



NATIONAL GROUND WATER ASSOCIATION

Well Owners Guide

Thank you for reading this Well Owners Guide. This is an important first step to maintaining your well.

Who is NGWA?

Our Mission

The National Ground Water Association (NGWA) is a community of groundwater professionals working together to advance groundwater knowledge and the success of our members through education and outreach; advocacy; cooperation and information exchange; and enhancement of professional practices.

NGWA Vision

NGWA's vision is to be the leading groundwater association advocating the responsible development, management, and use of water.

Our Goals

NGWA and its members will use its outstanding scientific and technical leadership, knowledge, and resources to pursue innovation, model best practices, and improve the business climate for the groundwater industry.

NGWA is a credible, valued resource on significant and timely issues that impact the groundwater industry and public access to safe, sustainable groundwater.

When you need your water well tested or serviced, we encourage you to use an NGWA-certified groundwater professional.



To find a qualified professional in your area, go to [WellOwner.org](https://www.wellowner.org) and click on "Find A Contractor."

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Well Construction

Proper construction of a well system is critical to producing a reliable supply of good quality water. Conversely, a poorly constructed well can adversely affect both the well's ability to produce adequate water and quality water. The following questions and answers address key topics related to proper well construction.

1

GETTING STARTED

I want to get a well drilled. What do I do?

Here are four steps toward getting a water well system installed by a qualified professional that provides an adequate supply of good water and meets legal requirements.

Step 1**Legal requirements**

Make sure you know any legal requirements relating to water well installation. Ask your local government about any required permits prior to the start of drilling—or you can ask a water well system professional if you already work with one.

To learn more, view state well construction agencies at NGWA.org.

For your state's information, click on your state and go to the "Domestic Water Well Information" section to view the construction and licensing agencies, regulations, and laws.

Step 2**Hiring a professional**

If you don't use a particular water well system professional, the next step is to find one. A professional should have the credentials, skills, experience, and business practices in place to ensure a good job will be done.

To learn more, visit NGWA.org and view the following topics:

- How to Hire and Work with a Water Well System Professional
- Guidelines for Written Contracts
- "Having a Well Drilled" consumer information sheet
- Find a Contractor

Step 3**The well location**

If you haven't built your house yet, it is best to plan for a water well before building the house to ensure the best location can be selected to produce an adequate supply of good quality water. Of course, before buying land, look into water availability, and plan accordingly.

The actual location of a well often is determined by limiting factors such as land surface features (i.e., steep slopes and poorly drained areas) and the location of potential contamination sources such as an on-site wastewater system (i.e., a septic system).

To learn more about planning a water well visit WellOwner.org.

Step 4**Determining your water needs**

Work with your water well system professional to determine your daily water needs. This could affect where and how the well is constructed. Having sufficient water means the ability to meet the following needs:

- Everyday use including drinking, cooking, plumbing (toilets, bathtubs, showers, automatic washers, dishwashers, and other automatic appliances)
- Seasonal use including lawn and garden watering, car washing, and swimming pool use
- Special uses such as animal watering, crop irrigation, and water treatment devices that require backwashing

- Fire protection is a special need for which a home seldom depends on a well, since fire departments usually have access to large quantities of water

A conservative estimate is that a house will need about 150-300 gallons a day for two to four people to meet all these demands. However, the bulk water use may be concentrated into short periods during the day, often in different areas of the house or property at the same time (i.e., laundry, bathroom, lawn). The water supply must be able to meet this type of peak demand, and a water well system professional can help you determine how to accomplish this.

Finally, other factors affecting a well's capacity to meet water demands are the well's

- **Flow rate:** The continuous rate at which the well yields water
- **The diameter and depth of the well:** This determines a certain amount of water storage within the system itself
- **Static level:** This is the level at which water stands in a well when no water is being pumped—also relating to the amount of water storage within the system and pump selection

To learn more about planning a water well or to use the water supply calculator visit WellOwner.org.

EXPLORING COST

2

How much does a water well cost?

The cost of a water well system can vary greatly depending on several variables. Following are the key contributors to the cost of a water well system. When considering a new well with a water well system professional, an itemized list of charges is better than a lump sum to get a clear picture of costs.

The well's depth

As part of their overall cost structure, water well drillers apply a cost-per-foot of drilling. Recent survey data indicates that the average cost-per-foot for drilling a 4-inch-diameter well is about \$24, and the average cost-per-foot for drilling a 6-inch-diameter well is about \$30.

This means the depth of a well can be a big factor in the overall cost of the well system installation. Using the average costs for drilling, a 120-foot-deep, 4-inch-diameter well would cost \$2,880 and a 6-inch-diameter well to the same depth would cost \$3,600. Drilling a 220-foot-deep, 4-inch-diameter well would cost \$5,280 and a 6-inch-diameter well to the same depth would cost \$6,600.

Since the depth of a well to get adequate water can vary significantly, even in a locale, it is important at the start to discuss with a water well system professional the anticipated depth of a well based on the best information available (such as the depths of area wells). It also is worth discussing the cost of drilling deeper or drilling a second well if required to ensure an adequate water supply.

Pump costs

Pumps are another significant contributor to the overall cost of a water well system. There are two primary types of pumps—submersible pumps, which are submersed in the water down in the well,

and jet pumps, which are on the surface of the ground in proximity to the wellhead.

Recent survey data indicates that the cost of a typical household submersible pump ranges between \$3,000 to \$3,200—and the cost of a typical household jet pump ranges from about \$1,545 to \$1,570.

While either type of pump might work satisfactorily in some wells, the performance demands of a particular well might suggest one type of pump over the other. This should be discussed with your water well system professional or a pump installation specialist. Learn more about pumping systems at WellOwner.org.

Other costs

Other typical costs charged for water well system installations are:

- Cost of casing per foot (casing is the vertical pipe inserted into the drilled hole)
- Other materials used in the well or the drilling process (i.e., grout, the well cap, and the drive shoe). Many wells require a well screen in the aquifer intake area, and this should be the highest quality possible

- Costs of operations other than drilling (i.e., grouting, further development of the drilled hole, test pumping, and well disinfection)
- Cost of properly abandoning a well should it prove necessary (for instance, if saltwater is encountered and another site for the well is selected)
- Any other costs related to the entire well system (i.e., the water distribution line to the house and the pressure tank)

Final considerations

- Consider the professional's judgment in solving unforeseen difficulties, and discuss unforeseen costs
- Consider the life-cycle cost: Buy the best original equipment you can manage – It is your water supply for your family, and good equipment puts off the return of the pump service tech. Good equipment, design, and professional service lowers total life-cycle cost
- If original construction plans must be changed, discuss the options with the contractor
- Do not expect the contractor to work for free if the well does not fulfill expectations
- When it comes to charges, a good written contract is the best protection for both the well owner and the water well professional. Learn more about written contracts at WellOwner.org.

Note: The figures used here provide a general indication and are not exact representations of costs in any locale. Costs can vary over time and by location.

3

HIRING A PROFESSIONAL

What should I consider when hiring a water well system professional?

There are several criteria you can use to evaluate and select someone.

You should know that there are two types of companies

- Full-service water well system companies that drill the well, install the pump, and install the rest of the system including components such as water pressure tanks and water treatment
- Companies that do part of the work, such as drilling the well or installing the pump

Whether you use one or more companies, always use a professional who can satisfactorily meet the criteria below.

Also, prior to selecting a water well professional for a job, it is a good idea to obtain information about several contractors in the area before making a choice.

Qualifications, skills, and experience

Check whether the contractor is licensed by or registered with the state. Not all states require licensing. To check, visit NGWA.org.



When considering specific water well system professionals, ask if he or she:

- Is certified by the National Ground Water Association
- Submits well logs on the well construction
- Has adequate equipment in good condition
- Has adequate liability and workers' compensation insurance to protect you
- Is familiar with applicable health and safety codes

- Will provide references from previous customers
- Will furnish a written contract specifying the terms and conditions of the job
- Is a member of the National Ground Water Association

For help in locating water well system professionals, click on Find a Contractor at WellOwner.org.

4

QUALIFICATIONS

How do I know if a well driller is qualified and competent?

Whether a water well system professional is qualified legally to drill a well or construct a well system usually depends on whether the state requires licensing or registration.

To find out what your state requires or to check on a water well professional visit NGWA.org and click on your state, scroll down to “Domestic Water Well Information,” then view contact information for “Licensing/Registration of Professional.”

Ask your local government about any legal requirements relating to water

well installation, including any required permits prior to the start of drilling. Whether a water well professional is competent is a different question. Since there is generally no authority charged with overseeing the quality of a water well professional’s work outside of the initial well construction, it is up to the customer to exercise due diligence before engaging a professional by:

- Checking references from previous customers
- Confirming that the professional will provide a written contract specifying in detail the work to be done along with any conditions
- Determining if the contractor has adequate liability and workers’ compensation insurance to protect you

WATER PRODUCTION

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How do I know if my well will produce enough water?

A well system professional who has drilled wells in your vicinity will be familiar with aquifer (water-bearing formations) in the area, and have a pretty good idea of how productive area wells are. However, it must be said that there is no assurance that a well, once drilled, will provide an adequate supply for the home it services. Some areas provide more reliable yield over an area than others. For a well to provide an adequate supply of water, it must be able to supply the maximum amount of water needed within the shortest period it is used.

Here are some key factors that determine whether a well can provide an adequate supply of water for a given household.

While (with a few exceptions), modern water wells are not designed to be an underground water tank, the amount of water stored within the well system itself is a key factor.

The well storage amount is determined by the diameter of the well, the depth at which the pump is set, and the height of the water within the well. A well may have some limited additional water storage in the pressure tank and auxiliary

water storage tanks. However, the characteristics of the aquifer and how the well is designed to access the aquifer, are the most important indicators of water availability.

Water flow into the well

Water flow is defined as the volume of water entering the well at a given depth in gallons per minute.

Two other factors key to determining whether a well can provide an adequate supply of water is on the demand side – your water use patterns. These determine

the peak load and peak load time. Peak load is the amount of water used during periods of the day when demand is highest; peak load time is the length of time in which the peak load is to be delivered.

You can discuss these variables with a water well system professional to better determine what your well system must provide to meet your household water demands. You can do some of these calculations online at WellOwner.org.

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WATER QUALITY

How do I know if my well will produce good quality water?

If you use a water well system professional who has drilled wells in your vicinity, he or she may have a pretty good idea of the water quality for area groundwater. Water quality issues can be aesthetic, involving an objectionable appearance, taste, or odor. Other water quality issues can present a health risk yet be invisible, tasteless, and odorless, such as arsenic, nitrate, and radon. Substances that present health risks can be naturally occurring or man-made contaminants.

