

Handbook for Developing a Public Water Supply Well

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Preface

STOP! This handbook is not applicable to the development of private wells. For more information on the site and construction criteria for private, non-public wells used for individual residences, small businesses, heat pumps, or irrigation, contact your local health department, or refer to the Commonwealth of Virginia State Board of Health Private Well Regulations Office of Environmental Health Services [website](#).

Objective

The Virginia Department of Health, Office of Drinking Water (VDH ODW) has prepared this handbook to assist prospective or current public water supply owners with the development of new water supply wells. The handbook describes the well site selection considerations, VDH ODW approval procedures, and methods and materials required to construct a well intended for potable water consumption.

Disclaimer

This document is not intended to be a comprehensive guide on drinking water wells, but it will provide a quick reference to state standards for development of wells to serve public water supplies. **It is the responsibility of the owner to ensure that the well driller is certified and complies with the requirements of the Virginia *Waterworks Regulations*.**

Additional Information

For more information regarding the rules and regulations pertaining to a public water supply system, refer to the Virginia [Waterworks Regulations](#).



Table of Contents

Preface	2
Step 1: Identify Potential Well Sites.....	4
Step 2: Schedule VDH ODW Well Site Visit	5
Step 3: Obtain Approvals	5
Step 4: Drill, Case, and Grout Well.....	6
Step 5: Develop Well.....	8
Step 6: Obtain VDH ODW Permits	10

Step 1: Identify Potential Well Sites

The siting, or placement, of a well is a crucial step in the development of a groundwater source. The location of a well should consider property lines, topography, geology and potential sources of contamination resulting from land use, such as waste disposal systems. The following sections describe issues that must be considered during the well siting process.

Future Property Needs When siting a well, it is very important to consider past, current, and projected land use in the proposed well area. Once a well is approved for public use, no construction or activity unrelated to the waterworks is allowed on the well lot.

Well Lot Dimensions

Well lots are typically 100 ft. by 100 ft., centered on the well casing. However, larger dedicated well lots may be required if topography could direct potential contamination toward the well. Well lot dimensions will be discussed and established during the well site inspection.

As an owner, you have the right to request specific sites for your proposed well or wells. A VDH ODW representative will complete an on-site inspection of the proposed well site(s). VDH ODW staff may suggest more suitable locations, based on the results of the site inspection. If you have concerns or reservations about future land use or development plans, discuss these with VDH ODW Field Office staff.

Potential Sources of Contamination (PSCs) When selecting a well site, you should be knowledgeable of the location of nearby PSCs, such as septic tanks, drain fields, and underground fuel storage tanks. VDH ODW can provide you with a preliminary source water assessment identifying potential sources of contamination from available records. Your Local Health Department may help you obtain information regarding waste disposal and private wells located in the vicinity of a proposed well.

Well Location Standards Do not locate wells in parking areas or inside a 100-year flood plain, unless appropriate protection measures are taken. The following table lists the minimum horizontal distances between the proposed well(s) and specific features.

Feature	Minimum Separation Distance
Barnyard, Animal Feed Lot	50 ft.
Cesspool, Pit Privy, Septic Tanks	50 ft.
Drain Fields and Purification Fields	50 ft.
Petroleum & Chemical Storage Tanks or Pipes	50 ft.
Power Lines & Utility Easements / Rights of Way	50 ft.
Property Lines	50 ft.
Sewage Pipes	50 ft.
All known sources of contamination not shown above*	50 ft.

** Even when identified features are farther than 50 ft away, they remain important items to consider under a [wellhead protection plan](#).*

Wellhead Protection The quality of groundwater can be seriously impacted by various factors, such as an improperly located or constructed well, failing septic systems, herbicide or pesticide usage, urban storm water runoff, nearby landfills, and chemical or fuel storage. Wellhead Protection Plans help to eliminate or reduce these potential contamination risks, thus increasing a well source’s sustainability. Wellhead Protection Plans are generally developed by following these five steps:

1. Select a planning team
2. Delineate the wellhead protection area
3. Identify potential sources of contaminations
4. Determine actions to mitigate the risks
5. Define contingency measures

Planning for wellhead protection while selecting a site may help to reduce the amount of PSCs associated to the proposed well(s). VDH ODW may offer additional guidance in developing a Wellhead Protection Plan, as well as funding opportunities to eligible waterworks. Additional information about Source Water Protection, references and assistance opportunities is available on the Source Water Protection [website](#).

