
ENVIRONMENTAL Fact Sheet



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2010

Bedrock (Artesian, Drilled) Well Design

This document assumes the reader will be installing a new well. See page 5 for suggestions concerning inspection of existing bedrock wells (also known as artesian or drilled wells). For well abandonment, see fact sheet [WD-DWGB-1-7, "Well Abandonment and Decommissioning."](#)

State Regulations: A person or firm in the well construction business must be licensed by the New Hampshire Water Well Board of DES. A homeowner can install their own well without a license. The Board requires the submission of a "well completion report" describing the well's design and construction, the soil and rock conditions encountered, and the well's yield within 90 days of the completion of the well installation.

State rules govern bedrock well construction and placement. These rules (We 100-1000) were originally adopted by the Board in 1983 and subsequently revised. There are no state requirements concerning minimum well water quality or quantity for private domestic wells. However, when selling a home with an on-site water system, RSA 477:4-c requires disclosure of the water system's location, malfunctions, date of installation, date of the most recent water test, and whether or not the seller has experienced a problem such as an unsatisfactory water test.

Local Regulations: Some municipalities have requirements relative to the placement, construction, water quantity, testing, or quality for private wells. Please contact your local health officer or code enforcement office for more information.

Evaluating a New Water Source: Determining How Much Water You Use

To determine needed well yield, you must first estimate your water demand. A typical household uses up to 5 gallons per minute (gpm) to meet modest domestic water needs. Factors to be considered when determining your household's water demand include: the number of water uses that you have, their flow rates, how many of these uses could occur simultaneously and for what duration.

Determining How Much Well Yield You Need

The minimum well yield that will satisfy your household's water needs is more difficult to identify. A low yield well (1 to 3 gpm) may be acceptable if the well casing and storage tank(s) provide enough storage. The typical 6-inch well casing has a storage volume of approximately 1.5 gallons per foot of water depth, although this storage will be reduced if the water table drops during the summer and fall.

Storage in the well may allow installation of a higher capacity pump if the duration of pumping will be short. In such cases, a low water cut-off device should be installed to prevent overheating damage to the pump's electrical motor. Large storage tank(s) installed in your basement can serve this same function of accumulating water during periods of low demand. However, an additional pump will be necessary to pressurize this water.

Bedrock wells are somewhat less affected by drought conditions than dug wells. Drought effects can be minimized by drilling a deep well. If a well yield is only a few gpm at a well depth of 100 to 200 feet, DES recommends that the well be drilled deeper. On the other hand, if there are only a few gpm at depth of 700 to 800 feet, it is reasonable to end

drilling on that particular well.

It should also be noted that a well's yield may change with time. A 1 gpm loss on a 2 gpm well is critical while a similar change in a 10 gpm well is not too significant. Thus, one should try to develop the maximum well yield possible, within economic reason, when the well is first drilled. The availability of groundwater in bedrock is very irregular and depends on the distribution of rock fractures, their size, orientation, the number of interconnections with other fractures, and with the overlying water-bearing soil to name but a few factors.

For more information on minimum well yield, read DES fact sheet [WD-DWGB-1-8, "Recommended Minimum Water Supply Capacity for Private Wells."](#)

Typical New Hampshire Bedrock Well Statistics

Most wells for household use are 100 to 500 feet deep; a few are over 1,000 feet. The median depth of bedrock wells in New Hampshire is approximately 295 feet. The median yield is 6.5 gpm. More specific well information for your community can be obtained from the New Hampshire Geological Survey.