In addition to asking a water well system professional about area water quality, consider asking the local county or state health or environmental health department about your local water quality—particularly whether there are known health risks associated with area groundwater.

Also, sometimes groundwater contamination can be very localized, for instance, surface contamination entering

the groundwater through an improperly abandoned well. So, doing an assessment of the area around where the wellhead will be can reveal actual or potential risks to one's future water supply.

Learn more about water testing and groundwater protection at WellOwner.org.

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DRILLING

Can I drill my own well?

In most cases, the answer is no. Laws and regulations usually require an individual drilling a well to be licensed or registered. In some states, a water well driller must pass a written test and have certain credentials to drill a well.

Regardless, the National Ground Water Association does not recommend that individuals drill their own wells. Rather, a qualified water well system professional should be used. There is a good reason for this. A drilled well provides a direct

conduit into the groundwater. If a well is not drilled properly with all the necessary sanitary seals in place, the well could provide a direct pathway for surface contamination into the well and the aquifer.

Learn more about the licensing and registration of water well system professionals at NGWA.org.



8

LOCATION

Where on the property should the well go?

There are multiple factors that determine where best to locate a well.

Topography

Generally, locating the well on higher ground is better to minimize the potential for standing water around the wellhead. Standing water can potentially infiltrate the well if the grout seal around the well casing is not watertight.

Separation from potential hazards

Most states and many local governmental jurisdictions have water well construction codes. Often these codes specify minimum separation distances between the wellhead and potential contamination hazards such as septic drain fields, animal enclosures, fuel storage tanks, roads, and fertilizers, pesticides, and herbicides.

Geology

Water-bearing geologic zones are called aquifers. Data from previously drilled wells or other sources may provide some direction on where on a piece of property a new well should be drilled.

Service access

Like any mechanical system, a water well system requires periodic maintenance and repair. It is therefore important to locate the well where it can be accessed by a drill rig or pump hoist, for instance, for servicing.

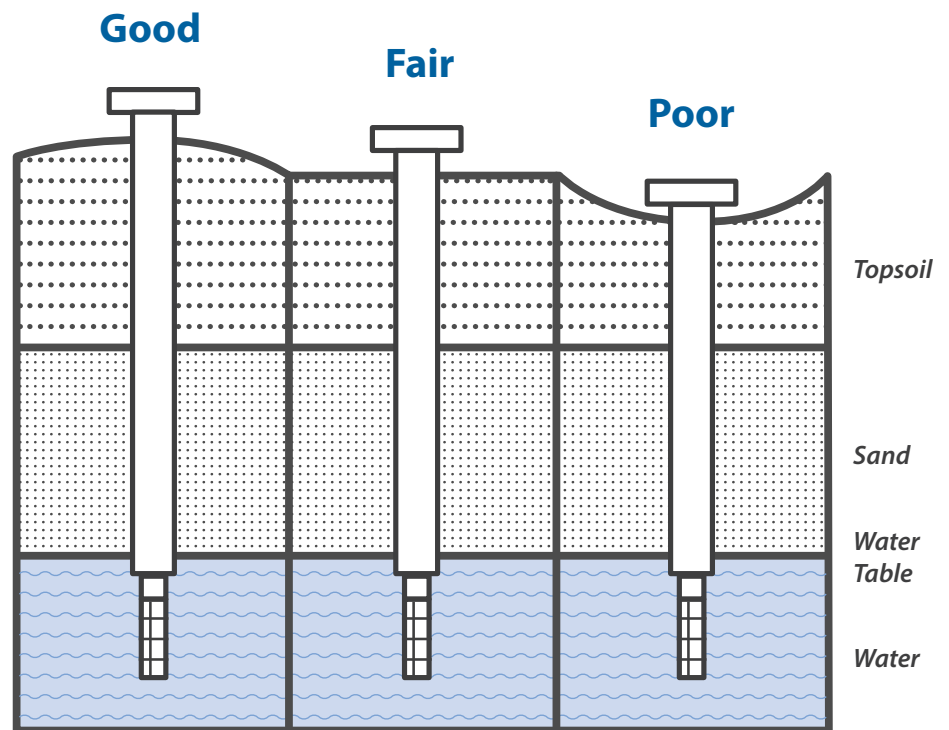
When it comes to the exact location of a water well, the water well system professional should at a minimum consider the preceding factors.

Some people by tradition use a “water witcher” or “water dowser” to pick a location for a well—where an individual uses a forked stick purportedly sensitive to the presence of water underground. The National Ground Water Association does not recommend this.

Water witchers/dowsers have been tested in unbiased experiments, and their success at locating water has been no better than random odds. Often other factors such as topography, separation from potential hazards, geology, and service access are more important drivers of where to locate the well.

To learn more about the following topics visit WellOwner.org:

- Planning a well
- Planning for a water well



Water Well Topography

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TIMING

How long does it take to construct a new well system?**The well construction process can be divided into two major phases:**

- The drilling of the well
- Construction of the rest of the system, which includes installation of the water distribution line to the house, the pump and associated wiring, the pressure tank, and any water treatment equipment that may be necessary depending on the water quality

Drilling the well can take hours or days, depending on how deep the well needs to be and the geology through which it is being drilled. The type of drilling technology also depends on the geology

through which the well is being drilled. Common drilling technologies for household wells include rotary, cable tool, down-the-hole, and reverse circulation drilling.

Well depths can range from less than 100 feet to 500 feet or more.

Installation of the pump and pressure tank tend to be routine as is installation of the water distribution line, although the work involved in the latter can depend on the length of the distribution line

from the well to the house. If additional water storage is required, more time to situate, build, or equip tanks may be necessary.

Some but not all water well system professionals install water treatment equipment. Treatment can involve one technology or a series of different technologies, depending on what or how many substances are being treated in the water.

Some well water needs no treatment at all if the groundwater quality presents no objectionable appearance, taste, or odor issues or health risks.

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CLEANUP

What happens to all the debris from the drilling process?

Just as drilling a hole in a piece of wood creates cuttings, drilling a well also creates debris. Failure to clean the bore hole of such debris can result in poor quality turbid water.

An important part of well construction is the well development, a process which removes loose material resulting from the

drilling process and leaves the bore hole more clean, stable, and permeable so that water flows more freely into the well. Proper well development can sometimes make a poor well a good one in terms of water quality and water production. Your agreement with the well contractor will set the terms for site cleanup.

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SHARING A WELL

Can I share a well with a neighbor?

It is not uncommon for two or more families to share a well. If you are thinking about a shared well, there are at least several matters that you should consider.

A shared well agreement

A shared well may make sense, for instance, if one's property is not suitable for drilling a well while a neighbor's property is suitable. Remember, however, that water is not the only thing you will be sharing. Sharing in the ongoing operation and maintenance of the well—as well as monitoring water quality and good groundwater protection practices—would normally be expected of all participants in the well.

To protect the interests of all involved, a shared well agreement is advisable. An agreement should be drafted by an attorney, such as a real estate attorney or another attorney proficient in drafting water agreements.

Areas commonly addressed in such agreements include:

- Ownership
- Cost of construction
- Cost of maintenance
- Water line easements
- Maintenance and repair of pipelines
- Prohibition practices, such as construction or land-use in proximity to the wellhead

Typically, privately owned water wells serving residences are not regulated on an ongoing basis for water quality. However, if a private well serves enough people, it qualifies as a public water system and comes under federal Safe Drinking Water Act regulation.

A public water system is defined as a system that provides water for human

consumption to at least 15 service connections or serves an average of at least 25 people for at least 60 days each year. This includes water used for drinking, food preparation, bathing, showering, brushing teeth, and dish washing. Public water systems range in size from large municipalities to small churches and restaurants relying on a single well.

Here are three types of public water systems:

- Community water systems serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents
- Non-transient, non-community systems serve at least 25 of the same persons over six months per year
- Transient non-community systems serve at least 25 different persons over 60 days per year

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LONGEVITY

Do wells have warranties?

The law regarding warranties on the materials and equipment are constantly changing. You should review with the contractor exactly what is warranted, and for how long—and obtain any written description of warranties for your records.

Ask your water well system professional whether they offer an ongoing well system maintenance or well testing service contract.

13

LONGEVITY

How do I know if I need a new well?

The best way to know if you need a new well is to get it thoroughly inspected by a water well system professional (see more on well inspections in the Well Maintenance section - pages 20-25). While it may not be visible from the surface, an inspection could reveal deterioration of a well that is unfixable. For example, sometimes the steel casing is so badly corroded that it can't be replaced or lined.

Possible signs that a well system may be at the end of its useful life are:

- A significant decrease in the flow rate of water into the well
- Degraded water quality due to deterioration of the well system
- A drop in the water table below the level of the well

Again, before deciding to get a new well, have a water well system professional evaluate your existing well. The professional should be able to explain why a new well must be constructed rather than repairing the old one.

Learn more about well system inspections at WellOwner.org.

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FUNCTIONALITY

Can I be sure my new well will have good pressure?**For a new well, two key factors for good pressure are the capacity of the pump and the pressure tank.**

If a household's water demand in gallons per minute is matched or exceeded by the pump's capacity, water pressure should be fine. However, if the water demand exceeds the pump's capacity, the pressure will be low.

Discuss your anticipated household water use with the water well system professional so that he or she can recommend an appropriately sized pump. That same information will also be helpful to the professional in recommending an appropriately sized pressure tank.

Typical pressure tanks range in size from 20 to 80 gallons. The tanks provide a limited amount of water under pressure created by the tank so that the pump doesn't have to run every time water is used.

Factors the professional considers in deciding how to construct the well to provide adequate water under pressure include:

- The flow of water into the well
- The storage capacity within the well itself
- Pump capacity
- Pressure tank size

Other devices that can help maintain good pressure are a constant pressure valve installed between the pump and the pressure tank, and a variable speed pump, which adjusts the speed of the pump based on the water demand.

Learn more about water pressure at NGWA.org.

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FUNCTIONALITY

How do wells work?**First, the basic components of a modern water well system consist of:**

- A steel or plastic well casing, which is inserted into the bore hole to keep the hole open and protect the quality of water in the well
- Some wells have one or more well screens in the aquifer zone, where water enters the well
- A pump, either submerged in the well or located on the surface with some components in the well
- A wellhead, which is the portion of the well casing that extends above the surface of the ground, is capped, and allows access to the well
- A distribution pipe that carries water from the well to the house, and in colder climates is buried to prevent freezing, but in warmer climates may be located above ground

- A pressure tank, which stores and delivers water under pressure so that the pump need not run whenever water is used
- Any water treatment equipment which, depending on what is being treated and how, could be located anywhere in the well system from the well bore hole and the wellhead to the water distribution pipe outside the house, inside the house, before the house plumbing, or somewhere in the house plumbing

A well operates much like a person using a straw in a glass of water. The straw is the well and the drinking water glass is the aquifer that holds underground water. The person using the straw is like a well

pump drawing water out of the aquifer—and the person's digestive system receives the water like a distribution pipe and removes impurities like water treatment equipment so that safe water is available to the body or, in the case of a household, the well owners.