Step 2: Schedule VDH ODW Well Site Visit

The second step is to contact the VDH ODW to schedule a well site inspection. During this inspection, you should be prepared to provide VDH ODW with information about the proposed well sites you have selected prior to going out into the field for a well site inspection.

If the proposed project requires a new septic tank and drain field, the Local Health Department should be contacted prior to the well site inspection to avoid conflicts between the placement of the well and waste systems. VDH ODW personnel will assist in making the determination whether additional state agency involvement is required. VDH ODW service areas map and staff contact information are available on ODW's contact us [website](#).

Step 3: Obtain Approvals



A representative from your VDH ODW Field Office will perform an on-site assessment of each proposed well location. The assessment will include a preliminary evaluation of the well's susceptibility to contamination. Sketches, maps, measurements, and coordinates will be noted during the well site inspection. If acceptable, tentative approval will be given in a written letter that shall include topographic maps with the proposed site(s) identified, well lot sketches identifying any potential sources of contamination, and significant landmarks.

VDH ODW's approval of the well site(s) is valid for 12 months. If drilling of the well is not started within 12 months of the approval date, the proposed sites will need to be re-inspected by VDH ODW personnel.

Wells located in Groundwater Management Areas (GWMA) The Virginia Department of Environmental Quality (DEQ) administers a Ground Water Withdrawal Permit Program to manage water resources within two specific geographical regions of Virginia. These geographic regions encompass all the Coastal Plain geology in Virginia. The following table describes the counties and cities that fall within the GWMA.

If you are developing a well within the coastal plain (GWMA), contact DEQ to determine if a Groundwater Withdrawal Permit is required. All persons who withdraw more than 300,000 gallons of groundwater in any month in the designated GWMA must obtain a groundwater withdrawal permit.

Name	Description
Eastern Shore GWMA	Counties Accomack and Northampton
Eastern Virginia GWMA	Counties Caroline*, Charles City, Chesterfield*, Essex, Fairfax*, Gloucester, Hanover*, Henrico*, Isle of Wight, James City, King George, King William, King and Queen, Lancaster, Mathews, Middlesex, New Kent, Northumberland, Prince George, Prince William*, Richmond, Southampton, Spotsylvania*, Stafford*, Surry, Sussex, Westmoreland, and York Independent Cities Chesapeake, Franklin, Hampton, Hopewell, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg

* Only those portions east of I-95 are included in the GWMA

If a Groundwater Withdrawal Permit is required by DEQ, it is crucial to coordinate the permitting requirements of both State agencies. DEQ may require specific construction features if a well is drilled through multiple aquifers (typical of the Coastal Plain region). Also, DEQ's Aquifer Test Plan differs from the well yield and drawdown testing typically required by VDH ODW. Consult DEQ to determine what construction and testing requirements will apply before drilling and developing a public water supply well.

Further information regarding DEQ's Water Withdrawal Permitting Program can be found on their [website](#).

The DEQ Office of Ground Water Characterization (OGWC) strongly suggests that bore hole geophysical logs be obtained in newly constructed public water supply wells in the Coastal Plain at the time of drilling, since it is impossible to obtain a geophysical log of the well once it is completed. By obtaining a bore hole geophysical log at the time of drilling, you will already have one of the most important pieces of information necessary to obtain a withdrawal permit. The geophysical logs can be used to select accurate screen placement depths and can assist in analyzing well yield and water quality issues.

Step 4: Drill, Case, and Grout Well

The proper drilling, casing, and subsequent grouting of a proposed well is essential to maintain water quality and reduce potential susceptibility to contamination. A variety of issues may contribute to the manner in which the well source is developed, including siting requirements, geological conditions, and borehole and casing depths. This step details information that may affect the methods, procedures, supplies, and materials used to develop a groundwater source.

