



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WATER WELL

CODE 642

(no)

DEFINITION

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

PURPOSE

This practice is used to accomplish the following purpose:

- To provide access to a groundwater supply suitable for livestock watering, fire control, wildlife, and other agricultural uses

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all types of agricultural land where the quality and quantity of underground water is appropriate for the intended purpose.

This practice does not apply to

- Wells constructed solely for domestic or public water supply
- Monitoring wells, injection wells, temporary test wells, or piezometers
- Pumps, surface supply line, storage facilities, related appurtenances

CRITERIA

General Criteria Applicable to All Purposes

Law and regulations

The investigation, design, and installation of an agricultural water supply well must comply with all applicable governmental regulations, laws, permits, licenses, and registrations. Federal law requires:

- A proposed well that has a domestic usage component must comply with criteria in the American National Standard (ANSI) American Water Works Association (AWWA), A100-06, "Water Wells" (2007), and A100-15, 2015.
- A proposed irrigation well must comply with criteria in ANSI American Society of Agricultural and Biological Engineers (ASABE or ASAE) EP400.3, "Designing and Constructing Irrigation Wells," (2007).
- The well design and installation must follow applicable industry consensus standards.

Roles and responsibilities

Licensed water well drillers are responsible for drilling and installing water wells according to state regulations.

The landowner is responsible for obtaining all permits and water rights.

Site suitability

Use reliable, local experience and review all relevant geologic maps, reports, and well records maintained by State and Federal agencies to evaluate groundwater quantity and quality. When local hydrogeologic data are limited or conditions are complex and uncertain, conduct on-site evaluation to provide professional recommendations regarding site suitability.

Do not locate the well near overhead or underground utility lines or other safety hazards.

Locate the well away and up-gradient from potential surface and subsurface contamination or pollution and areas subject to flooding, according to state regulations. In determining hydraulic gradient, consider both pumped and static water levels.

Clear the site of all trees, brush, and obstructions. Construct a relatively flat, reasonably dry, working surface for the drill rig and related equipment to ensure a safe and effective working environment.

Wellhead protection

Divert all surface runoff, precipitation, and drainage away from the wellhead. Compact, mound, and slope earth material away from the wellhead.

Protect the wellhead and associated appurtenances from contamination or damage by wildlife, livestock, farm machinery, vehicle parking, or other harmful human activity.

Locate the well at least 300 feet down gradient and/or 100 feet up gradient from potential sources of surface and subsurface pollution. Potential sources of pollution to avoid are waste storage facilities, barnyards, feedlots, silos, manure transfer systems, animal mortality facilities, domestic sewage systems, and any other practice or facility that could adversely affect the quality of water in the well. Local and state laws could require longer setbacks.

Grouting and sealing the casing

When drilling into hard rock formations or physically stable geologic materials, install a minimum of 10 feet of casing.

For erodible, friable, or otherwise unstable materials, install (at a minimum) watertight grouted casing.

Install a watertight seal in the annulus of all well casing. Acceptable sealants include mortar containing expansive hydraulic cement, bentonite-based grout, bentonite chips and pellets, sand-cement grout, neat cement, or concrete.

Use sealant, packers, or similar retaining device to isolate one or more aquifers or zones that produce poor groundwater quality to prevent commingling or cross-contamination. Provide a similar positive seal to separate water-bearing zones where co-mingling is not desired.

For (flowing and non-flowing) artesian wells, grout in the casing and geologic units directly above and below the aquifer to retain its confining pressure.

When casing extends to the bore hole bottom, install a watertight end cap or grout seal to prevent entry of geologic material. For designs requiring telescoped screen assemblies, install one or more sand-tight seals between the top of the telescoped screen assembly and the casing.

After well completion, provide a suitably threaded, flanged, welded cap, or compression seal to prevent entry of contaminants into the well.

Casing materials

Acceptable materials for casing include steel, iron, stainless steel, copper alloys, plastic, fiberglass, concrete, or other material of equivalent strength and which has sufficient chemical resistance to the ground water for the design life of the well. To prevent galvanic corrosion, do not join dissimilar metals.

