



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 agricultural water supply.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Address the need for adequate livestock water quality and quantity
- Provide water for terrestrial wildlife
- Provide irrigation water

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 for domestic or public water supply.
- Monitoring wells, NRCS Conservation Practice Standard (CPS) Monitoring Well (Code 353), injection wells, temporary test wells, or piezometers.
- Pumps, surface supply lines, storage facilities, and 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 according to NRCS Title 450, General Manual (GM), Part 405, Subpart A, "Compliance with Laws and Regulations." Where applicable laws and regulations do not exist, follow industry standards, such as—

NRCS reviews and periodically updates conservation practice standards. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide online by going to the NRCS website at <https://www.nrcs.usda.gov/> and type FOTG in the search field.

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- A proposed well must comply with criteria in the current version of American Water Works Association (AWWA), A100-15, "Water Well Standard."
- A proposed irrigation well must comply with criteria in the current version of American Society of Agricultural and Biological Engineers (ASABE or ASAE) EP400.3, "Designing and Constructing Irrigation Wells."
- The well design and installation must comply with criteria in the current version of National Ground Water Association (NGWA) 01, "Water Well Construction Standard."

Roles and responsibilities

Licensed water well driller is responsible for drilling and installing the water well, according to State regulations.

The landowner is responsible for obtaining all necessary permits, rights, or approvals according to NRCS 450-GM-405 and applicable laws, rules, and regulations.

The landowner and/or licensed contractor are responsible for locating all buried utilities in the project area, including drainage tiles and other structural measures.

Site suitability

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

Locate the well according to the Occupational Safety and Health Administration (OSHA) Standard 1926.1408 (h), "Power line safety (up to 350 kV)—equipment operations" to comply with setback distances from overhead or underground utility lines or other safety hazards.

Locate the well away and upgradient 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.

Laterally locate the well to comply with applicable conservation practice standards and State-specific water well setback zones and prohibitions. Locate the well at least 100 feet from potential sources of surface and subsurface pollution.

Clear the site of all trees, brush, and obstructions. Locate the drill rig, related equipment, and the well on relatively flat, reasonably dry, working surface for 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.

The top of the casing shall be equipped with a cap or well seal to prevent rainfall or insects from entering the well. If the top of the well casing is subject to flooding from surface water, the cap shall be water tight and equipped with a vent that extends two feet above the 10-year flood level. As an alternative, the well casing may be extended two feet above the 100-year flood level.

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 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 ground water quality to prevent commingling or cross-contamination. Provide a similar positive seal to separate water-bearing zones where comingling is not desired.

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

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.

When casing extends to the borehole 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, which have sufficient chemical resistance to the ground water for the design life of the well. To prevent galvanic corrosion, do not join dissimilar metals. Select a casing diameter to permit satisfactory installation and efficient operation of a submersible pump, if used. Typically, the casing diameter should 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 watertight 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 NRCS National Engineering Handbook (NEH) (Title 210), Part 631, "Geology," 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, "Standard Practice for Design and Installation of Groundwater Monitoring Wells" and ASTM D6725, "Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers." 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;

- Hole 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 prepacked well screen for horizontal, vertical, or angled wells. Use an artificial filter pack 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 210-NEH-631, and ASTM D5092.

When bentonite seals are allowed, hydrate bentonite to facilitate expansion and fill voids. Hydrate bentonite according to manufacturer's recommendations.

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 well performance (aquifer) 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 "Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers" for well development procedure.

Water quality testing

Conduct a water quality test of the well water using parameters that pertain to well performance and the suitability of the water for its intended usage. 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 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

Ensure that the aquifer and well can deliver water at a flow rate appropriate to design. At a minimum, collect enough information to determine what pumping rate the aquifer and well can

produce and sustain to support the design of associated practices, such as pumping plant and livestock and/or irrigation pipeline.

Design the well so at maximum drawdown, the water surface does not drop to the top of the highest screen or pump intake. When pumping the well for development and testing, discharge water far enough away from the well and in such a way as to reduce erosion to the land surface and prevent potential artificial recharge.

Take all measurements from the top of well casing.

CONSIDERATIONS

Consider the following when planning and designing a water well:

- Evaluating the potential for adverse interference with existing nearby production wells when planning and designing the water well
- Health impacts of nitrates in groundwater used for livestock consumption. In areas of nitrogen fertilizer use, consider checking with the local Health Department for excess nitrogen levels in ground water
- Health impacts of ground water mineral content used for irrigation or animal watering. Minerals contained in ground water, such as selenium, sodium, sulfate, and others have the potential to negatively impact soil, plant and animal health
- For (aquifer) testing, consider the potential for ground water overdraft and the long-term, safe aquifer yield
- Wells intended for human consumption are required to meet different criteria, for example surround the well casing at the ground surface with a 4-inch-thick concrete slab extended at least 2-feet in all directions from the outside of the casing for additional contamination prevention. Slope the slab away from the well.
- The industry standard for determining specific capacity and dynamic water level is an aquifer (pumping) test. See CEMA 224: "Aquifer Flow Test." Refer to NRCS 210-NEH-631 Chapter 31, "Groundwater Investigations" and 210-NEH, Part 650 Subpart L Section 650L.5, "Wells" for guidance on conducting, recording, and analyzing aquifer tests.

PLANS AND SPECIFICATIONS

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

- Well purpose and required yield.
- 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 and liner diameters, fill, bentonite, or grouting surface elevation, and top of well head elevation.
- Disinfection method and solution used, and date the well is disinfected.
- Copy of the driller's "PA DCNR Water Well Completion Report" including documentation of the pumping test results for actual well yield in gallons/minute (GPM) shall be submitted to PA DCNR, the owner, and for project certification.

OPERATION AND MAINTENANCE

Prepare a site-specific 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.

Do not store or mix agricultural chemicals, such as fertilizers and pesticides, or rinse containers within a 100-foot radius of the wellhead.

Regular inspection must include conditions that affect well performance, based upon the well's intended 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.
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- Presence of algae or iron bacteria.

For wells that have blank casing installed below the screen, 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 Conservation Practice Standard Well Decommissioning (Code 351).

REFERENCES

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