NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WATER WELL

(CODE 642)

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

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. It does not apply to wells installed solely for monitoring or observation purposes (see NRCS Conservation Practice Standard (CPS) Monitoring Well (Code 353)), injection wells, temporary test wells, piezometers or decommissioning of wells (ASTM D 5299).

This practice does not apply to pumps, surface supply lines, storage facilities, and related appurtenances.

CRITERIA
Laws 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. In particular, federal law requires:

- A proposed irrigation well must comply with criteria in ANSI/ASAE American National Standard, EP400.3, 2007;
- The well design and installation must follow applicable industry consensus standards.

The landowner shall be made aware of the water withdrawal permit requirements of the Massachusetts Department of Environmental Protection’s Water Management Act.

All persons drilling wells shall hold applicable license as set forth in 313 CMR 3.00, “Water Well Diggers and Drillers Registration.”

The landowner is responsible for obtaining all permits and water rights prior to construction. Drilling permits, logs, and any work performed must be reported to the State on prescribed forms. Copies of all permits, logs and reporting shall be provided to NRCS.

Suitability of Site. Use reliable local experience and all available relevant geologic maps, reports, and well records maintained by State and Federal agencies. Review design, construction, and maintenance records of nearby wells to help determine whether groundwater is available in sufficient quantity and of the desired quality for the intended use. If local hydrogeologic data are limited or if conditions are complex and uncertain, use additional expertise to conduct on-site evaluation and to provide professional recommendations regarding the suitability of the site. Dowsing shall not be considered a reliable or scientific means to determine the suitability of the site.

Do not locate the well near overhead and underground utility lines and other safety hazards. All applicable set back requirements in relation to property lines, building, roads, rights-
of-way, surface water, wetlands, or wastewater treatment system shall be observed.

Wells located within 100 ft of a wetland or within the 100-year floodplain or any river or stream are subject to Chapter 131, Section 40 of the Massachusetts General Laws and 310 CMR 10.00 "Wetlands Protection". If a well must be located within this area, approval must be obtained from the Conservation Commission and special provisions shall be taken to protect the wellhead.

Wells proposed within wellhead protection areas or sole source aquifers may be subject to more stringent regulation. If a well is proposed within these areas approval must be obtained from the appropriate Town regulatory committee or commission.

Locate the well at least 100 feet from potential sources of surface and subsurface pollution. If site conditions allow, locate the well up-gradient from any potential or known sources of surface contamination and away from areas subject to flooding. In determining gradient, consider both pumped and static conditions.

310 CMR 15.00, "Minimum Requirements for the Subsurface Disposal of Sanitary Sewage, State Environmental Code, Title 5" specifies that wells shall be located with minimum setback distances from sewers, septic tanks and leaching fields.

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

Construction Considerations. Drilling fluids used in the construction of water wells may either be water or air based. All drilling fluids must be nontoxic and of food grade quality and drilling fluid additives should be biodegradable, NSF or UL approved. Drilling fluid additives should be stored in clean containers and should be free of material that may adversely affect the well, the aquifer, or the quality of the water to be pumped from the well.

Wellhead Protection. Divert all surface runoff, precipitation, and drainage away from the wellhead. No unsealed openings should be left around the well that could conduct surface water or contaminated groundwater vertically to the intake portion of the well or transfer water from one formation to another. At the wellhead, compact, mound, and slope earth materials to direct surface runoff away from the wellhead. The well should be cased to a sufficient height, with a minimum of 1 ft. above the established ground surface (or 2 ft. above the level of the highest recorded flood, whichever is higher) to prevent the entry of surface and near-surface water.

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

Grouting and Sealing the Casing. Hard rock formations or physically stable geologic materials may not require casing except for the uppermost 20 feet through unconsolidated overburden deposits. The well casing should be installed securely into the rock and the borehole into the rock should be left open and unscreened.

If drilling encounters erodible, friable, or otherwise unstable material, install watertight, grouted casing throughout, with the exception of the intake portions.

Provide 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.

If one or more zones are encountered that produce water of unacceptable quality, use grout or packers to prevent comingling of waters or cross-contamination of aquifers.

Provide a packer, or similar retaining device, or a small quantity of sealant between the casing and the less pervious material overlying the aquifer of artesian wells. Provide a similar positive seal to separate water bearing zones where co-mingling of waters is undesirable.

For artesian conditions, seal the confining geologic units directly above and below the aquifer in such a manner as to retain its confining pressure. Flowing artesian wells shall be equipped with a shut-off valve so that the flow of water may be stopped when the well is not in use.

If casing extends to the bottom of the drill hole, install a watertight end cap or grout seal to prevent entry of geologic material into the well from the bottom.

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When the design requires telescoped screen assemblies, install one or more sand-tight seals between the top of the telescoped screen assembly and the casing.

Do not design maximum drawdown to reach the top of the highest screen or pump intake.

