosis

In this process, raw water flows past a reverse osmosis (RO) membrane. Some of the water molecules migrate through the membrane while the fluoride and other contaminants, remain on

the raw water side of the membrane. This raw water concentrate is disposed of to a leach field or a dry well. Treated water accumulates and is stored in a small pressure storage tank until needed. Some water treatment suppliers also suggest installing a second treatment device in series for added treatment reliability. This device could be another RO or a small amount of activated alumina as described below. See fact sheet WD-WSEB-2-11 for more information on RO. If there are any solids in the water, a sediment pre-filter should precede the RO device. There is little maintenance required for RO units. This size treatment would be typically categorized as point-of-use (POU) treatment.

Distillation
Distillation, in either an under-the sink or counter configuration, uses temperature change to evaporate and recondense water. Fluoride and other inorganic minerals will generally not transfer from the boiling chamber to the condensate chamber. Some organic contaminants can transfer across. Energy cost and reject heat are some concerns. See fact sheet WD-WSEB-2-15 for more information. Maintenance requirements are minor; consisting only of periodic cleanout of the solid minerals in the boiling chamber and possible wipe down of the condensate chamber.

Activated Alumina
Where much larger volumes of treated water are needed, the treatment process known as activated alumina may become more cost effective. In this process the well water passes through a bed of activated alumina media. The fluoride "sticks" to the surface of the alumina by adsorption. Aluminum from the adsorption media is not given off by this media. Alumina also removes arsenic. Although technically capable of fluoride removal, the economics of activated alumina treatment for fluoride maybe poor. This approach would be categorized as whole house.

Periodic Maintenance for Activated Alumina
Maintenance would consist of replacing the alumina media periodically. The old alumina may be disposed of along with your household trash. During startup, and subsequent operation, periodic laboratory testing is necessary to determine when breakthrough begins. The relationship between gallons treated and the alumina's treatment longevity is important in establishing a monitoring program. Once this relationship is known, sampling frequency over the long term can be reduced.

Installation and Operation
For further information concerning the layout of a water treatment system and its purchase, DES suggests reviewing the fact sheet entitled, "Considerations when Purchasing a Water Treatment System," WD-WSEB-2-5.

Any water treatment system should be occasionally sampled to determine its effectiveness.

FOR MORE INFORMATION
For further information, please call the DES Water Supply Engineering Bureau at (603) 271-2513. We would appreciate your suggestions concerning this fact sheet. Drinking water fact sheets are available through the DES web site at: **http://www.des.nh.gov/wseb** then select: **wseb fact sheets**. Please check the internet annually for updates to this document. 1-07