Hydro-fracturing to Increase Well Yield

Well yields can be increased by a technique called hydro-fracturing. The process includes pumping high volumes of water into the drill hole at pressures up to 3,000 or 4,000 pounds per square inch (psi). In the past dynamite, dry ice, and compressed air were used to accomplish this same affect. Hydro-fracturing in water wells does not create new fractures; it enhances the productivity of existing fractures, joints and faults by flushing and opening existing fractures in the well. If hydro-fracturing is being considered, ask your licensed water well contractor or the Water Well Board about the various methods available. For detailed information on hydro-fracturing, see fact sheet [WD-DWGB-1-3, "Bedrock Well Development by Hydrofracturing."](#)

Water Quality Considerations

Some water quality characteristics, such as amount of bacteria, are better in bedrock wells due to the longer time required for the water to percolate through the soil and into the bedrock, and the tighter construction of a bedrock well casing due to superior materials. The occurrence of iron, manganese, taste and odor in bedrock wells is approximately the same as in dug wells. On the other hand, bedrock wells can experience contamination from the rock they are drilled in and can experience one or more of the following water quality problems:¹ arsenic (20 percent), bacteria (19 percent), radon (33 percent), radium (4 percent), and uranium (6 percent). In bedrock wells, radon concentrations are, on average, much higher than those for dug wells. Dug wells rarely experience the chemical problems mentioned above, but are much more affected by low yield during droughts and by bacterial contamination.

DES strongly recommends testing private wells when new, deepened, or hydrofractured, when a home with a private well is about to change hands, and every three to five years thereafter. For more information, see fact sheet [WD-DWGB-2-1, "Suggested Water Quality Testing for Private Wells."](#)

Well Protection and Placement

Bedrock wells obtain water from fractures in the bedrock. The fractures are recharged from the saturated earth materials overlying the bedrock. Care should be taken in what activities are allowed to occur near your well in order to prevent contamination.

Examples of chemical hazards to your well include the improper application of fertilizer and pesticides, and inappropriate disposal of used motor oil, anti-freeze or solvents, or waste salt brine from water softeners to name a few. The use of chemicals in your backyard or in that of your uphill neighbors may negatively affect the quality of the water from which your well draws. Tests for the full range of possible pollutants involve complex and costly laboratory procedures. The best and least costly approach to achieving good water quality is pollution prevention rather than treatment.

¹ Percentages given are estimates of New Hampshire private wells with contaminant levels exceeding the maximum levels allowed in public water supplies, with the exception of radon, which has no regulatory limit.

The following protective distances are required or recommended when locating a well for a private single family home:

- a. Surface water and drainage culverts should not pass within 25 feet of a well; 50+ feet is recommended.
- b. Animals should not be penned or tied within 20 feet of a well; 75+ feet is recommended.
- c. Leach fields and septic tanks may not be located within 75 feet of a well.
- d. Wells may not be located within 50 feet of the right-of-way line of state maintained roads, preferably more.
- e. Wells may not be placed within 75 feet of adjacent property which you do not control. (See RSA.485-A:30-b). If placement is made necessary within 75 feet, a standard release form is required to be signed by the well owner and given to DES, the town health officer, and the registry of deeds. Since most zoning codes require a 10 foot setback from property lines, this distance is effectively 65 feet.
- f. A well should not be placed in locations subject to any flooding unless the immediate vicinity (25 foot radius) of the well is built up above the maximum possible flood level.

See fact sheets [WD-DWGB-21-1, "Site Selection for Private Drinking Water Wells,"](#) and [WD-DWGB-21-4, "Best Management Practices for Well Drilling Operations,"](#) for more information pertaining to locating private wells.

Choosing the Well Type You Will Purchase

Based on the considerations above, such as water needs, soil depth, and existing sources of potential pollution, you should be ready to choose the type of well that you believe is best for your lot and home.

Contracting With a Well Driller

Prior to actual drilling, you will need to provide the well driller with guidance to govern the amount of work to be done. Typical options include drill to a specific depth, drill to a specific well yield, or drill to a specific budget amount. The nature of the well installation contract is strictly between the well owner and well driller.

Drilling Techniques

Two techniques are used to drill bedrock wells. In the rotary process, a drill bit on a long shaft is rotated to grind and crush the rock at the bottom of the well hole. A water/mud slurry is pumped down through the rotating drill bit to flush the rock cuttings up and out of the well. These cuttings overflow the casing and typically fill the annular space between the outside of the steel well casing and the surrounding soil. Most bedrock wells are drilled using the rotary process.

In the percussion process, otherwise known as cable tool drilling or "pounder" drilling, a falling weight is used to pulverize the bedrock at the bottom of the drill hole. Periodically a separate, long thin bailing device is used to remove the rock cuttings from the drill hole.

