NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

# WATER WELL, (NUMBER)

**Code 642**

## DEFINITION

A hole drilled, dug, driven, bored, jetted or otherwise constructed to an aquifer.

## PURPOSE

To provide water for livestock, wildlife, irrigation, human, and other uses.

To provide for general water needs of farming/ranching operations.

To facilitate proper use of vegetation on rangeland, pastures, and wildlife areas.

## CONDITIONS WHERE PRACTICE APPLIES

All irrigation wells shall be planned and located to serve as a source of water for an irrigation water distribution or conveyance system designed to facilitate the conservation use of the soil and water resources on a farm or group of farms.

Irrigation wells are limited to geological sites where sufficiently large volumes of underground water are available at a rate that will permit practical irrigation of the land on which the water is to be used. Wells may be the only source of water or they may supplement other sources. The land on which the water is to be used must be suitable for the production of locally adapted crops grown under irrigation farming. The water must be of adequate quality to ensure that it will not materially reduce the productive capacity of the soil on which it is to be used.

Wells are applicable on rangeland, pastures, cropland, and wildlife and recreation areas where present water facilities are inadequate and the underground water supply is adequate in quantity and quality for the purpose to be served and can be developed at an economical cost.

This practice standard applies only to production 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 (ASTM D 5299).

## CRITERIA

**General.** The suitability of the well site and the type of well installed shall be based on detailed geologic investigations, including test well drillings, on groundwater assessment studies made by local, state, or federal agencies, or on reliable local experience. The design should include groundwater conservation measures, provisions for controlling contamination from one aquifer to another in the well, and methods for obtaining a maximum supply of sediment-free water.

Any well which is part of a system supplying water for human consumption shall meet the requirements of Section 567, Chapter 49, Iowa Administrative Code, which gives state rules for nonpublic water wells.

Surface runoff and drainage that might reach the wellhead from areas used by livestock shall be diverted.

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

**Well Diameter**. The diameter of the well shall be adequate to meet the yield capacity of the formation in relation to the nature and extent of the water-bearing area and to permit the installation of a pump to deliver the needed amount of water to the projected lift elevation.

**Casing and Materials.** Wells shall be cased, but the lower sections passing through consolidated strata do not require casing. Materials shall meet the requirements detailed under "Well Specifications."

The maximum depth for well casings shall be based on critical collapse pressure as calculated by the Cleindeinst Equation in ASTM F-480, appendix X2. Depth, as used in this standard, applies to the difference in static head between the inside and outside of the casing. This can be determined by measuring the static head or by using the total depth of the well.

Table 1 gives the depth limitations for polyvinyl chloride (PVC), acrylonitrile-butadiene-styrene (ABS), and styrene-rubber (SR) well casing pipes having different standard dimension ratios and moduli of elasticity.

Table 2 gives the dimensions and maximum depth of installation for PVC Schedules 40 and 80 pipe constructed of material having a modulus of elasticity equal to 400,000 $lb/in^2$. The factors given at the bottom of this table may be used in calculating depth limitations for ABS Schedules 40 and 80 pipe and other PVC classifications.

Figure 1 can be used in determining the maximum depth of plastic and fiberglass casings not covered by Tables 1 and 2.

Table 3 gives the dimensions and maximum depth of installation for reinforced plastic mortar (RPM) well casings of various sizes and wall thickness.

Table 1. – Maximum depth of installation for plastic (SDR-PR) pipe

| Material | | | | |
|---|---|---|---|---|
| SDR | PVC | | ABS | SR |
| | Modulus of elasticity (E) | | | |
| | 400,000 | 320,000 | 300,000 | 250,000 |
| ----------ft---------- | | | | |
| 13.5 | 985 | 785 | 735 | 615 |
| 17 | 475 | 380 | 355 | 295 |
| 21 | 245 | 200 | 185 | 150 |
| 26 | 130 | 100 | 95 | 80 |
| 32.5 | 65 | 50 | 50 | 40 |

Concrete water well casings shall be limited to wells not greater than 500 feet in depth.

Table 4 gives the minimum allowable thickness of metal casings. Table 5 gives the maximum allowable depth of installation for steel casings.

Casings having a different wall thickness can be used in the same well if the maximum allowable depth for each is maintained.

**Screens.** All wells constructed to recover water from unconsolidated aquifers shall be equipped with manufactured screen sections, well points, or field perforated sections meeting the criteria stated below. The screen openings for aquifer material of near uniform size shall be smaller than the average diameter of the aquifer material. The screen or slotted casing section must be protected with a device immediately above the intake section if necessary to prevent well stabilizer materials from entering the intake section area.