Use only steel pipe casing in driven wells.

Casing diameter must be a minimum of 2 inches larger than the maximum outside diameter of the pump and pump column.

Select casing material that can withstand all anticipated static and dynamic pressures imposed on the casing while maintaining a water tight seal during installation, well development, and use throughout the design life of the well. When needed, mechanically support casing during installation to maintain joint integrity. Refer to NEH 631.3200, *Water Well Design* for guidance in determining proper differential head limitations for approved casing materials.

Screen and filter pack

Screen slot size and filter pack (artificial or natural) must conform to the characteristics listed in ASTM D5092 and ASTM D6725. Use only manufactured well screen that consists of corrosion-resistant material.

Install a well screen and filter pack (artificial or natural) if any of the following conditions exist:

- Presence of a poorly graded, fine sand aquifer or heaving or caving sands
- Presence of a highly variable aquifer, such as alternating sand and clay layers
- Presence of a poorly cemented sandstone or other loosely compacted material
- Requirement for maximum yield from a low-yielding aquifer
- Holes drilled by reverse circulation

Refer to ASTM D5092 for filter pack quality criteria and filter pack and well screen slot size compatibility with formation rock and soil.

Use a pre-packed well screen for horizontal, vertical, or angled wells. Use artificial filter packs if natural filter pack is unavailable.

Screen and filter pack installation

Position the well screen according to the depth of the water-bearing zone(s) below the ground surface and thickness of the water-bearing zone penetrated by the drill hole. Install a conventional filter pack from the bottom up and place in a manner that avoids segregation and bridging of particles. Install filter pack according to NRCS NEH Part 631.31 and 631.32, and ASTM D5092.

When bentonite seals are allowed, hydrate bentonite to facilitate expansion and fill voids. Hydrate bentonite according to AWWA, A100-15, 2015.

For a screened well cased to the well bottom, install several extra feet of blank screen or casing at the bottom of the well to accommodate sediment that passes through the well screens and settles to the bottom of the well.

Access port

Install an access port with a minimum diameter of 0.5 inch to allow for unobstructed measurement of depth of the water surface, or for the installation of a pressure gage for measuring shut-in pressure of a flowing well.

Seal or cap access ports, pressure gages, and all other openings in the well cover to prevent entry of unwanted materials and to discourage tampering. A removable cap is acceptable for an access port.

Well development

After completing well construction, but before conducting pumping tests, develop the well to remove fines, drill cuttings, mud, drilling fluids, and additives. Well development is required for all water wells. Pump the well at approximately 120 percent of the anticipated normal production rate until water discharge is clear. Do not use the permanent pump to conduct any well development work. Refer to ASTM 5521 for well development procedure.

Water well quality testing

If local water quality conditions are unknown or questionable, test the well water using parameters that pertain to well performance or the suitability of the water for its intended usage. Test well water according to NRCS CPS Groundwater Testing (Code 355).

Disinfection

Prior to final chemical disinfection, remove foreign substances, such as grease, soil, sediment, joint dope, and scum from the well and near the wellhead. Clean all pump parts before placing them into the well. Disinfect the well using a chlorine compound at a concentration of a minimum 50 mg/L (50 ppm).

Well performance (aquifer) testing

Design the well so at maximum drawdown, the water surface does not drop to the top of the highest screen or pump intake. Wait no less than 24 hrs after well development is completed and the water level has stabilized, to conduct a pumping test for determining specific capacity and dynamic water levels. Refer to NRCS 210-NEH-631 and 210-NEH, Part 650, Chapter 12, Section 650.1205, "Wells" for guidance on conducting, recording, and analyzing pumping tests.

Discharge water a minimum of 300 feet from the well and in such a way that reduces erosion to the land surface and prevents potential artificial recharge during the test.

Take all measurements from the top of well casing.

CONSIDERATIONS

Consider evaluating the potential for adverse interference with existing nearby production wells when planning and designing the water well.