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

**Casing Materials.** The well should be constructed of durable materials such as steel meeting ASTM A589, and must be properly constructed and finished to prevent contamination. Acceptable alternate materials for casing include, iron, stainless steel, copper alloys, plastic, fiberglass, concrete or other material of equivalent strength and which has sufficient chemical resistance to the groundwater for the design life of the well. To prevent galvanic corrosion, do not join dissimilar metals.

Use only steel pipe casing in driven wells.

Select a casing diameter to permit satisfactory installation and efficient operation of a submersible pump, if used.

Select casing material that can withstand all anticipated static and dynamic pressures imposed on the casing during installation, well development, and use throughout the design life of the well. Refer to NEH 631.3200, Water Well Design, for guidance in determining proper differential head limitations for approved casing materials. The well casing wall thickness should be sufficient to withstand hydraulic loading if the casing is pumped dry.

Ensure well casing joints have adequate strength to carry the weight of casing throughout its length while maintaining a watertight seal. If needed, mechanically support the casing during installation to maintain joint integrity. Terminate mechanically supported casings on material that can adequately support the casing weight.

**Screen and Filter Pack.** Use a screen and filter pack (also called gravel pack) 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.

If acceptable filter materials are unavailable, use a commercially manufactured, pre-packed well screen. A pre-packed well screen consists of inner and outer screens that contain the engineered filter material. The material must meet the following quality criteria:

- Less than five percent fines (the proportion that passes the number 200 sieve);
- Predominantly rounded, dense, siliceous materials;
- No angular particles, such as crushed rock, or flat particles, such as mica;
- No earthy or soft materials, such as clay, shale, silt, gypsum, or anhydrite;
- No organic matter, no other impurities or metallic substances;
- No material soluble in hydrochloric acid, such as limestone.

Use a pre-packed well screen for horizontal or angled wells.

Position the well screen according to the depth of the water-bearing zone(s) below the ground surface and the 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.

Screen perforation by any method is allowable with the following provisions:

- For uniform size aquifer material, screen openings are smaller than the average diameter of aquifer material;
- For non-uniform aquifer material, screen openings are smaller than 60 percent of the aquifer material;
- Screen openings, for filter/gravel pack must exclude at least 85 percent of the filter pack material;
- Size the length and open area of the screen to keep entrance velocity or shear stress

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below the threshold for erosion of filter pack particles and transport into the well;

- Casing must not be functionally weakened or deformed.

For a screened well cased to the bottom of the well, 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 completion of well construction, ensure that the well is developed. Well development is required regardless of whether the well is finished in unconsolidated materials or hard rock aquifers. Use one or more development techniques to effectively loosen and remove silt, fine sand, drill cuttings, drilling muds, or additives deposited by the drilling operation on the uncased borehole face and in adjacent portions of the aquifer. For screened zones, the development technique must collapse sand bridges and remove fines outside the screen. Following the development process, remove accumulated sediment at the bottom of the well bore by bailing or pumping.

Pump the well at approximately 120 percent of the anticipated normal production rate until suspended sediment and associated turbidity clears. Do not use the permanent pump to conduct any well development work.

Refer to NEH 631.32 for guidance on various well development techniques. Explosives shall not be used. All water used in well development shall be potable.

**Well Water 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) or water quality criteria specified in the Massachusetts Drinking Water Regulations (310 CMR 22.02), whichever is more stringent.

**Disinfection.** Prior to final chemical disinfection, remove all 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 no less than 100 mg/L (100 ppm) available chlorine in solution to treat the entire well.

**CONSIDERATIONS**

Consider evaluating the potential for adverse interference with existing nearby domestic supply or production wells when planning and designing the water well. Well development by hydrofracturing shall not be permitted in cases where existing neighboring wells are at potential risk of productivity loss or physical damage. In planning, consider the potential for groundwater overdraft and the long-term safe yield of the aquifer.

**Well Performance Testing.** After completion of well construction and the water level is stable, a pump test (yield test) shall be conducted to determine specific capacity (flow rate) and dynamic water level. Record the length of test and pumping rate and report this information to the NRCS.

The yield from pumping tests conducted during times of seasonally high groundwater may need to be adjusted to reflect expected yield during the season of highest demand on the 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 of the physical location reliably locate the well
- Name of well owner
- Type of casing material or schedule, and whether new or used
- Height of casing extending above ground surface
- Static water level measured from top edge of casing or from ground surface

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• Notification of whether aquifer is artesian or non-artesian. If well is flowing artesian, provide flow rate and pressure
• Well development method(s) used
• Results of pump test including length of test, stability of water level, pumping rate, and specific capacity after water level had stabilized, if needed.
• Driller’s log
• 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.

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 ft. 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 shall be decommissioned according to NRCS CPS Well Decommissioning (Code 351).

REFERENCES


USDA, NRCS, Conservation Engineering Division, Agricultural Waste Management Field Handbook 651.01, Laws, Regulations, Policy, and Water Quality Criteria.


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