

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

WATER WELL

(No.)

CODE 642

DEFINITION

A hole drilled, dug, driven, bored, jetted or otherwise constructed to an aquifer for water supply.

PURPOSE

- Provide water for livestock, wildlife, irrigation, and other agricultural uses
- Facilitate proper use of vegetation, such as keeping animals on rangeland and pastures and away from streams, and providing water for wildlife

CONDITION WHERE PRACTICE APPLIES

This practice applies on all land uses where the underground supply of water is sufficient in quantity and quality for the intended purpose.

This practice applies only to production water wells. Specifically excluded are any types of wells installed solely for monitoring or observation purposes, injection wells, and piezometers. The standard does not apply to pumps installed in wells; above ground installations, such as pumping plants, pipelines, and tanks; temporary test wells; and decommissioning of wells (refer to NCPS No. 351, Water Well Decommissioning).

CRITERIA

Laws and Regulations. The investigation, design, or installation of water wells according to this standard shall adhere to all applicable local, State, Tribal, and Federal laws and regulations, ***and governing activities in or along streams, pollution abatement, health, and safety.***

**NRCS, NHCP
September 2010**

The owner or operator shall be responsible for securing all required permits or approvals and for performing all planned work in accordance with such laws and regulations. NRCS employees are not to assume responsibility for procuring these permits, rights, or approvals, or for enforcing laws and regulations. NRCS may provide the landowner or operator with technical information needed to obtain the required rights or approvals to construct, operate, and maintain the practice.

There are specific WV requirements for wells issued by the WV Department of Health and Human Resources. Permits and well certifications may be required from the following agencies:

- 1. Local Health Department Requirements***
- 2. WV Department of Health and Human Resources***
- 3. West Virginia Department of Agriculture***

All required permits and certifications will be obtained prior to construction implementation.

Suitability of Site. The availability of groundwater for its intended use at the site shall be determined by using reliable local experience and reviewing all available relevant geologic maps and reports; well records maintained by State and Federal agencies; and design, construction, and maintenance records of nearby wells. An appropriate level of investigation, including test well drilling, is conducted on-site, as needed, prior to well

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Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State Office](#) or visit the [Field Office Technical Guide](#).

Note: Bold Italics is information added or changes made.

construction to determine site-specific hydrogeologic conditions.

Geological investigations shall be made to document:

1. **Potential water supply availability and well yield (based on other wells in area and /or geologic maps) for the intended purpose (WVEng WS 642-A).**
2. **Evaluation of the well location to determine if site is in "Karst" topography or over deep, underground mines.**
3. **Evaluation of the well site for salt water intrusion depth or unsuitable water.**
4. **Evaluation of the well site for accessibility and suitability, ease of maintenance and repair, cleaning, treatment, and testing or other concerns.**

Well Head Protection. Wells shall be located at safe distances from potential sources of pollution, including unsealed abandoned wells. The allowable distance shall be based on consideration of site-specific hydrogeologic factors and shall comply with requirements of all applicable local, State, Tribal, or Federal regulations or construction codes.

Surface runoff and drainage that might reach the wellhead from potential areas of contamination, such as those used by livestock, shall be diverted.

Construct the upper well casing a minimum of 12 inches above the 25 year, 24 hour flood elevation or to the elevation necessary to prevent floodwater from entering the well from an adjacent watercourse or impoundment. A watertight cap shall protect the well according to state regulations.

Wells shall be located a safe distance from both overhead and underground utility lines and other safety hazards.

Table A specifies the minimum distance between a water well, (non-public water system) and the source of concern.

Borehole. Drilled, jetted, bored, and driven wells shall be sufficiently round, straight, and

of adequate diameter, to permit satisfactory installation of inlet, well casing, filter pack, and annular seal, and passage of tremie pipe (including couplings), if used.

Use of Casing. Casing shall be installed to seal out undesirable surface or shallow groundwater and to support the side of the hole through unstable earth materials. The intake portion of a well through stable geologic materials may not require casing.

Casing Diameter: Casing diameter shall be sized to permit satisfactory installation and efficient operation of the pump, and large enough to assure that uphole velocity is 5 feet per second or less for the designed discharge to protect against excessive head loss.