It is important to note that a properly constructed and installed water well system has sanitary seals that prevent certain types of contamination, such as bacterial contamination, from entering the system in key areas of vulnerability. Certain well construction features can also block off subsurface water-bearing zones from contributing water with naturally occurring contamination to the well.

16

FUNCTIONALITY

What are the key components of a water well?

A water well is really a water well system because it consists of numerous components—several of which can affect water quality if not maintained.

The following well system components are designed to protect water from substances that are harmful to health or adversely affect the water's appearance, taste, or odor.

The well casing

This is the tubular structure that is placed in the drilled well to maintain the well opening. Along with grout, which seals the space between the drilled hole and the casing, the casing confines the groundwater to its zone underground and prevents contaminants from mixing with the water. The most common materials for well casing are carbon

steel, plastic (most commonly PVC), and stainless steel. Different geologic formations dictate what type of casing can be used.

The well cap

The well cap goes on top of the well casing above the surface of the ground. It should fit snugly so debris, insects, or small animals can't find their way into the well system.

The well cap should be bolted or locked so that it cannot be easily removed. The well cap also provides access to the well for servicing by a water well system professional.

Well caps are usually aluminum or thermoplastic and have a vented screen so that the pressure difference between the inside and outside of the well casing may be equalized when water is pumped from the well.

A cracked or loose well cap could allow outside contaminants, including bacteria via insects or vermin, into the well. Well owners should periodically inspect the well cap and contact a water well system professional if a problem is detected.



The pitless adapter

This connector installed underground below the frost line provides a sanitary seal between the well casing and the water line running to the house. If this seal is compromised, it could allow bacteria or other contamination into the well. A water well system professional can determine whether the pitless adapter is contributing to such water quality problems.

The well screen

The well screen attaches to the bottom of the casing, allowing water to move through the well while keeping out most excess sediment, sand, and gravel from entering the well.

There are different styles of screens, including perforated pipe, continuous slot, and slotted pipe. A water well system professional can determine which type is best suited to your well. Many wells completed in rock aquifers are completed “open hole” without screens.

The following components perform other vital functions in a water well system:

The pump

Two types of pumps dominate the household well market—jet pumps, which are mounted above the ground, and submersible pumps, which are housed underwater down in the well.

Jet pumps are most often used for shallow wells up to a depth of 25 feet or so, although jet pump technology can be configured to pump water from several hundred feet deep. Jet pumps use suction created by a vacuum to lift water out of the well.

Submersible pumps can be used at shallow depths or in deeper wells. They push water up through a pipe installed in the well.

Variable speed drive pumping systems vary the speed of the pump motor to deliver the amount of water needed under pressure on demand.

The pressure tank

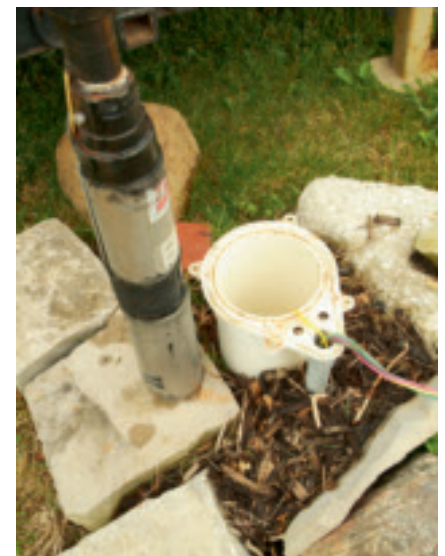
The pressure tank is usually located in the house, and they generally range in size from 20 to 80 gallons. These tanks deliver water under pressure so that the pump doesn't have to operate every time water is used.

Water treatment equipment

A well owner may desire water treatment either to treat actual water quality problems or, for peace of mind, as a safeguard against possible contamination.

To learn more, see the Water Treatment section - pages 32-43.

Learn more about well system components at WellOwner.org.



17

REGULATIONS

How deep should a well be?

The biggest factor affecting water well depth is the geology beneath the ground surface. Finding an adequate supply of good quality water may be dictated by the location of a suitable aquifer, which is a water-bearing formation.

In a given location, there may be only one aquifer from which to choose, so the water well professional must drill to that depth. In other locations, aquifers may be layered but of differing water quality and quantity—so a decision must be made about which aquifer to tap into. In other locations, the best aquifer could

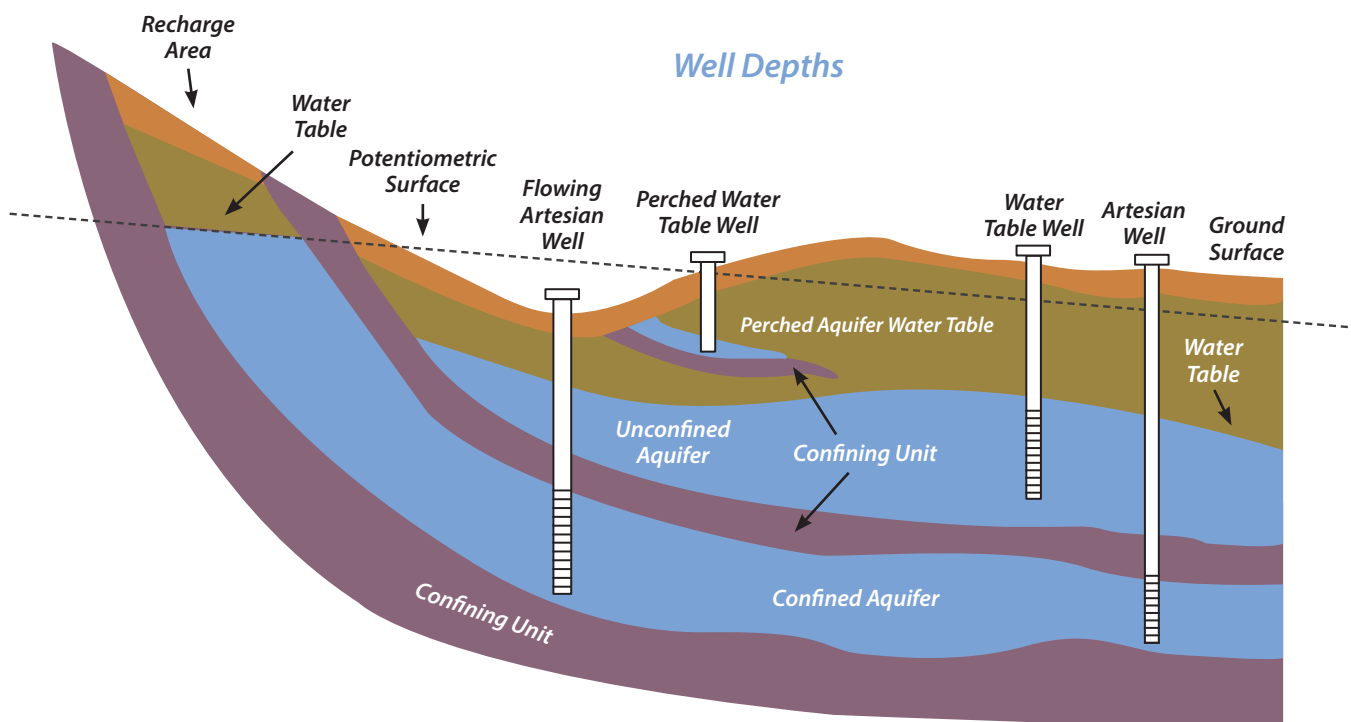
be dozens of feet thick to 100 or more feet thick—so a decision needs to be made how far into that aquifer to drill. One should also consider water levels could drop in the aquifer over time if it is an area where groundwater pumping is heavy.

Information from area well logs—records of the subsurface from drilled wells—could provide an indication of the approximate depth at which suitable water may be found. The water well system professional should be able to explain what he or she estimates the well depth will be and why.

Understand, however, that anomalies occur in the subsurface, and there are no guarantees about the depth at which a suitable water supply will be found or whether water will be found at all.

While “dry holes” are uncommon, they do happen. Some water well contractors offer discounts for dry holes. Before drilling begins, it is worth discussing with the professional the costs and next steps if a dry hole or poorly producing well results.

There are electronic geological techniques known as geophysics that can be used to locate more likely drilling sites in areas with uncertain groundwater prospects.



18

REGULATIONS

Are private household wells regulated?

Most private household wells do not have ongoing regulation of water quality or the well system's maintenance. However, most states do have some limited regulation.

**Three areas where private wells are most likely to be regulated are:****Well construction**

Most states have some well construction standards. Often states adopt the well construction standards, but sometimes local governmental jurisdictions will adopt more stringent construction standards. These standards are intended to protect the groundwater and the health of persons who will be consuming the water.

At completion of construction

In many states, the water will be tested for certain potential contaminants that present a health risk before the water is allowed for human consumption. In some states, for instance, the water must be free of coliform bacteria, which, if present, indicates that the conditions exist for potentially harmful pathogenic bacteria. In such cases, the system would need to test free of bacteria before the state would allow the water to be consumed.

At property transfers

While most states don't regulate water quality in private household wells beyond a well's construction, some states do require testing the water if a property being purchased has a private well.

To find out your state's private well regulations, visit NGWA.org and click on your state and scroll down to "Construction," then "Contact Information" or "Regulations."

A person wearing a hard hat and safety glasses, working on a well system. The background is a dark, purple-tinted image of a person in a hard hat and safety glasses, working on a well system. The person is wearing a dark shirt and a hard hat with a chin strap. They are holding a tool or part of the well system. The overall tone is professional and industrial.

Well Maintenance

Routine water well inspection and maintenance can help ensure your well is operating properly, prolong the useful life of the well system, protect your investment—and, most importantly, protect your water quality and your health.

Catching and addressing maintenance problems early can often avoid costlier and inconvenient service interruptions. This is like performing routine maintenance on a car. If you have the oil changed at specified intervals, it protects the engine and extends its longevity.

This is the water you drink, so it's in your best interest to take care of the well system that provides it.

1

GETTING STARTED

I don't know anything about maintaining my well. Where do I start?

If you work with a water well system professional who you trust, talk with him about getting a water well system inspection if you have not had one. If you don't have an established relationship with a professional, contact several at WellOwner.org/find-a-contractor and talk with them about an inspection and what's involved.