Certified Water Well Systems Provider Only certified water well system providers are allowed to develop, remediate, or abandon public wells. More information can be found on the Virginia Department of Professional and Occupation Regulation [website](#).

Planning for Sampling

After the well is drilled, a yield and drawdown test of the well is performed, and bacteriological, chemical, and radiological samples are collected. Prior to drilling, it is essential that you discuss the sampling requirements with your certified water well system provider to have the necessary sample containers on hand. These procedures are described in Step 5.

Materials, Casing, and Grouting All well construction materials and components must meet appropriate specifications and standards stated in the Virginia *Waterworks Regulations*. This includes well casing material (steel or plastic) and grout.

IMPORTANT: Requirements for materials acceptable for use in the installation of PUBLIC WATER SUPPLY WELLS are more stringent than those for PRIVATE WELL construction. Should there be any questions regarding the proper materials to use, contact your VDH ODW field office.



Six-inch steel well casing. Photo courtesy Dempsey Steel Pipe, Inc.

Well construction classification Your well site approval letter will specify the minimum construction class for your proposed wells. The well construction classifications are described below:

Class	Description
I	<ul style="list-style-type: none"> • Drilled and cased to a depth sufficient to exclude undesirable groundwater, NO LESS THAN 100 feet in depth • Drill hole diameter at least 3 inches greater than the outside diameter of the couplings of the casing • Annular space around the casing grouted to a depth of at least 100 feet
II	<ul style="list-style-type: none"> • Drilled and cased to a sufficient depth to exclude undesirable groundwater, NO LESS THAN 50 feet in depth • Drill hole diameter at least 3 inches greater than the outside diameter of the couplings of the casing • Drill hole terminates in solid rock or other impervious formation (when practical) • Annular space around the casing grouted to a depth of at least 50 feet

Wells In Rock Class II wells constructed in hard rock must have well casing extended to a minimum depth of 50 feet, terminating in rock. If rock is encountered at a depth of less than 50 feet, the casing must still extend to a depth of at least 50 feet (100 feet for Class I wells). The well must be pressure grouted with neat cement in accordance with the *Waterworks Regulations*.

Wells in Groundwater Management Areas Wells in groundwater management areas must not have screens in multiple aquifers. Gravel pack and grout must prevent movement between aquifers. Gravel pack shall be terminated close to the top of the well screens and shall not extend above the top of the screened aquifer. The remainder of the annular space shall be filled with grout material. Pump intakes shall not be set below the top of a confined aquifer or the bottom of an unconfined aquifer that supplies water to the well.

Drilling Documentation The certified water well systems provider must complete a Water Well Completion Report (GW-2 Form) for all new or rehabilitated wells, or a Well Abandonment Form (GW-5) for all abandoned wells.

Copies of the GW-2 Form and GW-5 form can be found on the DEQ's [water well registration webpage](#). Water well system providers may submit GW-2 Forms through this webpage.

Grouting The annular space around the well casing requires grouting per the *Waterworks Regulations*. Please note: while bentonite grout is allowed for private wells, it is NOT acceptable for public wells. The well driller must notify the appropriate VDH ODW Field Office of the date and time that the well will be grouted. This information should be provided as soon as possible so that a VDH ODW representative may be present during grouting.

Proper Well Abandonment Any well, whether intended for production, observation, or study that is not completed in accordance with the construction requirements of the *Waterworks Regulations* must be permanently abandoned (sealed) in a manner that restores the pre-existing geological conditions. Once the decision is made to not place the well into service, it should be promptly abandoned. Wells that are not properly abandoned increase the risk of contamination of the aquifer(s).

In some instances, the DEQ may want to use the well for research or testing purposes. Therefore, it is good practice to contact the DEQ's Office of Groundwater Characterization and offer them an opportunity to assume responsibility of the well. Their contact information is available on the Groundwater Characterization [webpage](#).

Step 5: Develop Well

Well development consists of conditioning (if warranted), disinfection, yield and drawdown testing, and sampling after the well is drilled. The well *should* be disinfected prior to sampling due to the activities and exposures associated with the drilling process. The well *must* be disinfected after the production pump (if different from the test pump) is installed. Generally, a certified water well system provider is aware of the proper methods required to disinfect a well. The correct disinfection procedures for disinfecting a well with chlorine are given in ANSI / AWWA Standard C654 - Disinfection of Wells.