PLANS AND SPECIFICATIONS

Develop plans and specifications that clearly describe requirements for applying the practice to achieve its intended purpose(s). If not already specified in the documentation required by the State regulatory authority, record the following information in the installation record:

- Location of water well by Global Positioning System (GPS) coordinates or in a sufficiently detailed narrative description to readily locate the well.
- Name of well owner.
- Type of casing material or schedule, and whether new or used.
- Height of casing extending aboveground surface.
- Static water level measured from top edge of casing or from ground surface.
- Well diameter, total well depth, and screened depth/interval.
- Notification of whether aquifer is artesian or non-artesian. If well is flowing artesian, provide flow rate and pressure.
- Screen slot size and filter gradation (if used).
- Drilling method and bore hole diameter.
- Well development methods used.
- Results of pump test, drawdown, pumping rate, specific capacity, and well efficiency.
- Driller's log for water-bearing and dry holes.
- If water quality was tested, record the parameters and test results, date of sampling, name of person who took sample, and name of laboratory that conducted tests.
- Schematic drawing of well construction showing well diameter and depth, casing or liner diameters, fill bentonite, or grouting debris.

In planning for well performance (aquifer) testing, consider the potential for groundwater overdraft and the long-term, safe aquifer yield.

OPERATION AND MAINTENANCE

Prepare a plan for operation and maintenance of the water well. The owner is responsible for keeping and maintaining well construction records with the maintenance plan. The owner must ensure periodic inspection of the well for proper functioning and water quality.

Ensure no agricultural chemicals, such as fertilizers and pesticides, are stored or mixed or containers rinsed within a 100-foot radius of the wellhead.

The inspection must include conditions that affect well performance as designed for the water use. As a minimum, these conditions include:

- Declines in discharge, static level, maximum pumping level, and pressure (for artesian wells) that are outside acceptable limits for the well design
- Appearance of sediment that may damage the well, pump, or appurtenances
- Changes in water quality including odor, color, taste, and chemistry
- Presence of algae or iron bacteria

For screen wells that have blank casing installed at the bottom, periodically bail or flush the well to remove excessive, accumulated sediment.

In the maintenance record, include statements describing identified problems, corrective action taken and date, and specific capacity of well before and after corrective action. The owner must remedy unacceptable conditions in a timely manner.

In the event the well becomes unserviceable, it may be decommissioned according to NRCS CPS Well Decommissioning (Code 351).

REFERENCES

USDA NRCS. 2010. Title 210, National Engineering Handbook, Part 631, Chapter 32, Section 631, Water Well Design. <https://directives.sc.egov.usda.gov/>

USDA NRCS. 2012. Title 210, National Engineering Handbook, Part 651, Chapter 1, Section 651, Laws, Regulations, Policy, and Water Quality Criteria. <https://directives.sc.egov.usda.gov/>

USDA NRCS. 2012. Title 210, National Engineering Field Handbook and National Engineering Handbook, Part 650.1203, Chapter 12, Springs and Wells. <https://directives.sc.egov.usda.gov/>

ANSI/NGWA-01-14 National Groundwater Association, Water Well Construction

ANSI/ASAE American National Standard *EP400.3*, 2007, "Designing and Constructing Irrigation Wells"

ANSI/AWWA American National Standard, A100-15, 2015, "Standard for Water Wells." American National Standard/American Water Well Association, Denver, CO, AWWA catalog no: 41100-2015, www.awwa.org

ASTM D5521, 2018, "Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers" ASTM International, West Conshohocken, PA, 2018, DOI: 10.1520/D5521_D5521M-18, www.astm.org

ASTM D5092, 2016 "Standard Practice for Design and Installation of Groundwater Monitoring Wells" ASTM International, West Conshohocken, PA, 2016, DOI: 10.1520/D5092_D5092M-16, www.astm.org

ASTM D6725, 2016, "Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers" ASTM International, West Conshohocken, PA, 2016, DOI: 10.1520/D6725_D6725M-16, www.astm.org