Materials. Casings may be of steel, iron, stainless steel, copper alloys, plastic, fiberglass, concrete or other material of equivalent strength and durability consistent with the intended use of the water and the maximum anticipated differential head between the inside and outside of the casing, using depth and material tables.

Steel well casings shall meet or exceed requirements specified in ASTM A 589. Steel pipe manufactured for other purposes may be used if the quality of the pipe meets or exceeds requirements specified in ASTM A 589 **or AWWA Standard A-100. Steel casing shall be new with a minimum wall thickness of 0.188 inches if the nominal pipe size is ten (10) inches diameter or less and with a minimum wall thickness of 0.375 if the nominal pipe size is greater than ten (10) and less than twenty (20) inches diameter.**

Only steel pipe casings shall be used in driven wells.

To prevent galvanic corrosion, dissimilar metals shall not be joined in direct contact.

Plastic casings made of acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC), or styrene-rubber (SR) shall conform to material, dimensional and quality requirements specified in ASTM F 480.

Filament-wound fiberglass casings (glass-fiber-reinforced-thermosetting-resin pipe, RTRP) may be used if material meets requirements specified in ASTM D 2996. Tests for long-term cyclic pressure strength,

long-term static pressure strength, and short-term rupture strength as required in ASTM D 2996 are not needed because the pipe is to be used for well casing. Joints shall meet requirements specified in section 3.8, ASTM F 480.

Fiberglass pressure pipe (also called reinforced plastic mortar pipe, RPMP, or fiberglass pipe with aggregate) shall meet or exceed requirements specified in ASTM D 3517.

Casing Strength. Well casing wall thickness shall be sufficient to withstand all anticipated static and dynamic pressures imposed on the casing during installation, well development and use. Required casing strength shall be determined as shown in NEH Part 631, Chapter 32, Well Design and Spring Development.

Joint Strength. Joints for well casings shall have adequate strength to carry the load due to the casing length and still be watertight, or shall be mechanically supported during installation to maintain joint integrity. Such mechanically supported casings shall terminate on firm material that can adequately support the casing weight.

Screen. Well screens shall be installed in any aquifer material likely to produce silt or sand. Well screens may be constructed of commercially manufactured screen sections, well points, or field-perforated sections.

The screen shall be constructed with the slot width determined from aquifer samples. Perforation by any method is allowable provided proper slot size and entrance velocity limits can be met. Screen open areas can range from 1 percent for field-perforated screens to 25 percent or more for continuous wire-wrapped screens. To assure good well efficiency, open areas should be designed to approximate aquifer porosity. High percentages of open area also make well development more effective.

The length and open area of the screen shall be sized to limit entrance velocity of water into the well in order to maximize water yield, while simultaneously preventing sand from being pumped into the well and preventing screen corrosion and encrustation.

A conservative water well design will have a well screen entrance velocity of about 0.1 foot per second, which has been the common industry standard for many years. The American Water Works Association (AWWA) Standard A-100-06, however, no longer stipulates a maximum screen entrance velocity and cites recent research and testing that indicate that allowable well screen velocities are a function of the aquifer characteristics, the overall well design and intended performance, and the quality of the groundwater being pumped. For the purposes of this standard, the maximum recommended entrance velocity shall be less than or equal to 0.7 foot per second.

Depth of the aquifer below ground surface and the thickness of aquifer to be penetrated by the well shall govern the position of the screen in the well.

Maximum drawdown shall not be permitted below the top of the highest screen or pump intake.

Seals (Packers). Telescoped screen assemblies shall be provided with one or more sand-tight seals between the top of the telescoped screen assembly and casing.

Filter Pack. Installation of a filter pack around the well screen shall be considered under the following conditions: presence of a poorly graded, fine sand aquifer; presence of a highly variable aquifer, such as alternating sand and clay layers; presence of a poorly cemented sandstone or similar aquifer; a requirement for maximum yield from a low-yielding aquifer; and holes drilled by reverse circulation.

Pre-packed Well Screens. For heaving or caving sands, silty or fine-grained aquifers, and for horizontal or angled wells, a commercial pre-packed well screen may be substituted for a conventionally installed (by tremie) filter pack.

