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 Oklahoma Conservation Practice Standard No. 351, Water Well Decommissioning).

CRITERIA

Laws and Regulations. The investigation, design, or installation of water wells according to this standard shall adhere to Chapters 30 and 35 of the Oklahoma Water Resources Board (OWRB) Rules and Regulations; as well as any applicable local, Tribal or federal laws not cited in the OWRB rules. A permit is required for all wells used for other than domestic use. All wells shall be constructed by a well driller with a valid license from OWRB.

This practice does not apply to wells intended for human consumption.

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 construction to determine site-specific hydrogeologic conditions.

The site shall be suitable for safe operation of the drilling equipment.

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. Minimum location standards are described in Chapter 35, Subchapter 7 of the OWRB Rules.

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

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

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. The well borehole shall be a minimum diameter of at least three (3) inches greater than the maximum outside diameter of the well casing.

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 A589. Steel pipe manufactured for other purposes may be used if the quality of the pipe meets or exceeds requirements specified in ASTM A589.

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 F480.

Filament-wound fiberglass casings (glass-fiber-reinforced-thermosetting-resin pipe, RTRP) may be used if material meets requirements specified in ASTM D2996. Tests for long-term cyclic pressure strength, long-term static pressure strength, and short-term rupture strength as required in ASTM D2996 are not needed because the pipe is to be used for well casing. Joints shall meet requirements specified in section 3.8, ASTM F480.

Fiberglass pressure pipe (also called reinforced plastic mortar pipe, RPMP, or fiberglass pipe with aggregate) shall meet or exceed requirements specified in ASTM D3517.

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 A100-06, 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. If required, the filter pack shall meet the OWRB installation requirements.

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. Wells located in areas where known flooding occurs shall be evaluated prior to construction in order to comply with OWRB Rules, Chapter 35, Subchapter 7, which requires the casing to extend twenty four (24) inches above the maximum level of such flooding.

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.

Well Development. Well development shall be performed, at a minimum, to remove drill cuttings and drilling mud, 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. Where the well is to be completed without a filter pack in unconsolidated granular aquifers, ASTM D5521- 05, Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers, may be used for guidance.

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 C845), bentonite-based grout, or bentonite chips and pellets. The length of the grout seal shall be no less than 10 continuous feet. All shall be in accordance with Chapter 35, Subchapter 7, of the OWRB Rules.

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. *The requirement of the concrete slab described above is waived with a variance granted by Noller Herbert, Director of the Conservation Engineering Division, effective January 22, 2013, provided all aspects of grouting and sealing as described in Chapter 35, Subchapter 7 of OWRB are followed.*

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 co-mingling 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 the OWRB Rules.

Water Quality Testing. Water quality testing shall be performed to determine if water quality meets the intended use. 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.

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
- 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

All of the information described above is included on the OWRB Form “Groundwater Well Completion Report”. A completed copy of the Completion Report is required for certification of this practice. OWRB does not consider a report complete unless it is stamped received by their office or is printed from their website.

- Water chemistry before and after disinfection. *The requirement for a water chemistry test before disinfection has been*

granted a variance by Noller Herbert, Director of the Conservation Engineering Division, effective January 22, 2013.

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.

REFERENCES

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

Title 785. Oklahoma Water resources Board, Chapter 30. Taking and Use of Groundwater

Title 785. Oklahoma Water Resources Board, Chapter 35. Well Driller and Pump Installer Licensing

American National Standards Institute (ANSI)/American Water Works Association (AWWA) Standard A100-06 Water Wells

American Society for Testing and Materials (ASTM), D2996 01(2007)e1 Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

ASTM D3517 - 11 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe

ASTM A589 / A589M - 06 Standard Specification for Seamless and Welded Carbon Steel Water-Well Pipe

ASTM F480 - 12 Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80

ASTM D5521- 05, Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers

ASTM C845 - 04 Standard Specification for Expansive Hydraulic Cement