ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Dug Well Design
(Wells Constructed by Excavation)

Dug wells, or wells installed by excavation, can be a viable source of water when installed and maintained properly. When considering to install and utilize a dug well as a water supply one must understand if the local surficial geology – unconsolidated materials below the ground surface – is thick enough to support a well and whether there are any local land uses, especially up gradient of the well location, that pose a risk of contaminating the groundwater. Hydrogeologic information specific to your community can be obtained from well records and geologic data on file with the New Hampshire Geological Survey and NHDES Water Well Program.

Well Location Considerations

Well drillers and pump installers in New Hampshire are licensed by the Water Well Board under NH RSA 482. The rules of the Board are We 100-1000. These rules govern contractor licensing, well construction standards (including location requirements), and well reporting processes. For a private single family home, water wells shall be located 75 feet from septic system components, 100 feet from livestock pens, 75 feet from property lines, and 50 feet from a surface water body. 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. Since dug wells take water from the highest water table, they are extremely sensitive to activities that take place in the immediate vicinity of the well, the well shall be located at least 75 from any potential contamination source. Refer to WD-DWGB-21-1, “Site Selection for Private Drinking Water Wells” for more information pertaining to locating private wells.

If a dug well must be installed at a location that does not meet the setbacks listed above or required in the Water Well Board rules, a Setback Reduction Form must be signed by the homeowner. This form is an acknowledgement that there is a risk of potential contamination of the well from land uses directly around the well. Wells installed specifically for irrigation uses do not need to meet all the setbacks.

Note: If an abandoned dug well is identified, it should be properly decommissioned (filled-in). Refer to NHDES fact sheet DWGB-1-7 “Decommissioning Inactive Wells” for more information and guidance.

Well Yield Considerations

There are no state requirements for what a private water well needs to yield. Ultimately, a well shall yield enough water to meet the daily demands of the home day after day.

Dug wells are installed with a large gravel pack around the tiles. Water is stored within this gravel and in the well itself. Typically, when the water table is high, this area can hold at least 600 or 900 gallons of water and that water can be extracted and will recharge within one day. However, due to fluctuations in the water table throughout the year and periodic droughts, dug wells that are less than 15 feet deep (or

have 10 feet or less water within) are susceptible to going dry. This condition can be minimized by excavating the bottom of the well significantly below the seasonal low water table. The seasonal high water table can be determined by soil experts based on color change of the soil. It is difficult to determine the seasonal low water table. Consequently, the depth of a dug well is normally governed by the capability of the construction equipment, or the level at which you encounter bedrock or till.

Water Quality Considerations

There are no state laws requiring private wells meet a certain water quality. Local ordinances may give towns authority to withhold building or occupancy permits if the water quality is poor. Water extracted from dug wells often has elevated levels of iron and manganese. The occurrence of arsenic, fluoride and radiological problems is less common in dug wells than in bedrock wells. Dug wells typically have a low pH which can lead to a corrosive condition within the plumbing of the home. Corrosion can leach lead out of older copper pipes and cause issues within appliances. Blue and green staining is indicative of copper leaching, if this is observed lead may be present. Households that use dug wells shall test for lead in their water and take step to remediate if detected.

Properly installed dug wells are normally resistant to bacterial problems as they should be well sealed and allow water only to enter from the bottom of the well. However, many dug wells have construction issues and can pose a risk of bacteria entering the water supply. Homeowners that use dug wells are urged to sample for bacteria at least once per year.

Screened wells are recharged by groundwater that is under the influence of the water table, therefore they are sensitive to contaminants from land use activities that take place in the immediate vicinity of the well. The best and least costly approach to protect the drinking water quality is pollution prevention rather than treatment. Be careful with the use and disposal of chemicals (fertilizers, pesticides, inappropriate disposal of oils, paints, or solvents, or water treatment backwash) near and upstream of your well or the wells of others.