The well yield and drawdown data are required to determine the capacity of the source, assist in selecting a pump, and verifying that the source will be sufficient for the public water system's needs. The samples are analyzed for bacteriological, chemical and radiological qualities, and are evaluated to determine if water treatment will be required.

Yield & Drawdown Tests The well and pump capacity of a groundwater source must be determined before the well is approved for public use. The data gathered from the yield test is crucial to the waterworks, since a low yield may mean additional sources or storage will be needed to meet the waterworks' needs, or limit the waterworks' service capacity.

If a new well is within close proximity of an existing well, DEQ or VDH ODW may require monitoring of the water level of the nearby well during the yield pump test. If the water level in the nearby well drops, a simultaneous pump test may be required. This will provide better information with which to determine the safe yield of both sources.



The yield and drawdown test duration required by VDH ODW is at least 48 hours. When the source water requirements for a noncommunity waterworks are determined to be three gpm or less over normal hours of operation, VDH ODW may reduce the minimum drawdown test to no less than 12 hours. DEQ may require additional testing procedures for wells located in the Coastal Plain (GWMAs). VDH ODW recommends that the pumping rate be controlled throughout the test to maximize the production from the well, and to produce a stabilized pump water level for at least the last six hours of the yield test. Immediately following the yield and drawdown test the water level recovery in the well should be recorded for no less than two hours or until the well returns to its static water level, whichever occurs first. A standard Well Yield and Recovery Report form is available on the Well Development Procedures [webpage](#).

Laboratory Selection The Division of Consolidated Laboratories (DCLS), or a laboratory certified by DCLS, must perform all bacteriological, radiological and chemical testing of the water samples from a proposed well. A list of DCLS certified labs is available their find-a-lab [webpage](#).

If you would like to use DCLS for your well development testing, the Office of Drinking water can assist with coordinating with DCLS for sample kit order forms and sample collection and shipping instructions.

Bacteriological Sampling The bacteriological quality of every proposed groundwater source for a public water supply must be evaluated. The purpose of these tests is to determine if continuous disinfection or additional treatment is required for the waterworks. For a newly constructed well, or a well undergoing modification or reconditioning, a series of 20 bacteriological samples must be collected during the latter portion of the yield and drawdown test. If the well was disinfected with chlorine, the well must be pumped to waste until all the chlorine residual has been removed from the well before collecting the bacteriological or any other water quality samples.



Sampling Challenges

Some of the developmental samples that must be taken at your new well may have special collection or shipping requirements. For example, bacteriological MPN samples must be received by your laboratory for processing within 30 hours of collection. Consult with your laboratory on sampling preservation, holding times, and other special requirements.

The 20 samples must be analyzed by a Most Probable Number (MPN) method for total coliform bacteria and *E. coli*. The MPN samples should be collected at minimum thirty-minute intervals during the last ten hours of the yield and drawdown test. If a different time interval is desired, contact your VDH- ODW Field Office for prior approval. Ensure hygienic methods are used during the

collection of these samples to avoid accidentally contaminating a sample.

If DCLS is used for MPN testing, you should notify DCLS at least 24 hours prior to sampling, to ensure that the samples will be accepted and processed. It is recommended that similar arrangements be made with any private laboratory that you use.

Chemical, Physical and Radiological Sampling In addition to monitoring the microbial characteristics of the well source, a variety of chemical, radiological and physical parameters must be checked during well development to ensure adequate water quality. The specific parameters required for testing and the number of samples required will be determined by VDH ODW. Tests may include analysis of metals, inorganic chemicals (including nitrate, nitrite, and cyanide), physical parameters, radiological contaminants, (such as uranium and radium), and volatile organic chemicals (such as fuels and solvents), and synthetic organic chemicals (including pesticides and herbicides).

The chemical and radiological samples should be collected near the end of the yield and drawdown test, prior to the recovery period.

For detailed information regarding water quality standards, potential health effects, and typical sources of contamination, refer to EPA's [National Primary Drinking Water Standards](#).