For graded aquifer materials (of non-uniform gradation), the screen shall be sized so that 25 to 40 percent of the aquifer material is larger than the screen opening. For wells in which a gravel pack envelope is used, the screen shall have openings that

will exclude at least 85 percent of the gravel pack material. The length and open area of the screen shall be adequate to maintain the entrance velocity of water into the well at an acceptable level, preferably less than 1/10 ft/s.

The position of the screen in the well shall be governed by the depth of the aquifer below the ground surface and the thickness of the aquifer to be penetrated by the well. If practical, the top elevation of the screen shall be below the lowest water level expected during pumping and be located opposite the most permeable area in the water-bearing strata.

Table 2. Dimensions and maximum depth of installation for Schedules 40 and 80 PVC plastic pipe

| Nominal diameter | Outside diameter | Schedule 40 | | | Schedule 80 | | |
|---|---|---|---|---|---|---|---|
| | | Minimum wall thickness | SDR | Maximum depth | Minimum wall thickness | SDR | Maximum depth |
| in. | in. | in. | | ft. | in. | | ft. |
| 2 | 2.375 | 0.154 | 15.4 | 650 | 0.218 | 10.9 | 1,960 |
| 2 1/2 | 2.875 | .203 | 14.2 | 840 | .276 | 10.4 | 2,260 |
| 3 | 3.50 | .216 | 16.2 | 550 | .30 | 11.7 | 1,550 |
| 3 1/2 | 4.00 | .226 | 17.7 | 420 | .318 | 12.6 | 1,220 |
| 4 | 4.50 | .237 | 19.0 | 340 | .337 | 13.4 | 1,010 |
| 5 | 5.563 | .258 | 21.6 | 230 | .375 | 14.8 | 740 |
| 6 | 6.625 | .280 | 23.7 | 170 | .432 | 15.3 | 660 |
| 8 | 8.625 | .322 | 26.8 | 120 | .50 | 17.3 | 450 |
| 10 | 10.75 | .365 | 29.5 | 90 | .593 | 18.1 | 390 |
| 12 | 12.75 | .406 | 31.4 | --- | .687 | 18.6 | 360 |

NOTE: Table is for PVC Schedule pipe made of material having a modulus of elasticity of 400,000 lb/in$^2$. For PVC pipe having a modulus of elasticity of 360,000, multiply the depths by a factor of 0.9. For PVC pipe having a modulus of elasticity of 320,000, use a factor of 0.8. A factor of 0.625 can be used for ABS Schedules 40 and 80 pipe having a modulus of elasticity of 250,000 lb/in$^2$.

Table 3. Dimensions and depth limitations for reinforced plastic well casings

| Diameter (inches) | Maximum depth (feet) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 20 | 60 | 100 | 200 | 300 | 400 | 500 | 750 | 1,000 |
| | Minimum wall thickness (inches) | | | | | | | | |
| 8 | 0.17 | 0.17 | 0.23 | 0.23 | 0.23 | 0.29 | 0.29 | 0.33 | 0.33 |
| 10 | .17 | .17 | .28 | .28 | .28 | .36 | .36 | .41 | .41 |
| 12 | .18 | .19 | .34 | .34 | .34 | .43 | .43 | .46 | .46 |
| 14 | .19 | .22 | .32 | .40 | .40 | .43 | .46 | .46 | .46 |
| 15 | .19 | .24 | .34 | .34 | .46 | .46 | .46 | .46 | .46 |
| 16 | .20 | .25 | .36 | .36 | .46 | .46 | .46 | .46 | .46 |
| 18 | .21 | .28 | .40 | .40 | .45 | .45 | .45 | .52 | .52 |
| 20 | .21 | .31 | .42 | .42 | .45 | .45 | .45 | .54 | .54 |
| 21 | .21 | .33 | .48 | .48 | .48 | .48 | .48 | .57 | .57 |
| 24 | .24 | .38 | .48 | .48 | .57 | .57 | .57 | .57 | .57 |
| 27 | .26 | .40 | .49 | .49 | .49 | .62 | .62 | .62 | .62 |
| 30 | .29 | .44 | .49 | .49 | .49 | .68 | .68 | .68 | .68 |
| 33 | .32 | .44 | .60 | .60 | .60 | .75 | .75 | .75 | .75 |
| 36 | .35 | .48 | .65 | .65 | .65 | .82 | .82 | .82 | .82 |

**Filter Pack.** Sand or gravel filter packs shall be used in wells constructed in fine material of relatively uniform grain size to prevent the aquifer materials from passing through the well screen or the perforated casing. The pack shall be three to twelve inches thick and shall consist of sand or gravel material having a $D_{30}$ grain size four to twelve times the $D_{30}$ grain size of the aquifer material. Provisions shall be made for centering the casing in the filter pack.

