

CONSTRUCTION SPECIFICATION

AR-642 WATER WELL

1. Scope

The work shall consist of drilling, casing, and developing a well at the location shown on the Job Sheet for Arkansas NRCS Conservation Practice Standard 642 – Water Well.

2. Regulations

Water well drillers and pump installers must be licensed by the Arkansas Water Well Construction Commission to drill and install wells in the State of Arkansas. Well drillers, pump installers, and landowners must also comply with all Federal, State, and local laws and regulations. It is the responsibility of the landowner to obtain all necessary permits from applicable Federal, State, and local agencies.

Water wells shall be constructed in accordance with the rules and regulations of the Arkansas Water Well Construction Commission (AWWCC):

<http://www.accessarkansas.org/awwcc/August%201%202009%20AWWCC%20rules.pdf>

3. Public and Private Utilities

Utilities are defined to be overhead and underground power or communication lines, and pipelines. All utilities discovered to be in the work area are shown on the drawings or sketches. However, the absence of indicators on the drawings or sketches does not assure the nonexistence of utilities in the work area. The contractor should conduct their own search and discovery of utilities in order to lessen or avoid potential damages. The landowner shall contact *Arkansas One Call* (866-237-5028) ten days prior to the commencement of construction activities to have underground utilities located in the work area

4. Site Preparation

The area immediately surrounding the well site shall be cleared, smoothed, and graded to allow for a safe and dry working area.

5. Well Diameter

The diameter of the well shall be adequate 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, to protect against excessive head loss.

6. Casing Materials

The well casing pipe shall be marked according to the ASTM specification for the material used.

All well casing pipe and couplings shall be homogeneous throughout and shall be free from visible cracks, holes, foreign materials, or other injurious defects. The well casing pipe and couplings shall be as uniform in color, density, and other physical properties as is commercially possible.

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. Only steel pipe shall be used for driven wells.

Steel

Steel pipe used for well casing shall meet or exceed requirements specified in ASTM A589.

The casing depth and nominal size shall be used to determine the minimum thickness for the steel water well casing (refer to NRCS National Engineering Handbook (NEH) Part 631, Chapter 32 <http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=26985.wba>).

A thinner casing may be used if it is determined that it will not collapse, based on analysis using the Timoshenko Elastic Formula and guidelines set forth in NRCS National Engineering Handbook (NEH) Part 631, Chapter 32. Thicker casing shall be used where corrosive conditions are expected. Neither used steel pipe nor galvanized sheet metal pipe such as "downspout" tile pipe shall be used as well casing.

Plastic

Plastic pipe used for well casing may be made of acrylonitrile-butadiene-styrene (ABS) or polyvinyl chloride (PVC), and shall meet or exceed requirements specified in ASTM F480. Plastic casing for wells that provide potable water shall be NSF approved.

Used casing and casing with eccentricity > 1.5% (0.015) or other defects shall not be used.

The modulus of elasticity and SDR marked on the pipe shall be used to determine maximum allowable depth. Greater depths may be used if it is determined that it will not collapse, based on a site-specific determination of the maximum differential head using the Clinedinst Equation.

Acrylonitrile-butadiene-styrene (ABS). ABS pipe used for water well casing shall meet or exceed the requirements specified in ASTM Specification D1527 (for Schedule 40 and 80 pipe) or D2282 (for SDR Series pipe). Neither ABS 1208 nor ABS 1210 shall be used; they do not meet the minimum strength requirements of ASTM F480.

Polyvinyl-chloride (PVC). PVC pipe used for water well casing shall meet or exceed requirements specified in ASTM D1785 (for Schedule 40, 80, and 120 pipe) or in ASTM D2241 (for SDR series pipe).

Fiberglass

The modulus of elasticity for fiberglass pipe shall be certified for use in determining maximum depth. Fiberglass casing for wells that provide potable water shall be NSF approved.

RTRP. Glass-fiber-reinforced-thermosetting-resin pipe (RTRP) used for well casing shall meet or exceed 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.