Well Development Test Results VDH ODW will review the well test data upon receipt. The yield and drawdown test results, along with results from the bacteriological and chemical sampling, will be used to determine how much water the well can reliably produce, and whether the water will need to be treated to meet water quality standards. Most laboratories (including DCLS) will report bacteriological and chemical test results directly to VDH ODW. You will be advised of the results, their interpretation, and any additional or follow-up testing needed.

Step 6: Obtain VDH ODW Permits

The approval you will have obtained from VDH ODW by following Steps 1 through 5 is limited to well drilling, casing, grouting, and testing. Steps 1 through 5 of the well development process are designed to answer basic questions about your proposed water supply source:

- Do the well lot and location meet basic requirements for size, clearances to boundaries, and protection from potential sources of contamination?
- After the well has been drilled and installed, does it produce enough water to meet the waterworks' needs?
- Based on the water quality tests, is the water quality suitable, or is treatment needed to remove contaminants?

Further construction of the waterworks, including installation of the permanent well pump, electrical service, well house, water treatment, storage, or distribution piping, is not authorized until VDH ODW issues a Construction Permit. Obtaining the Construction Permit is your next step. Contact the VDH ODW Field Office to discuss the project and schedule a Preliminary Engineering Conference.

A Permit Application will need to be submitted to the VDH ODW Field Office. Additional information regarding permits can be found on the Permit Program [webpage](#).

The Preliminary Engineering Conference (PEC) is a meeting held between VDH ODW staff, the owner, and the design engineer. Depending on the complexity of the project, the meeting may be held in person, virtually, or over the telephone. During this meeting, VDH ODW staff will discuss the sample results, required and recommended treatment, engineering document submittal requirements, and answer any questions you or your design engineer may have. VDH ODW will determine at this meeting if a Preliminary Engineer Report (PER) is required.

A PER is typically necessary for new sources with difficult water quality issues such as arsenic, nitrates, and high dissolved solids. The PER must be completed by a licensed Professional Engineer, and the report must be approved by VDH ODW.

Design Considerations

The Virginia *Waterworks Regulations* provides detailed standards for the design and construction of public water supply wells. Required appurtenances include a sanitary seal for the top of the well casing, a properly screened vent, sampling tap, well pump controls, a concrete floor or apron surrounding the well, and well pump support. A means for measuring water level in the well is also recommended. All such appurtenances must be detailed in the construction plans and specifications that you and your design engineer must submit to VDH ODW. However, such features should not be installed until the plans have been approved, and a Construction Permit issued.

Plans, specifications and design calculations for the project must be developed by a licensed Professional Engineer (PE) and submitted to VDH ODW. An exemption to the PE requirement is allowed under specific conditions for Transient Non-community waterworks. VDH ODW staff will review the plans to ensure the design complies with the Waterworks Regulations. Often, VDH ODW staff will provide comments on the design and require revisions to the plans and specifications.

A well lot plat and dedication/certification document are required for all community waterworks wells. The intent of these materials is to describe the proposed well lot and record the information to ensure the well lot is only used for waterworks-related activities. Additional buildings, parking lots, or storage may not occur within the well lot. The plat must be signed by the clerk of the respective court, noting the deed book, page number and date. The well lot dedication/certification document must be signed by the clerk of the court and notarized. You will be required to submit these documents when you submit plans and specifications to obtain a waterworks Construction Permit.

Templates are available on the Permits and Design [webpage](#).

Once the final plans and specifications are approved and the well lot plat and dedication document have been recorded by the clerk of the court, VDH ODW may issue a Construction Permit. The Construction Permit is your authorization to complete the construction of your new well system. Your Construction Permit will provide details to you regarding the items that need to be performed prior to placing your new well into operation. These may include pressure testing, bacteriological testing, letter of substantial completion from the engineer, and final inspection by VDH ODW staff.

The final permit you will be issued is the Operation Permit. If you have an existing waterworks and already have an Operation Permit, it may be amended to include the new source. For a new waterworks, you will be issued a new Operation Permit. Contact your VDH ODW Field Office for specific requirements for new permits, monitoring, and reporting.

Your new well may now be used!