For recommendations on water quality testing, refer to a brochure developed by NHDES and the New Hampshire Department of Human Health Services titled “What’s in Your Water” or fact sheet WD-DWGB-2-1, “Suggested Water Quality Testing for Private Wells.”

Construction of a Dug Well

Water should be entering a dug well only from the bottom. When inspecting an existing dug well, look for any defects or openings in the casing that will allow foreign substances or small animals to enter the well. Also look for points where surface runoff can enter the well casing directly. The essence of good construction is ensuring filtration of all water that enters the well. Dug wells are required to be made out of inter-locking concrete tiles (3 or 2 feet in diameter), steel, or plastic (typically 4-6-inches in diameter). The plastic must be schedule 40 thickness or greater and be approved for drinking water purposes. It is prohibited to construct dug wells out of sewer pipe, corrugated plastic or cinderblocks.

Dug wells constructed of 6-inch schedule 40 PVC are getting more common. These wells use lengths of solid PVC pipe that is glued or threaded together. The bottom section of pipe is perforated or screened. It is possible to place a “T” fitting at the bottom of the pipe and have performed pipe extending out horizontally as to increase the area (holes) where water can enter the pipe/well.

When using concrete tiles, they must be joined by bell and spigot, or tongue and groove connection configuration. The joints between the highest two well casings should be cement mortared to achieve a water tight condition. Another sealing alternative is the use of a safe manmade sealant. ConSeal CS-665 and 665 WS are products that have passed the NSF-61 test for product purity. Other products certified by NSF-61 will be listed as identified by their manufacturers.

Existing dug wells built of field-stone are frequently subject to construction deficiencies which allow surface runoff, carrying bacteria and viruses, to enter the well unimpeded. It is very difficult to seal all the holes in a field-stone well. If bacteria persist in a field-stone well, it is recommended you replace it with a new dug well.

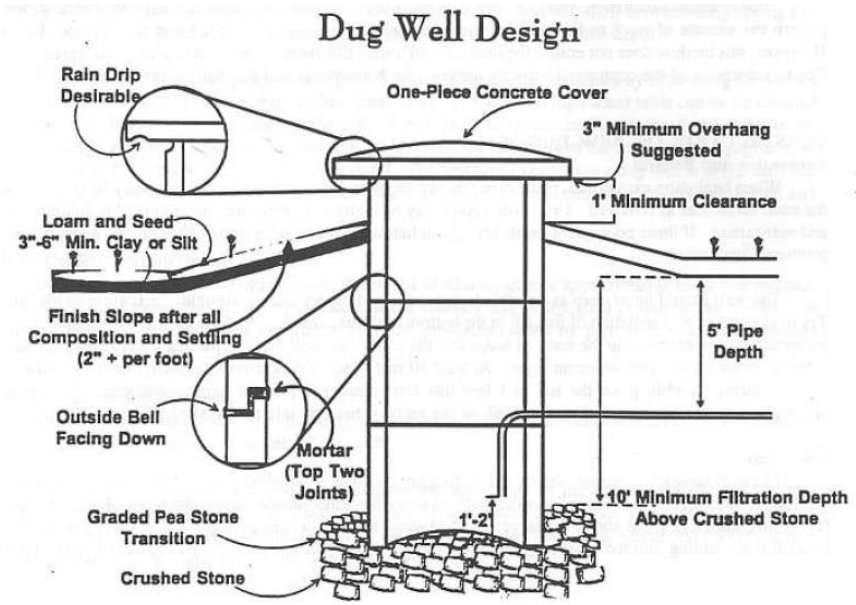
Excavation and Backfill

When beginning excavation, place different soil types in different piles so that they may be replaced in the same sequences as removed. Upper soil layers may be high in bacteria, organics and readily soluble iron and manganese. If these poor quality soils are placed below the water table during backfilling, water quality problems may occur. The well should be as deep as possible to prevent its going dry during droughts.