A thorough inspection includes both a visual inspection of the well system components above the ground and a physical inspection of the well system components below ground. A competent water well system professional has the knowledge and skills to evaluate a well system, provide a written report, and recommend any actions that might be warranted.

To learn more about what a professional well inspection involves, view the best suggested practices document at NGWA.org for professionals from the National Ground Water Association.

2

INSPECTION

How much does a professional well inspection cost?

It depends on the professional and the thoroughness of the inspection. The National Ground Water Association

(NGWA) has developed a best practice document on well inspections that can be downloaded for free at NGWA.org.

You can ask a professional to give you an estimate of the cost of an inspection based on what NGWA recommends.

3

WATER PRESSURE

My water pressure tank doesn't seem to be working very well. What should I do?

First, contact the manufacturer or your water well system contractor, if you have one. Sometimes the pressure setting

in the tank can be too low, or the tank may be waterlogged, meaning it has too much water in it to function correctly.

Often it is less inconvenient and costly to let a water well system professional fix it than to try to do it yourself.

4

MAINTENANCE PLAN

Is there a well maintenance schedule that I can follow?

There is no standardized water well maintenance schedule. Well systems can vary significantly in their construction and in the type and quality of components. Furthermore, local weather and geologic conditions vary and have differing effects on the well system.

However, there are best practices for staying on top of your well system's maintenance. These best practices fall into the categories of:

1. Knowing key information integral to maintenance of your well system
2. Visually checking the wellhead and its environs
3. Visually checking other above-ground well system components and equipment
4. Knowing when to call a water well system professional
5. Recognizing and minimizing groundwater contamination threats

For a more detailed explanation of maintenance practices by the well owner, visit WellOwner.org. You also can download a free *Well Owner App* that enables you to program automatic well maintenance reminders.

1. A well log is a document containing vital information on the history of the well and the ground surrounding it. Contractors must file well logs with their respective states upon completion of new wells. However, well owners should have a copy, too, in case a need for maintenance arises over the lifetime of the well. Quick access to and understanding of the well log can be crucial at such times.

Here is an abbreviated look at water well maintenance practices.

Knowing key information about your well

Two key types of information well owners should possess are (1) a log¹ of the well's construction, including the well materials and components, and (2) maintenance and warranty information on well system components, including water treatment equipment. This information can provide important guidance for proactive or reactive well maintenance.

If you are getting a new well, ask the water well system contractor for any warranties or maintenance information on individual well components such as the well pump and pressure tank—but also any water treatment equipment.

Visual inspection by the well owner

Well owners lack the knowledge and experience to diagnose most well maintenance problems. However, they can through observation see evidence of possible maintenance problems that should be checked by a professional.

Here are some of the things well owners should look at routinely:

At the wellhead

- **The casing:** This is the pipe in the bore hole that extends vertically out of the well. Check its general condition and whether it extends at least 12 inches above the ground
- **The well cap:** Check to see whether it's secure, the seals are in good condition, and that it is not loose, cracked, or otherwise broken
- **The electrical conduit:** Visually verify that all connections are secure

Well system components

Visually inspect:

- Any above-ground pumping equipment for proper cooling and venting of motors, shaft seal leaks, rust, or weakened fittings
- Wiring and parts such as pipes, connections, joint seals, gauges, pressure relief valves, and the water meter (if present)

Other equipment

- Note the condition and accessibility of above- and below-ground storage tanks
- Visually examine the electrical control box and connections
- Follow manufacturer directions for water treatment system maintenance and water testing
- Evaluation by a water well system professional

Consult a water well system professional:

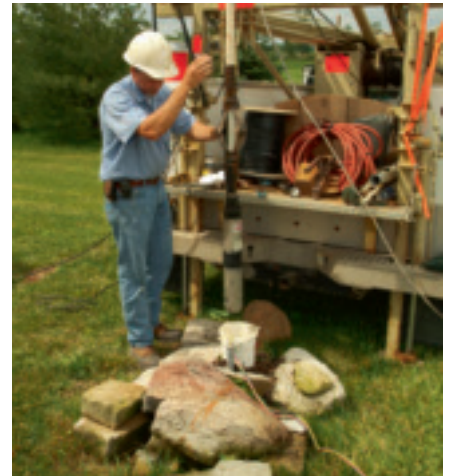
- Anytime the well needs to be opened
- If you experience water taste, odor, or appearance problems
- If there is a loss of capacity or pressure
- Whenever a water test reveals a health risk
- When you find a possible problem with the wellhead and the area around it, or anything related to the well system
- If you want a well system cleaning or disinfection
- If the breakers serving the pump are tripped or any control warning indicators show a need for attention

Groundwater protection

Here are some general considerations for protecting your groundwater supply:

- Check for potential sources of contamination, flooding, or physical dangers
- Look for any weeds, trees, shrubs, or grasses with root systems within 10 feet of the well, as these should be removed
- Do not mix any chemicals or potential contaminants near your well and do not spill such substances on the ground, since they could infiltrate your groundwater supply

- Prevent back-siphoning by keeping hoses out of mixing tanks and having back-flow preventers installed at spigots and yard hydrants
- Do not pile snow, leaves, and other materials around the well



5

PUMP MAINTENANCE

My well pump is cycling on and off frequently. Is there something wrong with the pump?

There could be multiple explanations, but two common causes for frequent pump cycling are a malfunctioning water

pressure tank or a faulty pump pressure switch. The best way to get an accurate diagnosis and remedy is to contact a

water well system professional or the equipment manufacturer. This could save you time and money in the long run.

6

WATER MAINTENANCE

There has been a change in my water quality [or quantity]. Could this be a maintenance issue?

Anytime there is a change in your water's taste, odor, or appearance—or a noticeable decrease of water flow into your well—this could indicate that your well needs maintenance.

For example, changes in water quality could indicate that the well needs to be cleaned or that surface water is infiltrating the well through a breach in the well system. A decrease of water flow into the

well could indicate clogged well screens or encrustation of water-bearing formations around the well. Well maintenance can often restore water quality and the well's productivity to previous conditions.

7

MAINTENANCE TIMING

How do I know if my water treatment system needs maintenance?



First, check the owner's manual or product information for recommended maintenance. If you do not have that information, contact the manufacturer or go online to see if you can find the maintenance information for your product's make and model.

You also can get a water test to see if the treatment system is working. Neglecting water treatment system maintenance can potentially create a worse problem if the system gets overloaded.

8

CHLORINATION

Is shock chlorination a part of routine water well maintenance?

No. "Shock chlorination" is a term loosely applied to using a relatively high concentration of chlorine to disinfect a water well system.

Disinfection is an important procedure to perform anytime a water well is opened, serviced, or if a water test result indicates the presence of bacteria. When bacteria are detected, it should first be determined whether there is a breach in the well system allowing surface water or bacteria-laden water to enter the well. If there is a breach in the well system, the first concern would be to repair it and then disinfect the well system.

The National Ground Water Association recommends that well owners use a water well system professional whenever possible to disinfect their well systems. Disinfection involves many steps and could easily be done incorrectly by inexperienced or untrained well owners. In some states, it is required that licensed professionals conduct disinfection of wells and water systems.

Learn more about shock chlorination at WellOwner.org.

9

WELL RESTORATION

Can an old abandoned well be fixed?

It depends on the condition of the well. A water well system professional should evaluate the well system to determine whether it can be repaired and put back into use.

If, however, it is determined that a well cannot be fixed, it should be properly decommissioned or “plugged” to protect the groundwater. An abandoned well can provide a direct pathway for contamination from the surface into the groundwater—potentially the same groundwater supply you are using for your functioning water well.

Well owners should search their property for abandoned wells. If one is found, contact a water well system professional to properly plug it. Attempting to plug a well yourself is likely illegal since there are usually state or local well decommissioning regulations.



A close-up, high-angle shot of water splashing into a circular sink drain. The water is captured in mid-air, creating a dynamic pattern of droplets and ripples. The background is a textured, light-colored surface, possibly a countertop or sink basin. The overall color palette is muted, with various shades of green and grey, giving it a clean, natural feel.

Water Testing

NGWA recommends well owners test their water at least annually for bacteria, nitrates, and any contaminants of local concern.

Check with your local health or environmental health department for recommendations regarding the type and frequency of testing specific to your location.

1

ANNUAL TESTING

Why is it important to test annually for bacteria and nitrate?

Bacteria are present throughout the environment. Consequently, a well system that is not properly sealed off from outside bacteria can be vulnerable. Wells can also be vulnerable if there is an overloading of the groundwater with bacteria, for instance from an animal enclosure or a septic system failure.

While many forms of bacteria are not harmful, some are pathogenic, meaning they cause disease, such as strains of *E. coli*, which also indicate sewage

contamination. Pathogenic bacteria can cause moderate to severe gastrointestinal illness or even death. Typically, well water is sampled first for total coliform bacteria, which are not necessarily harmful. A test that is positive for coliform bacteria indicates that the conditions exist in the well to support other types of bacteria, including pathogenic bacteria.

Nitrate is common in rural areas, which tend to rely more on water wells for household drinking water. Nitrate is

often used in fertilizer, and it also is a byproduct of animal and human waste. The greatest danger from nitrate is its ability to inhibit the blood's capacity to carry oxygen in infants under the age of about six months. This condition is called methemoglobinemia, commonly known as "blue baby syndrome."

Learn more about water testing, bacteria, and nitrate at WellOwner.org.

2

BACTERIA & NITRATE TESTING

How do I know if I have dangerous bacteria or nitrate in my well water?

If your water tests positive for coliform bacteria, it means the conditions exist in your well to support other bacteria, including harmful disease-causing (pathogenic) bacteria. Consult with your drinking water testing laboratory about doing further testing for pathogenic bacteria.

The maximum contaminant level for nitrate in water from public water systems is 10 parts per million. Remember, this is a health threat to infants under the age of about six months who may be drinking formula made with nitrate-contaminated well water.

Learn more about interpreting water test results at ohiowatersheds.osu.edu.

3

CONTAMINANT TESTING

Can there be contaminants locally? If so, for what should I test?

Yes, there can be localized contamination. Such contamination can occur naturally in the geology, such as arsenic or radon. Other local contaminants may be manmade, for instance, toxic substances from former industrial sites, landfills, or chemical spills or current activities: mining, oil and gas, etc.

To learn what might be of local concern, start with your county health or environmental health department. Be aware of activities around you.

Many county health departments provide water testing and may know about localized groundwater contaminants.

You can also check with drinking water testing laboratories that serve your area to find out about localized groundwater contamination threats.

Learn more about water testing at WellOwner.org.



