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 (refer to Kansas Conservation Practice Standard 353, Monitoring Well), injection wells, temporary test wells, or piezometers.

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, all state, local and tribal laws, permits, licenses, and registrations. In particular, federal law requires:

- A proposed well that has a domestic usage component must comply with criteria in American National Standards Institute/American Water Works Association (ANSI/AWWA) American National Standard, A100-06, 2007.
- The well design and installation must follow applicable industry consensus standards.

The water well contractor must be properly licensed by the Kansas Department of Health and Environment (KDHE) and must drill and install according to rules and regulations of that agency.

Comply with state laws where water use appropriation is involved. Owners are responsible for securing permits for such appropriation.

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.

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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.

Do not locate the well near overhead and underground utility lines and other safety hazards. If site conditions allow, locate the well up-gradient from potential sources of surface contamination and away from areas subject to flooding. In determining gradient, consider both pumped and static conditions.

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 working environment.

**Wellhead Protection**

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

Extend the well casing a minimum of one (1) foot above the finished ground surface. Do not cut the casing off below the ground surface except to install a pitless well adapter unit, which shall extend at least one (1) foot above the ground surface. Design and fabricate pitless well adapters to prevent soil, subsurface, and surface water from entering the well.

Install a sanitary well seal on all wells.

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 100 feet from potential sources of surface and subsurface pollution. Install pump pits at least two (2) feet away from the water well. Seal the pipe from the pump or pressure tank to the well in a watertight manner, where it passes through the wall of the pump pit.

**Grouting and Sealing the Casing**

Seal wells by grouting the annular space between the casing and the well bore from the ground level to a minimum of 20 feet or to a minimum of five (5) feet into the first clay or shale layer, if one is present, whichever is greater. If groundwater is encountered at a depth less than the minimum grouting requirement, the grouting requirement may be modified to meet local conditions, if approved by NRCS and KDHE.

Provide a watertight seal in the annulus of all well casings. Acceptable sealants are neat cement grout, cement grout, or bentonite-based grouts, meeting the definition found in KDHE Article 30, 28-30-2.

To facilitate grouting, drill the well bore hole a minimum diameter of at least three (3) inches greater than the maximum outside diameter of the well casing.

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

If one or more zones are encountered that produce water of unacceptable quality due to natural or man-made pollutants, use grout or packers to prevent comingling of waters or crosscontamination 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 comingling of waters is undesirable.

For artesian conditions or confined aquifers, seal the confining geologic units directly above and below the aquifer in such a manner as to retain its confining pressure.

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.
When the design requires telescopied screen assemblies, install one or more sand-tight seals between the top of the telescopied 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**

Acceptable materials for casing include steel, iron, stainless steel, plastic, 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 Chapter 32, “Well Design and Spring Development,” in National Engineering Handbook Part 631 (NEH 631), Geology, for guidance in determining proper differential head limitations for approved casing materials.

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, prepacked well screen. A prepacked 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 prepacked 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 nonuniform 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 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 gauge for measuring shut-in pressure of a flowing well.

Seal or cap access ports, pressure gauges, 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 Chapter 32, “Well Design and Spring Development,” in National Engineering Handbook Part 631 (NEH 631), Geology, for guidance on various well development techniques.

**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 Kansas Conservation Practice Standard 355, Groundwater Testing.

**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 (pump column, casing, and screen)
before placing them into the well with a 200 mg/L (200ppm) available chlorine solution. Disinfect gravel for gravel packed wells by immersing the gravel in a 200 mg/L (200ppm) available chlorine solution. 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.

**DEFINITION OF WELL TERMS**

See Figure 1 below for a diagram of the following terms.

**Static water level.** The surface of the groundwater at the top of the saturated zone in a water-bearing formation is known as the static water level. It is also referred to as the static water table.

**Cone of depression.** As water approaches a well that is being pumped, the water table decreases. As distance from the well increases, the slope becomes flatter until it merges with the water table level beyond the influence of the well. The water surface in the influence of a pumped well is an inverted cone with its apex in the well and its base in the static water table. This is known as the cone of depression.

**Radius of influence (R).** The area affected by the discharge from a well is known as the area of influence. The boundary of the area of influence is known as the circle of influence. The radius of the circle is the radius of influence (R).

**Profile of cone of depression** (drawdown curve). If a cross section is made through a pumped well (as shown in Figure 1) the water table appears in profile and is known as the profile of cone of depression.

**Thickness of aquifer (H).** This is the saturated thickness before pumping.

**Pumping level (h).** The depth of water in the well while pumping is known as the pumping level.

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**Figure 1—Definition of Well Terms**

![Diagram of well terms](image)

**Drawdown (H-h).** Drawdown is defined as the distance from the position of the static water table before pumping to the level of the water in the well during pumping.

**Lift (L).** The term lift or head (as applied to a pumped well) is defined as the vertical distance from the water level in the well during pumping to the ground surface or some other specified point such as the center of the discharge pipe.
Lost head (l). Lost head is defined as the difference in the elevation between the water level inside the well (during pumping) and outside at the point where the drawdown curve intersects the casing.

Gravel pack or filter. This is a gravel envelope surrounding the casing and designed to prevent surrounding sand from entering the well.

Well casing. This is a rigid pipe installed in the well to prevent the walls of the well from sloughing into the well.

Well screen. A perforated or slotted section of pipe used to separate the water from the surrounding aquifer is a well screen.

Grout seal. This is a permanent impervious material injected between the casing and the walls of the borehole to form a seal. This seal prevents potentially contaminated surface and/or groundwater from entering the well, or where necessary, aquifer mixing.

CONSIDERATIONS

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

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, conduct a pump test to determine specific capacity and dynamic water level. Record the length of test and pumping rate.

PLANS AND SPECIFICATIONS

Develop plans and specifications that clearly describe requirements for applying the practice to achieve its intended purpose(s). Obtain KDHE Form WWC-5 “Water Well Record” for each well and file with as-built documentation. 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.
- Height of casing extending above ground surface.
- Static water level measured from top edge of casing or from ground surface.
- 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 has stabilized, if needed.
- Lithologic 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 feet 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 screened 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 the well before and after the 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 Kansas Conservation Practice Standard 351, Water Well Decommissioning.

REFERENCES


Kansas Administrative Regulations (KAR) Agency 28, Article 30 (KAR 28-30). KDHE Water Well Contractor’s License; Water Well Construction.


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


USDA, NRCS, FOTG, Kansas Conservation Practice Standard 351, Water Well Decommissioning.

USDA, NRCS, FOTG, Kansas Conservation Practice Standard 353, Monitoring Well.

USDA, NRCS, FOTG, Kansas Conservation Practice Standard 355, Groundwater Testing.