The well casing is required to be set on and surrounded by clean crushed stone. This allows convenient leveling of larger diameter well tiles, and also allows the storage and entry of water from the outside surrounding soil. Place multiple layers of graded pea stone above the larger crushed stone to act as a transition zone. This will prevent the backfill from settling into the crushed stone in the future. Do not use straw, tar paper and other degradable materials on top of the crush stone, as they may potentially cause bacteria and taste problems, and will likely also disintegrate with time.

Pipe or Concrete Tile Sections

Water should enter the well at the bottom, either horizontally or up through the bottom. This will ensure maximum filtration of water through the soil. The lowest concrete casing may have perforations in its side wall. Wire reinforced concrete is suggested for well casing rings and the top cover.



Impermeable Apron

To insure filtration of all water entering the well, an impervious apron of clay or fine silt should be placed entirely around the well. This apron is required to be at least 2 feet thick and as wide as the excavation that was made to install the well. The apron slope should be approximately 2+ inches per foot. A greater slope should be considered if substantial settlement of the backfill is expected. Finally, the apron should be loamed and seeded to achieve a stable condition.

Well Cover

Dug well casings must extend at least 18-inches above ground surface. The cover must be sealed and

secured. For concrete tiled wells, the cover shall be concrete. A center observation hole in the cover is NOT recommended. If one exists within an existing well cover, it should be sealed tightly to prevent the leakage of contamination into the well from above. For smaller diameter wells (4 to 6-inches) a typical well cap shall be used. Wood covers are not allowed to be used on dug wells.

Water Supply Line and Pump System

A NH Pump Installer's license is required to install a pump on a water system. Provide at least one foot of clearance between the suction end of the pipe/pump and the bottom of the well. The water line to the home comes off the well at a pitless adaptor buried four to five feet deep for frost protection. The water line shall be steel or thick plastic rated for 160 psi or greater. Fittings used shall not be made of nylon.

Larger diameter screened wells (4" or greater) may be able to utilize submersible pumps. If a submersible pump can be used, it is recommended to use one. If a submersible pump is used, the electrical wires that run from the well to the house must be buried at least 18 inches deep in a conduit. It is good practice to seal around the electrical conduit in the basement and at the wellhead to reduce radon migration into the home and to keep groundwater out of the basement.

The typical pump used in dug wells is a centrifugal pump (also known as a jet pump or suction pump) located in the basement of your home or in a protective enclosure at the top of the well. This configuration is subject to at least two operational limitations. First, no matter how good the pump's vacuum, water cannot be raised by suction more than approximately 32 feet at sea level. As a practical reality, conventional centrifugal pumps can only raise water by suction 20-25 feet. Where the water table is deeper than 25 feet below the centerline of the pump, conventional pumping equipment will not work. A "deep well" packer jet pump mechanism can be installed, although this requires a larger vertical casing/well screen, which creates more expense.

The second constraint occurs if the vacuum is lost by air entering the well line through leakage at the piping joints or because the water level is below the intake. The most important part of using a suction pump is that the entire assembly is airtight and the pump maintains a vacuum within the well. Air entering a point well will cause a loss of vacuum and the inability to pump. Piping joints must be tight and the well point must be below the lowest seasonal water table.

Disinfection: Chlorination

For new dug wells, or where well pumps have been recently replaced, it is most important to clean the well before chlorinating or testing for bacteria. The well may have to be continuously pumped for days (or weeks, in a few new well cases) before this cleaning process is complete. Chlorine, regardless of its concentration is NOT able to reach bacteria trapped inside accumulations of mud. We strongly advise that a bacterial test NOT be taken until the well has been thoroughly flushed. For more information on disinfection, see fact sheet WD-DWGB-4-11, "Disinfecting a Drinking Water Well."

For More Information

Please contact the Drinking Water and Groundwater Bureau Water Well Program at (603) 271-1974 or dwgbinfo@des.nh.gov or visit our website at www.des.nh.gov.

Note: This fact sheet is accurate as of September 2019. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.