4

TESTING LOCATIONS

How do I find a drinking water testing laboratory?

You can start by checking with your health or environmental health department at the county or state levels. These departments often do some water testing.

Learn more about water testing at WellOwner.org.



5

TESTING COST

How much does a water test cost?

It depends. Some contaminants are more or less difficult to test and therefore more or less expensive. Also, the number of substances being tested can affect the price significantly. Consequently, depending on the type and number of

tests you want, the cost could be from under \$50 to hundreds of dollars or more. Often if the well owner tests for bacteria, nitrate, and anything of local concern, this will amount to a handful of tests. Some laboratories provide packages that cover different ranges of testing. To decide on

your testing needs, get the advice of your water well system professional, local health department, or a drinking water testing laboratory.

Learn more about water testing at WellOwner.org.

6

TESTING PROCEDURES

How are water samples taken, and who takes them?

Drinking water testing laboratories, or local governments that offer water testing, often provide a test kit to the well owner. The test kit will have everything the well owner needs to take a sample.

Testing kits have instructions on precisely how to take the sample. This is VERY important, since some sample collection requires very careful handling—for instance, in the case of bacteria. Great care must be taken to properly disinfect the faucet or spigot and to not inadvertently introduce bacteria into the sample by touching the lip or inside of the bottle—or allowing anything to touch the inside of the lid.

Some types of samples must be processed by a lab within a certain time or be kept at a certain temperature. The sample collection instructions should make these details clear. When in doubt, ask the lab or the testing program.

The testing of other substances may be comparatively simple.

Some labs or testing programs will do the sampling for the well owner, but many if not most do not. As you may hire a water well professional for well work, hiring an environmental professional can assure that sampling—critical to valid results—is conducted properly. Some types of sampling are difficult or may be critical in legal proceedings.

Learn more about water testing at WellOwner.org.



7

TESTING PROCEDURES

How often should I test my water?

Answer: It depends. The National Ground Water Association recommends that well owners test annually for bacteria and nitrate, though organizations may differ on their recommendations.

Changing circumstances might warrant water testing at more frequent intervals. Three examples are (1) a sudden change in one's water quality, (2) the occurrence of a nearby chemical spill, or (3) contamination that is spreading in

groundwater over time and approaching nearby wells. Conversely, some contaminants, once discovered, may not need to be tested again because they exist naturally in the geology and groundwater and will always be present.

Anytime there is a change in your water's taste, odor, or appearance—or a noticeable decrease of water flow into your well—you should test your water. Discuss the symptoms to your water well

system professional or a drinking water testing laboratory for recommendations on what to test.

Sudden changes in water quality could signal that the well needs to be cleaned or that surface water is infiltrating the well through a breach in the well system. Well maintenance often can restore water quality to previous conditions.

Learn more about water testing at WellOwner.org.



8

TESTING SCHEDULE

Should I test water from my water treatment system periodically?

Yes. First, check the water treatment system owner's manual for recommendations on water testing. If you do not have that information, contact the manufacturer or go online to see if you can find the maintenance information for your product's make and model.

Generally, treated water should be tested after the treatment system is installed to make sure it is working. You also can test the water after the treatment system is serviced to make sure it is working properly. Another reason to test is if the treatment system has not been maintained according to the product maintenance recommendations. Neglecting maintenance such as the timely replacement or cleaning of a filter could impair the treatment system's effectiveness.

9

TESTING LOCATIONS

Will my water test results show me if I have a water quality problem and how to fix it?

Drinking water testing labs vary in the degree to which they explain test results and give guidance on what to do if there is a problem. Some labs provide a simple explanation of results and suggest appropriate treatment technologies if there is a problem. Other labs provide numerical results of contaminant levels with little explanation or guidance.

If the lab does not interpret the results or provide next steps for the well owner, consider showing your results to a groundwater professional—or talk with someone at your county health or environmental health department.

Another option is to use a water test interpretation tool online. There are a number of such tools available.

Lab test results are very important if you are considering getting a water treatment system. You should always compare your water test results against the specifications of the treatment system you are considering. This should tell you whether the system is designed to treat what you need to treat in the concentration at which it exists in your water.

Learn more about water testing at [WellOwner.org](https://www.wellowner.org).



Water Treatment

Water quality problems can be divided into two broad categories: (1) those that present aesthetic concerns, such as undesirable tastes, odors, or appearance, and (2) those that present a health risk.

Some water quality problems are caused by a contamination source that, if eliminated, could result in improved water quality. Generally, it is better to eliminate the cause of a water quality problem than to simply treat the contaminated water.

When treating the cause of a water quality problem is not possible—such as with naturally occurring geologic arsenic affecting groundwater—water treatment can be a good option.

Depending on what is being treated and how, water treatment equipment may be located at almost any stage within the well system. More often than not, water treatment equipment is installed at the point of water use, such as the kitchen sink, or at the point where water enters the house, treating all the water.

The most common types of water treatment are:

- **Continuous disinfection** which kills bacteria and other microorganisms. The most common approach is the use of ultraviolet light, which requires proper installation, pre-treatment of the water, and maintenance. Another technology regularly releases a disinfectant into the well water. There should be filtration leaving the well, before other treatment, if adding disinfectant.
- **Ion exchange** is a physical-chemical process in which ions are exchanged between a solution phase and a solid resin phase. Ion exchange is most commonly used for water softening, but it also can be used for other purposes such as treating arsenic and nitrate in water.
- **Reverse osmosis (RO)** is a process for the removal of dissolved ions from water, in which water is forced through a semipermeable membrane, retaining most ions while transmitting the water. When coupled with granular activated carbon filters before and after the RO treatment, this system can achieve a high degree of removal of many of the substances that cause water quality problems.
- **Whole-house sediment filters** are installed in the water line coming into the house. They remove particulate from the water to enhance treatment effectiveness and reduce maintenance of other treatment systems that follow.
- **Adaptable automatic backwashing filters** require relatively little maintenance because they backwash the filter media bed automatically. While these filters do not treat everything, they can be fitted with different types of media to address various water quality problems.

Check to see if the system you are considering has been certified effective by independent product testing laboratories, such as those operated by NSF International and the Water Quality Association.

1

WATER TREATMENT

How do I know if I need water treatment?

The first step is to determine what kind of water quality issues you have. Aesthetic water quality problems are noticeable. However, some contaminants that present a health risk have no odor, taste, or appearance.

The National Ground Water Association recommends that all well owners test their water annually for bacteria, nitrate, and anything of local concern. To find out what might be of local concern, check

with your local health department, an area water well system professional, or an area drinking water testing laboratory.

The second step is to have the water tested by a certified drinking water testing laboratory. These labs can measure substances in parts per million or parts per billion. Depending on the type and number of substances for which you are testing the water, costs can range from less than \$50 to over \$100.

Water test results are important to providing the information necessary to select the right system for what you need to treat in the concentration at which it exists in your water.

Learn more about water treatment at WellOwner.org.

2

DETERMINING TREATMENT TYPE

How do I know what kind of water treatment I need?

Selecting a water treatment system begins with water test results from a certified drinking water testing lab. Find the lab closest to you at epa.gov. Such test results should be compared to the water treatment product specifications to ensure that the treatment system being considered is designed to treat:

1. The substances you want to treat
2. In the concentrations at which they exist in your water.

There is no one-size-fits-all water treatment technology that addresses all water quality problems. In some cases, one treatment technology may meet all your specific needs. In other cases, you may need a “treatment train”—a series of treatment technologies in a sequence that treat one or more water quality problems.

Again, when considering water treatment, use your lab test results as a guide and make sure the technology you are considering is designed to treat the problematic substances in your water.

Learn more about water treatment at WellOwner.org.

3

DETERMINING TREATMENT TYPE

Is there one treatment technology that will take care of all water quality problems?

No. Of all the home water treatment technologies, reverse osmosis (RO) and distillation cover the widest range of substances. Reverse osmosis and distillation are not effective in treating everything.

RO, for instance, does not treat some pesticides, solvents, and volatile organic chemicals, including ions and metals such as chlorine and radon. RO is popular because of its ease of installation, reasonable cost, and relatively minimal maintenance. Distillation is highly effective but uses significant amounts of energy.

Both methods remove almost all of the minerals in the water, many of which are beneficial.

4

TESTING PROCEDURES

How do you determine whether to treat water at the tap or for the whole house?

To decide whether to get whole-house treatment at the point where water enters the house (point of entry or POE) or at the tap (point of use or POU), it is helpful to ask yourself several questions:

1. Which approach is necessary to protect health?
2. Which approach is necessary to get rid of a taste, odor, or appearance problem?
3. Which approach is necessary for my peace of mind?
4. What can I afford?

Let's consider the answers.

Protecting health

Most of the time, the substances that commonly present a health risk must be consumed to cause harm. Two examples are arsenic and nitrate. When the health risk comes through water consumption, treating water at the tap is sufficient to protect health.

Sometimes, however, a health risk can occur through means other than water consumption. For example, radon gas can be released from water when the water is agitated by clothes washing, dish washing, or passing through a shower head or faucet, for instance. Once radon is released into the air, radon can be breathed. This released radon, when combined with radon gas coming up through the house foundation, can be a greater health threat than when radon in water is consumed.

Another example would be methane gas in water. When methane is released from water and accumulates in confined spaces within a house, it can present an explosion hazard. In the case of radon and methane gas, treating the water where it enters the house is recommended.

Eliminating taste, odor, or appearance problems

To a large degree, ridding water of taste problems can be treated at the tap. Often homeowners treat water at the kitchen tap where most water is drawn for drinking and food preparation. For many homeowners, it is not practical to treat water at every tap in the house.

When the problem is an unpleasant odor, cloudy water, or water that stains orange or black, treating water at the tap would only be a partial solution since it would not address water in the toilet, washing machine, or dishwasher, for instance. Odor problems can be caused by hydrogen sulfide gas, and staining can be caused by iron (orange or brown) and manganese (black). In these cases, treating the water where it enters the house may be a better overall solution.

Whole-house treatment also is standard when treating "hard" water, which is water with a high mineral content related largely to calcium and magnesium.

Peace of mind

While treating water at the kitchen tap may be adequate for some homeowners, others may choose more treatment so as not to worry about health risks or aesthetic issues. For instance, some homeowners get continuous water disinfection systems because they don't want to worry about harmful bacteria in their water—even though periodic water testing and disinfection when necessary may be adequate to protect against bacterial problems.

Affordability

Whole-house systems are more expensive than point-of-use treatment. If either approach can be used to address your water quality issues, your budget may dictate which approach you take.