Installation. Casing shall extend from above the ground surface down through unstable earth materials to an elevation of at least 2 feet into stable material or to the top of the screen.

All wells shall be cased to a sufficient height (minimum of 12 inches) above the ground surface to prevent entry of surface and near-surface water.

Casing for artesian aquifers shall be sealed into overlying, impermeable formations in such a manner as to retain confining pressure.

If a zone is penetrated that is determined or suspected to contain water of quality unsuitable for the intended use, the zone shall be sealed to prevent infiltration of the poor-quality water into the well and the developed portion of the aquifer.

Water well drillers shall adhere to all State licensing requirements and regulations.

Well Development. Well development shall be performed to repair damage done to the formation by the drilling process, and to alter the physical characteristics of the aquifer surrounding the borehole so that water will flow more freely to the well.

The method of well development used shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

Aquifer Development. For massive, unfractured rock that is unresponsive to well development procedures, the use of aquifer stimulation techniques may be considered to improve well efficiency and specific capacity. Techniques may include dry ice, acidizing, explosives, or hydrofracturing, depending on the composition and structure of the formation.

Grouting and Sealing. The annulus surrounding the permanent well casing at the upper terminus of the well shall be filled with mortar containing expansive hydraulic cement (ASTM C 845), bentonite-based grout, or bentonite chips and pellets, in accordance with State requirements. The length of the grout seal shall be no less than 10 feet and not less than the minimum specified in state or locally applicable construction codes.

The full length of the well casing shall be filled with grout from the lower terminus to the ground surface, except as noted

- a. ***When drilling through caves, mines, or other cavities, the lower portion of the casing shall be grouted in accordance with the method described in b. of this section and a packer or similar bridging device shall be used to allow grouting above the cavity.***

- b. ***In unconsolidated aquifers (i.e., sand and gravel) above bedrock, the permanent casing shall be grouted.***

- c. ***In cases where a pitless adaptor is installed, upward grouting may terminate at the pitless adaptor (reference WV state law).***

The casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 feet in all directions from the outside of the casing to prevent contamination. The slab shall slope away from well.

A positive seal (grouted in place) or packer shall be provided between the casing and the less pervious material overlying the aquifer of artesian wells, and in all aquifers where commingling of waters is undesirable.

Access Port. An access port with a minimum diameter of 0.5 inch shall be installed to allow for unobstructed measurement of depth of the water surface, or for a pressure gage for measuring shut-in pressure of a flowing well. Access ports and pressure gages or other openings in the cover shall be sealed or capped to prevent entrance of surface water or foreign material into the well. Removable caps are acceptable as access ports.

Disinfection. Wells shall be disinfected immediately following their construction or repair to neutralize any contamination from equipment, material, or surface drainage introduced during construction. The disinfection process shall comply with all Local or State requirements.

Water Quality Testing. Sampling and testing shall comply with all applicable Federal, State and Local requirements. These requirements vary according to the water quality parameters associated with the intended use(s) of the water. ***Well water for microirrigation shall be tested if known contaminants, high turbidity or potential harmful ingredients such as iron, sulfides or hardness is a concern and could result in plugging of the microirrigation system.***

CONSIDERATIONS

The potential for adverse interference with existing nearby production wells should be evaluated in planning and designing the water well.

The potential for groundwater overdraft and the long-term safe yield of the aquifer should be considered in planning.

If practicable, wells shall be located in higher ground and up-gradient from sources of surface contamination or flooding. In determining gradient, both pumped and unpumped conditions should be considered.

Potential effects of installation and operation of the well on cultural, historical, archeological, or scientific resources at or near the site should be considered in planning.