RPMP. Reinforced plastic mortar pipe (RPMP) used for well casing shall meet or exceed requirements specified in ASTM D3517. The casing size and depth shall be used to determine the minimum thickness for the RPMP water well casing. Thinner casing may be used if an evaluation using manufacturer's data documents that it will not collapse given the geologic, hydraulic, and construction conditions at the site.

Concrete

Concrete well casings shall be reinforced and shall meet or exceed the requirements of ASTM C76. The minimum 28-day compressive strength shall be 4,000 lbs. /in².

Joints

Joints for well casing shall have adequate strength to carry the load due to the casing length and still be watertight, or shall be mechanically supported during the installation process to maintain joint integrity. Such mechanically supported casings shall terminate on firm material that can adequately support the casing. Couplings used with plastic well casing may be solvent cement or threaded, and shall have a strength equal to or greater than the pipe to which they are attached. Couplings shall be made of a material compatible with the casing and recommended for use by the casing manufacturer. If they are made of material susceptible to corrosion, provisions must be made to protect them. Threaded couplings for SDR pipe shall conform to requirements set forth in ASTM F480. Solvent cement must meet the requirements of the ASTM specification appropriate for the material used:

ABS	D2235
PVC	D2564

7. Screen and Filter Pack Materials

Screen

All screen materials shall be homogeneous throughout and shall be free from visible cracks, holes, foreign materials, or other defects.

The length and open area of the screen shall be sufficient to limit entrance velocity of water into the well to less than or equal to 0.1 feet per second.

Well screens may be constructed of commercially manufactured screen sections, well points, or field-perforated sections. Perforation by any method is allowable provided proper slot size and entrance velocity limits can be met.

For naturally developed wells in which the screen is placed in direct contact with graded aquifer materials, the screen openings shall be such that 25 to 40 percent of the aquifer material is larger than the screen opening. The screen openings for aquifer material of near uniform size shall be slightly smaller than the average diameter of the aquifer material.

In wells using a gravel packed envelope, the screen shall have openings of a size that will exclude at least 85 percent of the gravel pack material.

Filter Pack

Where a filter pack is used, the designed gradation and thickness shall be provided by the contractor and shall be approved by NRCS prior to installation.

The filter pack materials shall be washed, screened, and disinfected with a solution of at least 100 mg/L chlorine. They shall consist of at least 95 percent rounded, dense, siliceous materials with less than 5 percent flat particles (such as mica), earthy or soft materials (such as clay, shale, or anhydrite), or highly soluble limestone or gypsum. The specific gravity of the filter pack shall equal or exceed 2.5, and the D_{30} grain size shall be 4 to 12 times the D_{30} grain size of the aquifer material.

The inside diameter of the tremie pipe shall be at least 12 times the diameter of the coarsest pack material if placed by gravity, and at least 10 times if pumped.

Filter pack materials shall be delivered to the well site on approval of the purchaser. Materials shall be protected from the weather and contamination until installed. Materials that come in contact with the ground shall not be used.

Pre-Packed Well Screens. A commercial prepacked well screen may be substituted for a conventionally installed (by tremie) filter pack, provided the screen/filter assembly meets criteria set forth in this specification.

8. Installation

Construction operations shall be done in such a manner that erosion and air and water pollution are minimized and held within legal limits. The owner, operator, contractor or other persons will conduct all work and operations in accordance with proper safety codes for the type of construction being performed with due regards to the safety of all persons and property.

The completed job shall be workmanlike and present a good appearance.

Drilling

Only clean, potable water shall be used in drilling fluid, whether employed alone or in combination with drilling additives. If organic drilling fluids are used, they must be broken down chemically according to the manufacturer's recommendations before or during development.

Lead- and mercury-bearing materials shall be strictly prohibited from the wellhead area during construction.

Whenever there is an interruption of work on the well (e.g. overnight shutdown, inclement weather), the well opening shall be closed and secured with a cover designed to ensure public safety, prevent damage to the well, and prevent introduction of unwanted materials into the well. The contractor shall be responsible for any objectionable material that may fall into the well and the effect it may have on water quality, until completion and acceptance of the work by the land operator and NRCS.