Other important considerations

1. Power use
2. Water use
3. Fate of water streams

RO and distillation are power-intensive. Is the power available, or will it be affordable? RO can waste as much water as it treats. RO and ion exchange have potential waste streams rejecting chlorides, fluoride, arsenic, etc. into the environment.

Learn more about water treatment at WellOwner.org.

5

FUNCTIONALITY

How do water treatment systems work?

There are a variety of system designs to treat various constituents in water:

- **Particle filtration:** There are various filters to remove particles from water. This type of filtration removes particles ranging in size from more than 1,000 microns to fewer than 10 microns. The width of a human hair is about 100 microns.

- **Chemical treatment:** This form of treatment creates chemical reactions that address various water quality problems such as hardness, pH imbalances, and sulfides.

- **Ultrafiltration and nanofiltration:** These approaches are used to remove total dissolved solids, which include salts, organics, and heavy metals such as arsenic and lead. Ultrafiltration removes such constituents in the range of less than 1 micron to as small as less than

1/10th of a micron. Nanofiltration removes constituents 1/10,000th of a micron or smaller.

- **Disinfection:** Disinfection is used to kill microorganisms such as bacteria, viruses, and protozoa.

Often, more than one type of treatment will be used in sequence to address water quality issues.

Learn more about water treatment at WellOwner.org.

6

MAINTENANCE

What kind of maintenance do water treatment systems require—and can I do the maintenance myself?

Some maintenance is simple, such as the replacement of a cartridge in a whole-house sediment filter.

Other maintenance is more complicated and may best be done by a professional. Take the removal of uranium. For each type of uranium treatment—reverse osmosis, ion exchange, and distillation—filters or membranes can accumulate

high concentrations of this radioactive substance. These filters or membranes must be handled carefully and disposed of properly.

Maintenance also can become more challenging if there is a “treatment train,” where multiple treatment technologies are used.

Discuss the maintenance requirements of your treatment system with your water well professional or water treatment professional to decide how much maintenance if any is feasible for you to perform.

Take a free online water treatment system maintenance lesson at WellOwner.org.

7

COST

How much do water treatment systems cost?

There are two sets of costs involved: the purchase/installation costs (capital costs) and operating costs. In the cost ranges shown, the higher ranges tend to apply to whole-house treatment while the lower ranges tend to apply to point-of-use treatment.

The capital costs of the most common types of water treatment generally range from less than \$100 to \$3,000 or more.

Learn more about water treatment at WellOwner.org.

Operating costs for the most common home water treatment systems generally range from less than \$100 a year up to \$1,000 annually.

8

TREATMENT

How do I treat arsenic in my water?

Arsenic can occur in discrete geologic zones. If these are known and can be isolated with casing or sealing, arsenic in raw groundwater can be greatly reduced without or before treatment. Arsenic will coprecipitate with iron oxides. If there is sufficient iron in the water along with arsenic, iron oxidation and filtration can also remove arsenic.

Three different water treatment technologies can be effective in treating arsenic:

- **Reverse osmosis (RO):** This is a nanofiltration system often accompanied by granular activated carbon filtration as the water enters and exits the RO membrane.

- **Ion exchange:** This is a physical-chemical process in which ions are exchanged between a solution phase and a resin phase.

- **Adsorption media:** This is a physical process involving the adherence of a contaminant to the surface of a porous medium.

Learn more about treating arsenic at WellOwner.org.

9

TREATMENT

How do I treat bacteria or other microorganisms in my water?

Water treatment technologies commonly used in treating microorganisms in water include:

- **Reverse osmosis (RO):** This is a nanofiltration system often accompanied by granular activated carbon filtration.
- **Chlorine compounds:** This is the most convenient, effective, and economical method of disinfecting large volumes of water. Chlorine for residential well systems is available either in liquid, granular, or tablet form. Continuous chlorine feeding into the water can create potential damage to the well system.
- **Ozone:** Ozone is a gas that can be dissolved in water to produce an excellent disinfectant. It is a more effective disinfectant than chlorine but must be produced on-site and administered by the ozone treatment system.



- **UV irradiation:** This technology has been used for years in disinfection. Some pre-filtering of the water may be necessary to enhance the disinfection process, UV bulbs must be kept clean, and there are some forms of bacteria that are more resistant to UV disinfection.

These treatments are for removal of bacteria and other microorganisms of health or process concern. *Biofouling*, coatings that are a product of bacteria naturally occurring in aquifers, may require periodic well treatments or filtration to protect downstream treatments and systems.

Note: When addressing bacteria, it is important to determine whether the bacteria's presence is an isolated incident or the result of a more persistent problem—for instance, a breach in the well system or an overloading of the groundwater with bacteria from a concentrated source such as an animal enclosure or a failing septic system.

If the bacteria's presence is due to an isolated incident, disinfection of the well system should get rid of the bacteria. The way to confirm this is to retest the water a week or so after the disinfection process has been completed to see if the bacteria returns. Until the water tests negative for coliform bacteria, drinking bottled water is a safe alternative.

If the presence of bacteria is persistent, consult with a water well system professional, who can inspect your well system and the area around the well to look for a cause that can be addressed.

Learn more about treating microorganisms and inspecting your well system at WellOwner.org.

10

TREATMENT

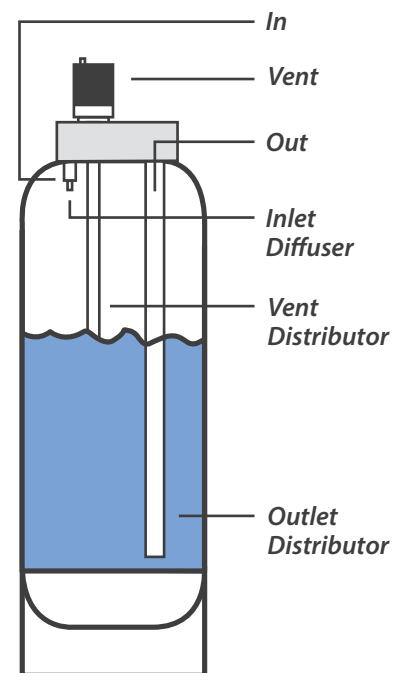
How do I treat hydrogen sulfide in my water?

Technologies used in treating hydrogen sulfide are:

- Aeration, which mixes air with water to separate out sulfide
- Carbon filters
- Chlorination to reduce the bacteria that produce hydrogen sulfide
- Ion exchange in which a resin absorbs hydrogen sulfide
- Manganese greensand filtration
- Oxidizing filters that change the hydrogen sulfide gas to sulfur for removal
- Ozone treatment in which a chemical reaction separates out sulfur for removal. For example, vented sulfide may cause asphyxiation if it accumulates in enclosed spaces, and may cause corrosion.

Most of these have significant maintenance requirements and some have unpleasant side effects. Work with a water treatment service provider to determine which treatment technology is the best approach to treating the hydrogen sulfide in your water.

Learn more about treating hydrogen sulfide at WellOwner.org.



Large Aeration Tank

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TREATMENT

How do I treat iron and manganese in my water?

There are two technologies used for the treatment of iron and manganese:

- **Ion exchange:** A physical-chemical process in which ions are exchanged between a solution phase and solid resin phase. A standard household water softener may effectively remove iron and manganese at certain concentrations.

- **Oxidation and filtration:** This involves oxidation of iron and manganese into forms which can then be filtered out.

Learn more about treating iron and manganese at WellOwner.org.

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TREATMENT

How do I treat methane in my water?

Any water well with methane present should have a gas venting system installed at the well to vent gas to the atmosphere. This may allow a portion of methane gas to escape before it can accumulate in the water distribution lines, pressure tanks, water heaters, water treatment equipment, or well houses. This option is most effective for dealing with free gas bubbling through the water. However, this method is unlikely to be fully effective against the portion of gas dissolved in groundwater.

If groundwater with methane is pumped into a pressurized tank, in rare circumstances when a faucet or similar valve is opened, the water can flame

when ignited as the gases are released from the water. In this case, a venting system installed in the water tank is required.

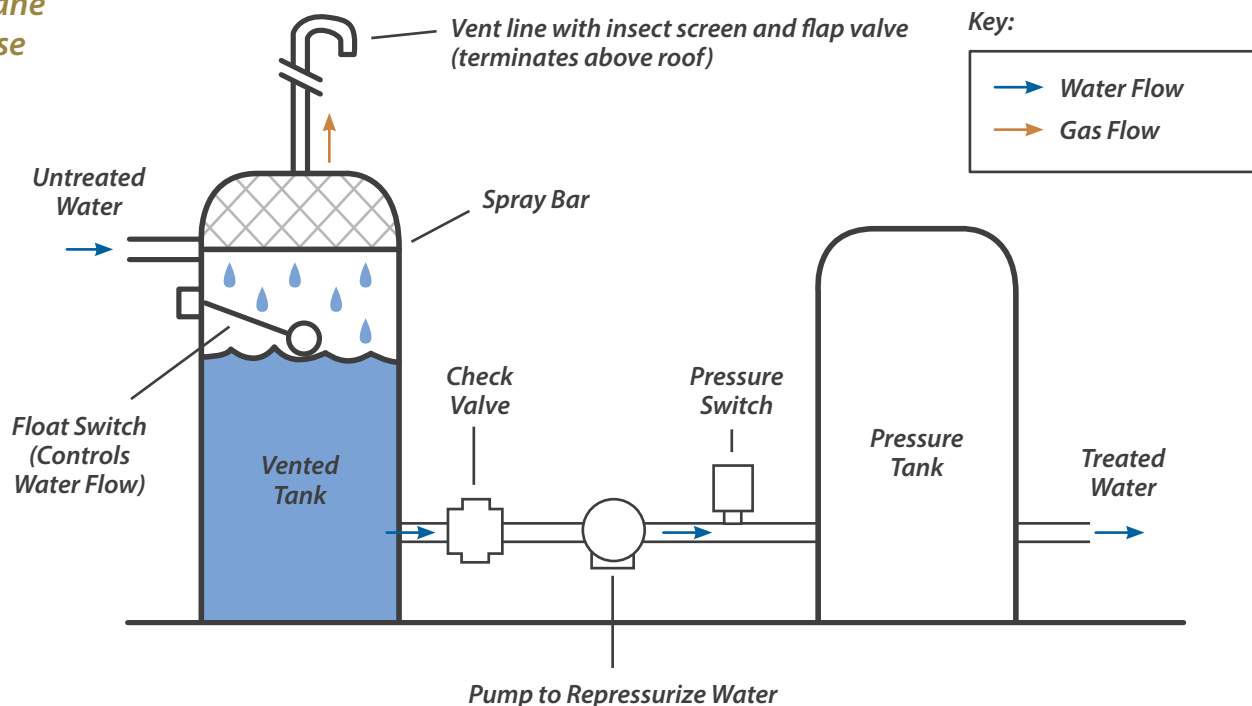
It may be possible to release methane outside of the building, using a specially configured pressurized water storage tank that vents the gas to the atmosphere. In such a system, the vent pipe needs to extend above the eave height of the well house or home where the tank is located. Using a combination of venting at the well casing, as well as installing aeration equipment in the water storage tank, will decrease the potential for methane. Aeration at the point of water entry into the house can also help remove

methane gas. Aeration releases gas from suspension in the water so it can be vented into the atmosphere through a pipe. Aeration equipment must be specially designed or modified by the manufacturer to safely remove methane gas. A totally closed system should be provided to prevent any methane gas from leaking out of the system and into the building interior.