Fencing of the well and associated equipment should be considered to prevent contamination and damage by wildlife, livestock, or human activity.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared for specific field sites in accordance with this standard and shall describe the requirements for applying the practice to achieve its intended uses. A record of the installation of this practice shall be made and shall include the following information:

- Location of the water well by Global Positioning System, latitude/longitude, township/range, or other georeferencing convention, of such precision that it can be readily re-located
- **Well Site Geologic Investigation Report**
- **Purpose of the well**
- **Planned Demand and Estimated Yield**
 - _____ **Estimated Yield (GPM)**
 - _____ **Pumping Time (HPD)**
 - _____ **Volume (GPD)**
- Date of completion of the water well
- Name of landowner
- Name, title, and address of person responsible for the water well

- Total depth of the water well
- Length of casing and screening
- Inside diameter of well bore or casing
- Type of casing material or schedule (e.g., standard weight steel, or PVC sch-80)
- Static water level measured from ground surface
- Water chemistry before and after disinfection
- ***The owner shall provide a copy of the driller's WV Certified Water Well Record to the NRCS representative prior to acceptance of well including documentation of test results for actual well yield in gallons/minute (GPM).***
- ***A WV Certified Well Driller shall be on site in direct charge of drilling, construction, altering or abandonment of the water well.***
- ***Compare the estimated and actual well yield information to the pump selection data curve and criteria according to Conservation Practice Standard Pumping Plant (533).***
- ***Complete and attach WV 642 A and 642 B worksheets and WV Form WV-ENG-63 (water well plan schematic and the associated engineering plan layout).***
- ***WV "700 series" Construction and/or Material Specifications as appropriate.***
- ***For water well decommissioning or abandonment, refer to NRCS Conservation Practice Standard Well Decommissioning (351) and WV Department of Health and Human Resources, Bureau for Public Health, Water Well Regulations and Water Well Design Standards.***
- ***Refer to WV Department of Health and Human Resources Legislative Rule 64CSR19, Title 64, Series 46, Water Well Design Standards 64-46-5 for Materials and 64-46-6 for General Construction criteria.***

Operation and Maintenance

A plan for maintenance of a water well shall be prepared. The well construction records shall be kept on file with the maintenance plan by the owner/operator. As a minimum, the plan shall include a statement of identified problems, corrective action taken, date, and specific capacity (yield per unit drawdown) of water well before and after corrective action was taken. The site shall be suitable for safe operation of the drilling equipment.

Refer to WV Conservation Practice Standard Water Well (642) Operation & Maintenance.

REFERENCES

National Engineering Handbook, Part 631, Chapter 32, Well Design and Spring Development.

WV Department of Health and Human Resources, Bureau for Public Health, Legislative Rule 64CSR19, Title 64, Series 19, Water Well Regulations

WV Department of Health and Human Resources, Bureau for Public Health, Legislative Rule 64CSR46, Title 64, Series 46, Water Well Water Well Design Standards

WV NRCS – WV 642A and WV 642B Conservation Practice Standard Water Well Worksheets

WV NRCS Form WV ENG-63 Water Well for Livestock or Other (water well schematic, materials list and plan view)

WV NRCS –WV Water Well (642) Operation and Maintenance

TABLE A	
Source	Minimum Distance (Ft)
Property Lines, Existing Building or Foundation	10
Streams, Rivers and Impoundments ^{1/}	25
Sewers and Drains (Watertight) ^{2/}	25
Drains (Non-watertight)	50 (100) ^{3/}
Septic Tanks, Holding Tanks, Privies (Vault)	50 (100) ^{3/}
Sewage Absorption Fields, Privies (Vault)	100
Sewers and Drains (Non-Watertight)	100
Barnyard/Feeding, Watering Areas	100
Cemeteries, Open Manure Pits, Existing Wells	100
Buried Oil, Gasoline Tanks (no leak)	50 (100) ^{3/}
Chemical Storage Tanks (no leak)	50 (100) ^{3/}
Silo or Seepage Pit, Storage or Preparation Site	150
Storage or Prep Site for Fertilizers or Pesticides	150
Other Known or Potential Contamination Sites	150
Lagoons, Waste Storage Ponds	300
Chemical Storage Areas	300
<p>^{1/} The upper well casing shall extend one foot above the twenty-five (25) year flood level or greater according to WV Department of Health & Human Resources (DOHHR) regulations.</p> <p>^{2/} Sewer and drain materials shall be of potable water main standards, installed, and hydrostatically tested as approved according to WV DOHHR regulations.</p> <p>^{3/} The distance noted in parenthesis is required when a water well is lower in elevation than the source of pollution or contamination referenced in Table A.</p>	