Alignment. Drilled wells shall be round, plumb, and aligned so as to permit satisfactory installation and operation of a pump of the proposed size and type to the greatest anticipated depth of setting.

The maximum allowable horizontal deviation (drift of the well from vertical) shall not exceed two-thirds of the smallest inside diameter of that part of the well being tested per 100 feet of depth.

Casing

All wells shall be cased to a sufficient height above the ground surface to prevent the entry of surface and near surface water. The height of the casing above the ground surface shall not be less than one foot.

In consolidated formations, the casing shall extend through the overburden material to an elevation at least 2 feet into consolidated materials.

In unconsolidated formations, the casing shall extend to the screen.

Joining

To prevent galvanic corrosion, dissimilar metals shall not be joined.

Screen and Filter Pack

Where practical, the top elevation of the screen should be below the lowest water level expected during pumping and be located opposite the most permeable areas in water-bearing strata. Screens shall have a minimum length of 2 feet.

Telescoped screen assemblies shall be provided with one or more sand-tight seals between the top of the telescoped screen assembly and casing.

Centralizers. Provisions shall be made for centering the casing in the filter pack. Centering guides (centralizers) shall be installed if casing and/or screen assemblies over 40 feet long are installed in drill holes having nominal diameters 2 inches or larger than the outside diameter of the casing.

To prevent galvanic corrosion, metallic guides shall be of the same alloy as the casing or screen assembly to which they are attached. Metallic guides shall not be directly welded to the screen, but rather on short sections of blank casing that can be inserted into the well at the desired interval.

Filter Pack. Where a filter pack is to be installed, the diameter of the drilled hole shall provide for adequate annular space to permit the passage of the tremie pipe(s), including couplings.

Filter pack material shall be placed with a tremie pipe from the bottom up in such a manner as to prevent segregation, bridging, or inclusion of excess material from the borehole sidewalls. The top of the tremie pipe shall be fitted with funnel fittings so the filter pack can be shoveled or dumped into the tremie. Clean water may be mixed with the filter pack to facilitate placement. The filter pack shall be placed so that the actual volume used can be calculated to within 10 percent.

Filter pack material shall extend a minimum of 20 feet above the top of the highest screened or perforated section and shall extend through the entire length of the water-bearing formation penetrated by the well.

Sealing and Grouting

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. A similar positive seal shall be provided to separate water-bearing units where co-mingling of waters is undesirable.

A transition seal consisting of a 2-foot length of fine-grained sand shall be placed between the filter pack and the neat cement.

A packer or similar retaining device, or a small quantity of sealant that is allowed to set, shall be placed at the bottom of the interval to be sealed before final sealing operations begin.

The annulus surrounding the permanent well casing at the upper terminus of the well shall be filled with expansive hydraulic cement (ASTM C845), shrinkage-compensating concrete, bentonite-based grout, clay, or other material with similar sealing properties.

Dry additives should be mixed with dry cement before adding water to the mixture to ensure proper mixing, uniformity of hydration, and an effective and homogeneous seal. The water demand of additives shall be taken into account when water is added to the mix.

In general, the grout seal extends at least 20 feet deep in agricultural and individual domestic wells. Exceptions to minimum seal depths can be made for shallow wells at the approval of NRCS, where the water to be produced is at a depth less than 20 feet. In no case shall an annular seal extend to a total depth less than 10 feet below land surface. County and local requirements may be more restrictive.

The casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 feet in all directions. The upper surface of the base shall slope away from the well casing. Contacts between the base and the annular seal, and the base and the casing, shall be water tight and shall not cause the failure of the annular seal or the well casing.

9. Appurtenances

Sanitary well seal. On completion, the well shall be provided with a suitable threaded, flanged, or welded cap or compression seal to prevent entry of contaminants into the well.

Air release valves shall be placed in the well system to provide a positive means for air escape or air entrance as specified by the Engineer.