If at all possible, a source should be identified and possibly dealt with. Excessive CO₂ in groundwater may be oxidized methane.

Learn more about treating methane at WellOwner.org.

Methane Release



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TREATMENT

How do I treat nitrate in my water?

Water containing nitrates can be treated by a variety of methods, including reverse osmosis and ion exchange.

The best nitrate solution is to remove the source. It may occur in certain formations that can be sealed off by well construction, or more widespread groundwater contamination. If that is not enough, treatment can be used. Reverse osmosis or a disposable mixed-bed deionizer work best on point-of-use systems installed in places such as the kitchen sink where water is used mostly for drinking or cooking.

Ion exchange, along with a water softening system, can provide a whole-house solution for nitrate contamination.

Learn more about treating nitrate at WellOwner.org.

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TREATMENT

How do I treat uranium in my water?

Uranium can occur in discrete geologic zones that may be detected and sealed off by well construction, or may be due to contamination. If the source can be removed, this is best. If not, turn to treatment.

The following methods can be used to remove uranium from water:

Reverse osmosis (RO): RO can remove up to 90 percent of uranium. Typically, RO is a point-of-use (POU) device installed where the water is used. It can also be used at the point-of-entry (POE) into the house so that all water is treated.

With POU RO units, a minimum three gallons of wastewater is discharged for every gallon of treated water produced. Since low concentrations of soluble minerals such as calcium, magnesium, iron, and manganese can foul an RO unit, some pretreatment device may be needed.

Maintenance involves replacement of filters and membranes. Filters should be handled carefully and disposed of properly due to potentially high uranium concentrations.

Ion exchange: This involves a physical-chemical process in which water passes through a specialized resin, inducing an exchange of ions removing uranium. Ion exchange is typically used in POE treatment systems.

Maintenance can involve replacement or regeneration of media and cartridges. Spent media and cartridges must be handled carefully and disposed of properly due to potentially high uranium concentrations.

Distillation: Distillation, involving evaporating water and condensing the vapor, requires significant heat energy and cooling capacity. It is generally used in POU systems. Residue disposal must be done according to applicable regulations. Filters should be handled carefully and disposed of properly due to high uranium concentrations. RO concentrate and ion exchange backflow can contain elevated radioactive Uranium, and also must be handled according to applicable environmental rules.

Learn more about treating uranium at WellOwner.org.

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TREATMENT

How do I treat radon in my water?

The primary source of radon exposure is from breathing contaminated air in the home. Therefore, water should be treated as it enters the house to prevent radon from being released into the air anywhere inside water is being used. Point-of-use devices, such as those installed on a tap or under the sink, treat only a small portion of the water in the home and are not as effective in reducing radon.

Radioactivity also can build up on the filters of these devices and become a hazard. The two most common treatment technologies are granular activated carbon and aeration:

- **Granular activated carbon:**

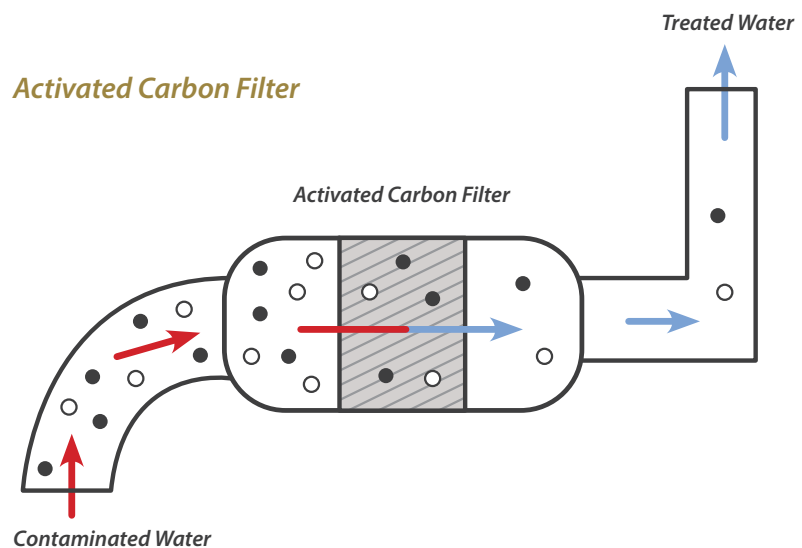
This technology will remove 95 percent of the waterborne radon. It works by adsorbing the radon onto the surface of activated carbon. There the radon continues to decay and give off radiation; however, the treatment equipment is usually not located in the living area of the home. Although the granular activated carbon system has few moving parts and should have

a long, useful life, radon buildup over extended periods of time becomes a low-level radioactive source requiring special disposal. This technology has a lower front-end cost, but there are costs associated with disposal of radioactivity buildup over a period of years.

- **Aeration:** Radon can be easily removed from water supplies by blowing air up through the water and venting the resulting vapor out through the roof. This is most commonly accomplished with an air diffuser mounted at the bottom of a storage tank filled with water to be treated. As the air bubbles rise through the water, they strip radon and carry it out of the top of the tank and through a vent pipe to

above the roof line. A greater level of success—as much as 99 percent removal—can be achieved when selecting a unit that uses a mister or nozzle located at the top of the tank to fill the tank along with a bubbler. This technology has a higher front-end cost than granular activated carbon but has no associated disposal costs.

Learn more about treating radon at WellOwner.org.



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TREATMENT

How can I address unsafe levels of lead in my water?

First, try to determine the source of the lead in your water. In most cases, it is not the groundwater but rather the household plumbing pipes, fittings, fixtures, or solder. If it is not the groundwater, a water well system contractor can inspect your well system for any components that contain higher lead levels. A plumber may be able to help in identifying the sources of lead in the household plumbing.

If household plumbing or well system components are the source of unsafe levels of lead, the homeowner has four options to address the source:

1. Replace the problem components with new components that meet current federal requirements.
2. Treat water that is being consumed with appropriate treatment technologies. The National Sanitation Foundation (NSF) recommends the following:

“Potential treatment options for lead can include filters, reverse osmosis units, and distillers. Make sure the system is certified under NSF/ANSI standards for lead reduction, which means that the system has been independently verified to be able to reduce lead from 0.150 mg/L to 0.010 mg/L or less.”
3. When pH levels drop below 7.0, water becomes acidic which can cause lead to leach from plumbing pipes, fittings, fixtures, and solder, according to NSF, adding: “Acid neutralizing systems are generally used to correct this situation. By adding a chemical like soda ash to the water to boost pH above 7.0, the system can help reduce both lead and copper leaching attributable to low pH.”
4. Flush water that has been sitting in your water system for a long time (such as overnight) to remove water into which lead has leached. Several water samples from different taps may be needed to determine how to effectively flush your system of lead-tainted water.

The preceding options vary in cost and ease of implementation, so what works best for one well owner may not have the same advantages for another.

Learn more about treating lead at WellOwner.org.

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TREATMENT

Should I periodically test water that’s gone through my water treatment system? If so, how often should I test the treated water?

First, check the treatment system owner’s manual or product information for recommendations on water testing. If you do not have that information, contact the manufacturer or go online to see if you can find the maintenance information for your product’s make and model.

Generally, treated water should be tested after the treatment system is installed to make sure it is working. You can also test the water after the treatment system is serviced to make sure it is working properly. Change in some water quality parameters can indicate a time to test, some of which can be used for continuous in-line testing. Among these are conductivity, pH, and sodium. Another

reason to test is if the treatment system has not been maintained according to the product maintenance recommendations. Neglecting maintenance such as the timely filter replacement or cleaning could impair the treatment system’s effectiveness.

Learn more about water treatment at WellOwner.org.



Groundwater Protection

As the term suggests, there is much from which groundwater needs to be protected. Any hazardous substance—if spilled on the ground, leaked underground, or poured down an abandoned well or bore hole—can infiltrate groundwater, the drinking water source for nearly 35 million Americans using privately owned water wells.

As a private well owner, you are the manager of your water system. Your practices as a property owner can directly impact your water quality or that of other well owners in the area. A little education in groundwater protection goes a long way.

1

PROTECTION

How is groundwater quality threatened—and what can I do to protect it?

Some issues that adversely affect the quality of groundwater for drinking water purposes are beyond the control of the well owner. For instance, arsenic and radon can occur naturally in the geology and therefore be present in groundwater used by wells. Also, some man-made contamination—for example, from a leaking landfill or an industrial site—cannot be managed by an individual well owner.

However, there are other practices within the control of a well owner that can protect groundwater from contamination, such as:

- Proper storage and disposal of hazardous substances such as herbicides, pesticides, fertilizers, paint, and petroleum products to name a few
- Making sure your well has a properly designed, installed, and maintained well cap

- Keeping a sufficient distance between your wellhead and other potential contamination sources such as roads, buildings, septic system drain fields
- Not disposing of hazardous substances in a septic system

Learn more about groundwater protection at WellOwner.org or Groundwater.org.

2

PROTECTION

What is the most common threat against which I can protect my groundwater?

The most common threat to groundwater within your control is disease-causing bacteria. These microorganisms are abundant in the natural environment.

A properly located, constructed, and maintained water well system is designed to keep microorganisms out of your well system.

Learn more about groundwater protection at WellOwner.org.



Want to protect groundwater? Support The Groundwater Foundation, a 501c3 organization that aims to protect, connect, and inspire others to advocate for groundwater.

3

BACTERIA PROTECTION

How can I protect my drinking water from harmful bacteria?

Two actions well owners can take to protect their drinking water from bacteria are to (1) make sure there is no pathway for microorganisms to enter your well system, and (2) keep your well away from any concentrated source of bacteria.

1. Well system maintenance:

A properly constructed well system has various sanitary seals, starting with the well cap. The well cap should:

- Be bolted or locked so that it cannot be tampered with or jarred loose
- Be watertight and resistant to rain, sleet, snow, or ice
- Have a rubber seal with the well cap, where it adjoins the well casing
- Not be cracked or otherwise broken

In areas where freezing occurs, a “pitless adapter” is another sanitary seal that prevents bacteria from entering the well where the water distribution pipe located below the frost line connects to the well.