Some experts contend that the percussion process better fractures the rock in the immediate vicinity of the hole, and the bailing of water and pulverized particles keeps the rock fractures from becoming clogged with the drilling mud and rock cuttings. These two actions are believed to result in higher yields of those wells drilled by the percussion process. In recent years, drill bits for rotary drilling machines have been redesigned to include a percussion action to better fracture and pulverize the rock. Rotary drilling is normally less expensive and much less time consuming than percussion drilling. DES does not recommend either method of construction over another.

Drilled Well Configuration

Steel Casing

A steel pipe is normally seated into a socket in the bedrock by 10 to 20 feet or more. Cement-grouting the casing to the bedrock is suggested by some experts to ensure a good seal. Grouting is expensive and is not the normal practice in New Hampshire for private wells, although it is required for public water supply wells to prevent water from the surface from channeling down along the well casing. A hardened steel drive shoe is required on the leading edge of the steel casing. The drive shoe improves the alignment and sealing of the steel casing to the bedrock socket. Plastic well casings are not recommended.

Pipe and Cable Spacer (Cable Guard)

Cable spacers prevent the abrupt swinging of the discharge pipe and power cable within the drill hole as the pump

starts and stops. Uncontrolled, this action can result in abrasive damage to pipe and wires resulting in possible short circuit of the power cable. Spacers are placed on the discharge line, every 20 feet or so, to position the power cable and discharge pipe in the center of the drill hole.

Anti-Torque Device

A torque arrestor prevents the twisting of the pump in the well at each start and stop of the pump motor. This will also extend the life expectancy of the discharge line and power cable. The anti-torque device recognizes that when the pump impellers begin to turn in one direction, the pump body turns in the reverse direction.

Water Supply Line and Pump

A submersible pump is most often used in bedrock wells. The pump is typically set so as to provide at least a 20- to 50-foot clearance between the bottom of the well and the submersible pump. Jet pumps can be used but are not energy efficient.

Drilled wells often act as electrical grounds. Lightning protection of the motor and electrical controls is recommended. The National Electric Code requires a well pump to be grounded to the home's electric service and the grounding conductor to be bonded to the well casing if steel well casing is used. The water line to the home is buried four to five feet deep for frost protection. Before the trench carrying the water line is backfilled, the owner should take field measurements and draw an accurate sketch of the precise route of the water line.

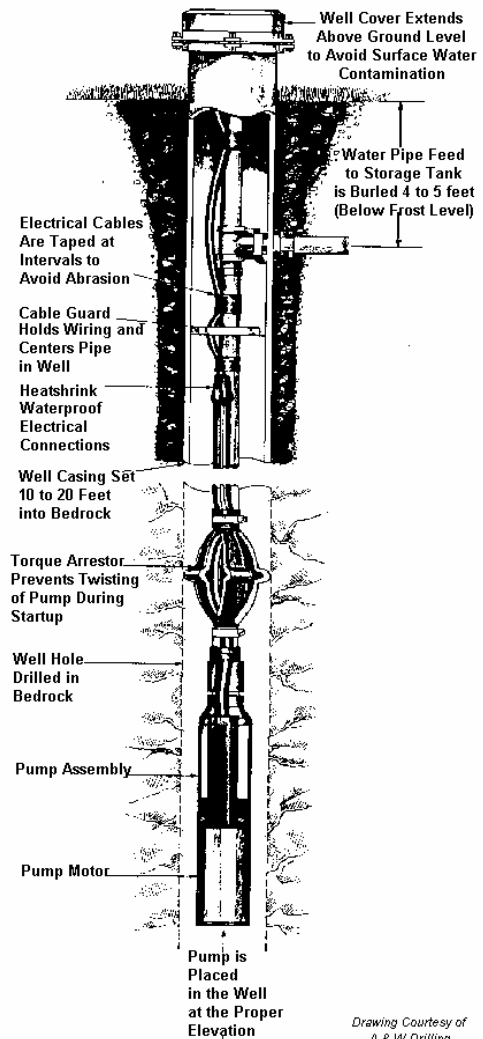
Place the sketch in a water proof envelope such as a sealed plastic freezer bag and attach it to your pressure tank or the water system control box. In the basement, seal around the electrical conduit to reduce radon migration into the home and to keep groundwater out of the basement.