Access Port. Every well shall be constructed with an opening of at least $\frac{3}{4}$ inch in diameter in the casing above the ground level to allow a measuring line to be inserted between the outside casing and the pump column. A removable cap shall be provided.

10. Development

Wells to be completed without a filter pack in unconsolidated granular aquifers shall be developed following guidelines set forth in ASTM D5521. The method shall be selected based on the geologic character of the aquifer, type of drilling rig, and type of screen.

The well shall be developed at a continuous discharge rate of up to 120 percent of the anticipated normal production rate, until it has stopped producing detrimental quantities of solid particles and when the predetermined fraction of the filter pack has been removed.

If water from the well is intended for human consumption, sand content shall not exceed 10 mg/L when the well is pumped at a discharge rate of 150 percent greater than the anticipated normal production rate against the total lift.

The discharge at particular rates may be held constant for as long as 2 hours. The test pump shall have neither a check nor foot valve, so that backwashing occurs when the power is shut off. Any sand damage to the pump is the responsibility of the contractor.

After aquifer development is complete, the accumulated sediment shall be removed from the bottom of the well bore by pumping or bailing.

11. Disinfection

The well shall be disinfected immediately following construction using the guidelines in Table 1. The disinfection process shall also comply with all state and local requirements.

Table 1: Well Volumes and Approximate Disinfection Quantities

Well or Hole Diameter ¹	Volume of Water (Per Linear Foot)	Added Chlorine ^{2,3} (Per Linear Foot)
Inches	Gallons/Foot	Fluid Ounces/Foot
2	0.16	0.04
3	0.37	0.09
4	0.65	0.17
5	1.02	0.26
6	1.50	0.38
7	2.00	0.51
8	2.61	0.66
9	3.30	0.84
10	4.08	1.04
12	5.88	1.49
14	8.00	2.03
16	10.44	2.65
18	13.22	3.35
20	16.32	4.15
24	23.50	5.97
36	52.88	13.43
40	65.28	16.58
44	78.99	20.06
48	94.00	23.87

Notes:

¹ Diameters are for cylindrical wells only.

² Typical 5.25% to 6.0% chlorine product. Common brand names include: Clorox, Purex, Snowwhite, Kandu, Topco, etc

³ Added volume produces an equivalent concentration of 100 parts per million of chlorine per linear foot of water.

12. Testing

Water Level and Yield

A pump test shall be conducted to estimate the capacity of the well. The test should last until an apparently stable pumping level has been achieved at a rate equal to that expected for the permanent pump.

The following data shall be collected and recorded on the Well Completion Report: date of test; static water level; corresponding values of discharge, drawdown, and length of test run; and water level measured approximately one day after the test.

Water Quality

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.

13. Reporting

The contractor shall complete and file all necessary reports concerning the construction, alteration, or destruction of water wells with the Arkansas Water Well Construction Commission (see Arkansas NRCS Job Sheet for Conservation Practice Standard 642 – Water Well). Copies shall be provided to the NRCS and the landowner. A report of construction will be filed with the Arkansas Water Well Construction Commission within 90 days after well construction/repair.

14. Abandonment of a Dry Hole

If a dry well is to be permanently abandoned, it shall be completely filled in such a manner that vertical movement of water within the well bore cannot occur. Refer to Arkansas NRCS Conservation Practice Standard 351, Well Decommissioning.

15. Measurement

The amount of well drilling is measured to the nearest foot of well drilled and cased. Wells abandoned for causes other than actions of the contractor will be included in the measurement.

The amounts of pipe and well screen installed are measured to the nearest linear foot at the time the riser is assembled. Pipe and well screen that cannot be salvaged from wells abandoned for causes not attributed to actions of the contractor will be included in the measurement.

The couplings, special fittings, and appurtenances are counted at the time the riser is assembled. Couplings, special fittings, and appurtenances that cannot be salvaged from wells abandoned for causes not attributed to actions of the contractor will be included in the measurement.

The time required to develop the well is measured to the nearest half-hour. Time required to develop wells abandoned for causes not attributed to actions of the contractor will be included in the measurement.