Table 4. Maximum depth of installation for steel casings

| Wall (uncoated) thickness | | Casing size (inches) 4 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Outside diameter (inches) 4.500 | 5.563 | 6.625 | 8.625 | 10.75 | 12.75 | 14.00 | 16.00 | 18.00 | 24.00 |
| Inches | | feet | | | | | | | | | |
| 20 Ga | (0.036) | 80 | 40 | 25 | -- | -- | -- | -- | -- | -- | -- |
| 18 Ga | (0.048) | 180 | 100 | 50 | 25 | -- | -- | -- | -- | -- | -- |
| 16 Ga | (0.060) | 370 | 190 | 110 | 50 | 25 | -- | -- | -- | -- | -- |
| 14 Ga | (0.075) | 720 | 380 | 220 | 100 | 50 | 30 | 20 | -- | -- | -- |
| 12 Ga | (0.105) | 2,030 | 1,060 | 620 | 280 | 140 | 80 | 60 | 40 | -- | -- |
| 10 Ga | (0.135) | -- | -- | 1,340 | 600 | 310 | 180 | 130 | 90 | 60 | -- |
| 8 Ga | (0.164) | -- | -- | -- | 1,080 | 550 | 330 | 250 | 160 | 110 | -- |
| 7 Ga | (0.179) | -- | -- | -- | 1,410 | 720 | 430 | 320 | 210 | 150 | -- |
| 3/16 | (0.188) | -- | -- | -- | 1,650 | 840 | 500 | 370 | 250 | 170 | 70 |
| 7/32 | (0.219) | -- | -- | -- | -- | 1,340 | 800 | 600 | 400 | 280 | 110 |
| 1/4 | (0.250) | -- | -- | -- | -- | -- | 1,190 | 890 | 600 | 420 | 170 |
| 9/32 | (0.281) | -- | -- | -- | -- | -- | -- | 1,280 | 850 | 590 | 250 |
| 5/16 | (0.312) | -- | -- | -- | -- | -- | -- | -- | 1,170 | 820 | 340 |
| 11/32 | (0.344) | -- | -- | -- | -- | -- | -- | -- | -- | 1,100 | 460 |
| 3/8 | (0.375) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 600 |
| 1/16 | (0.438) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 960 |

NOTE: Based on the Cleindeinst Equation for Critical Collapse Pressure, using Poisson's ration ($\mu$) of 0.30 and a modulus of elasticity (E) of 30,000,000 lb/in$^2$.

$$D = \frac{2E}{1-\mu^2} \times \frac{2.31}{SDR\ (SDR-1)^2}$$

**Sanitary Protection.** Wells shall be located a safe distance from sources of contamination. If sources are severely limited, a groundwater aquifer that might become contaminated can be used as a water supply for human consumption if adequately treated. Details pertaining to local water wells, such as depth, type of construction, and vertical zone of influence, together with data on the geological formations and porosity of subsoil strata, shall be considered in determining the safe allowable distances. The recommended minimum horizontal distance between the water supply and the source of contamination is:

| Source of contamination | Minimum distance |
|---|---|
| | ft |
| Waste disposal lagoon | 300 |
| Cesspool | 150 |
| Livestock and poultry yards | 100 |
| Privy, manure pile | 100 |
| Silo pit, seepage pit | 150 |
| Septic tank and disposal field | 100 |
| Gravity sewer or drain (not pressure tight) | 50 |
| Gravity sewer or drain (pressure tight) | 25 |

If possible, wells shall be located in ground that is higher than any source of contamination or flooding. Drainage that might reach the source from areas used by livestock shall be diverted. Wells must be readily accessible for maintenance and repair and be located a safe distance from overhead utility lines or other safety hazards. Each well shall be provided with a watertight cover or seal to prevent the entry of contaminated water or other objectionable materials. The annular space around the casing shall be at least three inches and shall be filled with cement grout, bentonite clay, or other suitable materials to a depth that will seal off surface waters. A positive seal shall be provided between the casing and the impervious material overlying the aquifer of artesian wells.

## CONSIDERATIONS

The potential for adverse interference with existing nearby production wells needed to be evaluated in planning.

The potential for ground water overdraft and the long-term safe yield of the aquifer needs to be considered in planning.

If practicable, wells should be located in higher ground and up gradient from sources of contamination or flooding.

Potential effects of installation and operation of the well on cultural, historical, archeological, or scientific resources at or near the site need to be considered in planning.

## 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 purposes.

## OPERATION AND MAINTENANCE

A plan for maintenance of a 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 well before and after corrective action was taken.