Jaswell Seal (Not Shown)

In some cases, poor water quality from certain fractures, or a poor seal of the casing to the bedrock, can be eliminated by sealing off particular fracture zone(s). This can be achieved by the use of special mechanical seals (e.g., a Jaswell seal) or concrete grouting. A Jaswell seal is a flexible rubber cylindrical shaped insert with circular rings designed to provide a water-tight seal between an attached smaller diameter well casing (typically 4 inch) and the larger-diameter well. The seal is placed within the well, at the proper depth, and may be grouted in place. Jaswell seals may also be installed at one or both ends of the drop pipe. It should be recognized, however, that it is very difficult to locate those fractures that contribute poor quality water versus those that contribute good quality water. In addition, sealing off poor quality water will reduce the well's capacity and may seal off all of the well's water. A Jaswell seal complicates the installation of the anti-torque device and cable spacers.

New Well Follow Up: Determining the Well's Safe Yield

Well drillers are required to conduct a 30-minute yield test of each new well, but DES recommends a 24-hour test if the owner wants a better understanding of what the well can be relied upon to produce. The safe yield of a newly completed well can be determined (and the well can be flushed) by pumping water to waste continuously over a sustained period of 24 or more hours. The pumping rate should be measured by noting the number of minutes required to fill a known volume container (such as a 20- or 32-gallon trash can). The water level in the well should be measured as the pumping continues.



Drawing Courtesy of A & W Drilling

The intent of the safe yield test is to develop an equilibrium between the amount of water being pumped out of the well and the amount which is replenished naturally from the bedrock. The discharge should be piped at least 200 feet from the well and downhill, if possible, to prevent recycling or “double counting.” Do not run this dirty water through your home plumbing.

If the drawdown in the well caused by the pumping has stabilized, the measured yield can be considered as the maximum safe yield of the well. This test should be run in the early fall when the groundwater table is at its lowest. The water level (or drawdown) in a bedrock well can be measured by use of an air line, echo device, or electrical probes. Measuring the drawdown is the most difficult portion of a pump test. For more information on well yield, see [WD-DWGB-1-13, “Determining the Yield of a Residential Well.”](#) or consult your well driller for detailed information.

Disinfection – Chlorination

For information on how to disinfect a well using chlorine bleach, read fact sheet [WD-DWGB-4-11, “Disinfecting a Private Well.”](#)

For newly installed bedrock wells, or where well pumps have been recently replaced, it is most important to clear the well of rock cuttings and surface dirt before chlorinating the well or testing for bacteria. The well may have to be continuously pumped for days (or weeks, in a few cases) before this cleaning process is complete. Chlorination is NOT able to reach bacteria trapped inside accumulations of drilling mud or soil attached to the newly installed pump, pump electrical cable, or water discharge line.

Inspecting Existing Bedrock Wells

The most common problem with an older bedrock well is that the top of the well is cut off below grade. If this is the case, it is quite possible to have bacteria problems caused by the leakage of unfiltered surface water directly into the top of the well.

Adding a Pitless Adaptor to an Existing Well If an existing bedrock well casing is cut off below grade, DES strongly recommends that the casing be extended above grade and a pitless adaptor closure be used. This new extension must be water-tight at the connection point with the old casing. For information on “Extending Bedrock Well Casings,” see [WD-DWGB-1-14](#). The pitless adaptor not only provides the greatest protection against leakage and subsequent bacteria contamination, but also provides a visual indication of the well’s location and easy access in all seasons.

For Additional Information

Please contact the Drinking Water and Groundwater Bureau and the New Hampshire Water Well Board at (603) 271-2513 or dwgbinfo@des.nh.gov or visit our website at www.des.nh.gov/organization/divisions/water/dwgb/index.htm. All of the bureau’s fact sheets are on-line at www.des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm.

Note: This fact sheet is accurate as of August 2010. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.