There is also a sanitary seal at the electrical conduit connection, where the electrical conduit containing wiring for a submersible pump connects to the well.

The well casing—the vertical pipe that goes down into the well—is also a sanitary seal which, in addition to keeping the bore hole open—prevents surface water and shallow groundwater from prematurely entering the well.

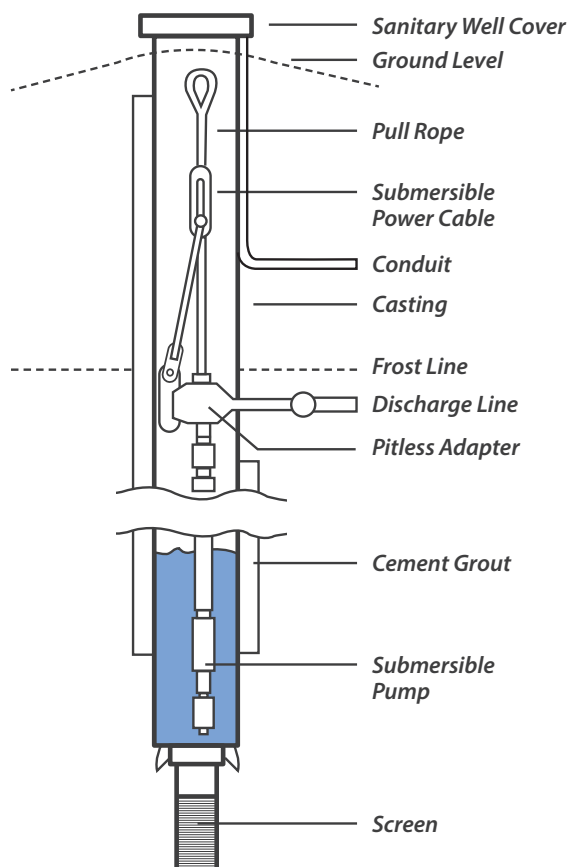
Another sanitary seal is the specialized well grout that fills the space between the outside of the well casing and the inside of the bore hole to prevent surface water from infiltrating the well.

2. Separation from contamination sources:

Many states and localities specify separation distances between a well and contamination sources. Separation distances in your area may take into consideration the local geology, which can affect the susceptibility of groundwater to surface contamination.

The following minimal distances should be maintained from the wellhead, unless other state or local codes or regulations prescribe more stringent standards:

- Cesspool (receiving raw sewage), 200 ft.
- Pit, privy, filter bed, 50 ft.
- Septic tank, tile sewer, foundation drain, 50 ft.
- Iron sewer with approved mechanical joints, 10 ft.
- Pumphouse floor drain, 2 ft.
- Property boundary, 5 ft.
- Outer boundary of any road, 20 ft.
- Landfill, garbage dump, 200 ft.



4

BACTERIA PROTECTION

What are common ways that bacteria get into a well?

Two of the most common ways that harmful bacteria get into wells are through a defective well cap or through improperly abandoned wells. Shallow bedrock where fractures intercept the surface or limestone *karst* (tending to form caves) are naturally vulnerable, and possible infiltration points must be protected.

Well caps:

Not just any covering will do on top of the well casing, that vertical pipe that extends above the ground in your well. A proper well cap should be:

- Bolted or locked, so that it cannot be easily removed
- Fitted with a rubber seal to prevent vermin from infiltrating the well where the cap is joined to the well casing
- Watertight
- In good condition

Conversely, a tight-fitting well cap that is not bolted or locked can be jarred loose or removed by someone other than the well owner. Also, a well cap that lacks a rubber seal or is cracked or otherwise broken can allow bugs, vermin, bacteria, or other types of contaminants above the ground surface into the well.

Well caps should be installed by a water well system professional, and any well cap maintenance or replacement should be done by a professional. Also, a well system should be disinfected when a well cap is installed, repaired, or replaced.

Abandoned wells:

First, the challenge is sometimes to find abandoned wells on your property. Some abandoned wells are obvious while others are not. Survey your property for:

- Pipes sticking out of the ground
- Small buildings that may have been a well house
- Depressions in the ground
- The presence of concrete vaults or pits
- Out-of-use windmills.

Other tips for finding old, abandoned wells can be found in:

- Old maps, property plans or property title documents
- Neighbors
- Additions to an old home that might cover up an abandoned well

A water well system professional may do additional checking—including a records check—for more information about abandoned wells.

A water well system professional should always plug an abandoned well using proper techniques, equipment, and materials. The professional should:

- Remove all material from the well that may hinder proper plugging
- Disinfect the well
- Then plug the well using a specialized grout that (1) keeps surface water from working its way into the bore hole, and (2) prevents water from different levels in the subsurface from mixing

The cost to plug a well depends on factors including:

- The depth and diameter of the well
- The geology of the area
- Accessibility to the well
- The condition of the well

Learn more about groundwater protection by watching the video on proper well caps and plugging abandoned wells at WellOwner.org.

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SEPTIC SYSTEM PROTECTION

Do I need to worry about my on-site wastewater system polluting my drinking water?

A properly located and maintained on-site wastewater system can be an effective way to treat household sewage.

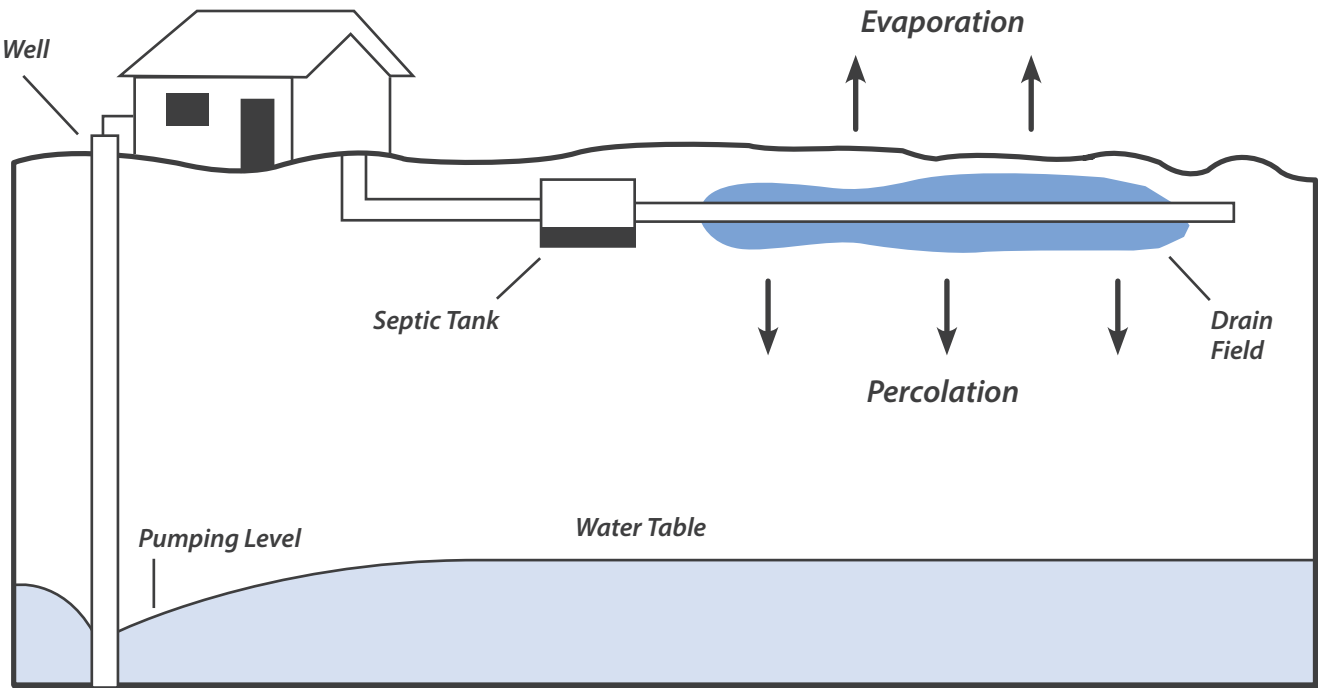
However, if the on-site wastewater system is not located in an appropriate place in relation to your well or the septic system is not maintained, it could contaminate the groundwater you or

other well owners consume. It is wise for well owners to test the drinking water annually for bacteria or when family or guests are experiencing recurring incidences of gastrointestinal illness.

To learn about the proper location and maintenance of a septic system, one type of on-site wastewater recycling system,

visit the National On-site Wastewater Recycling Association's website at nowra.org.

Learn more about groundwater protection at WellOwner.org.



Septic System

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FLOODING

Flooding has happened in my area. Does flooding on the surface affect my well water?

While not a certainty, it is possible for surface flooding to affect well water. Well construction and where the wellhead is located can affect how susceptible a well is to flooding. Consequently, well owners should determine their well’s possible vulnerability to flooding.

Casing

- Check the general condition and whether the casing extends at least 12 inches above ground. If it is in a flood-prone area, the casing may need to be extended above the historic flood level.
- Generally, the well casing is best located on relatively higher ground to minimize the pooling of surface runoff around the well casing. Be sure the ground surrounding the wellhead is sloping away from the well to divert surface runoff. If there is no concrete pad surrounding the well casing, contact your local health department or regulatory agency to determine if one should be installed by a water well system professional.

Well Cap (cap on top of casing)

- Check the condition of the cap and any seals, and that it is securely attached.

In the event of flooding

After a flood, the owners of household wells should take certain precautions to make sure their water is safe and their well is in good operating condition. An obvious concern is that flood water loaded with bacteria, chemicals, or other pollutants may have gotten into the well or area groundwater. A less obvious concern is electrical shock if a non-submersible pump or any part of the well electrical system is flooded.

After a flood one should:

1. Stay away from the well pump while it is flooded to avoid electrical shock
2. Not drink the water from the well or use it for washing to avoid becoming sick
3. Get help from a water well system professional or pump installer to:
 - Clean and turn on the pump
 - Flush the well
 - Disinfect the well
 - Perform any other necessary maintenance

Next steps

If you find any potential maintenance issues, consult with your water well system professional. To find a water well professional, visit WellOwner.org and select “Find a Contractor.”

You may find other water well system professionals (1) in your local Yellow Pages, (2) by asking other water well owners what professional they use or recommend.

Water wells are specialized systems that require knowledge and expertise to repair and disinfect. If your well has been flooded, use bottled water or boil your water until a water well system professional can check out your well system. Well owners also can benefit from reading the well maintenance and water quality sections of this website.

Learn more about groundwater protection at WellOwner.org.





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