

**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.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes.

1. To provide water for livestock, wildlife, irrigation, human, and other uses.
2. To provide for general water needs of farming/ranching operations.
3. To facilitate proper use of vegetation on rangeland, pastures, and wildlife areas.

CONDITION WHERE PRACTICE APPLIES

On all land uses where the underground supply of water is sufficient in quantity and quality for the intended purpose.

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 (American Society for the Testing of Materials, ASTM D 5299).

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.

CRITERIA

Criteria Applicable to All Wells.

Laws and Regulations. Wells shall comply with all Federal, State, and local rules and regulations. Wells shall comply with the requirements of *Chapters 1 and 2 of the "Water Well Rules, Regulations, and Standards, State of Louisiana", Department of Transportation and Development (DOTD), Water Resources Section.*

Louisiana R.S. 38:3097.3.C(4)(a) requires that before any well is drilled, an advance notification of intent to drill a water well be submitted by the well owner to the Commissioner of Conservation at least 60 days prior to drilling the well. The Act exempts several well types from the prior notification requirements, but requires the same information within 60 days after the well completion. These well types are:

- Domestic wells – water well used exclusively to supply the household needs.
- Replacement well – a well located within 1000 feet of the original well and within the same property boundary as the original well, installed within the same aquifer over an equivalent interval with an equivalent pumping rate, and used for the same purpose as the original well.
- Drilling rig supply well – a temporary well used only for the duration of the oil and gas drilling operation at the drilling location where sited for the immediate needs of rig operations.
- Drought relief wells (contact the Office of Conservation – DNR for more information).

- All other wells the Commissioner exempts for just cause.

Both of the above notifications (pre-installation and post installation) shall be accomplished by completing the Water Well Notification form (GWR-01).

All well drillers shall be licensed by the State of Louisiana.

Free Flowing Wells that produce more than 25,000 gallons per day shall also comply with Chapter 4 of the above rules and regulations.

Policy. The Natural Resources Conservation Service (NRCS) will assure itself that the completed water well meets the minimum criteria called for by this standard. *A copy of the completed "Water Well Notification form (GWR-01)" and a copy of the completed "Louisiana Well Registration Form" (DOTD-GW-1) shall be obtained from the well owner and filed in his case file.* The form data will be checked for conformity with this standard.

All wells shall be designed by a Louisiana licensed well driller and submitted for approval on form LA-ENG-56, prior to installation.

Suitability of Site. The availability of ground water 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 and shall be located so as to not pose a threat to the water resources of the state and to provide for the protection of the health, safety, and welfare of the user. The allowable distance shall be based on consideration of site-specific hydrogeologic factors and shall comply with set back distance established in Chapter 2, Section 2.2.5.0 thru 2.2.5.4 of the

"Water Well Rules, Regulations, and Standards of Louisiana".

Surface runoff and drainage that might reach the wellhead from areas used by livestock shall be diverted. Refer to NRCS Conservation Practice Standard, "Diversion", Code 362.

Safety. 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 ground water and to support the side of the hole through unstable earth materials. The intake portion of a well through stable geologic formations may not require casing.

Materials. Casings and liner pipe shall meet the requirements of Chapter 2, Section 2.4.0.0 "Casing" of the "Water Well Rules, Regulations, and Standards of Louisiana".

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.

Steel well casings shall also meet or exceed requirements specified in ASTM A 589. Steel pipe manufactured for other purposes may be used if the quality of the pipe meets or exceeds requirements specified in ASTM A 589.

Only steel pipe casings shall be used in driven wells.

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

Plastic casings made of acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC), or styrene-rubber (SR) shall also conform to material, dimensional and quality requirements specified in ASTM F 480.

If the water is to be used for human consumption, plastic pipe shall be approved by the National Sanitation Foundation.

Plastic pipe manufactured for water or irrigation pipelines may be used if the quality equals or exceeds requirements specified in ASTM F 480.

Filament-wound fiberglass casings (glass-fiber-reinforced-thermosetting-resin pipe, RTRP) may be used if material meets requirements specified in ASTM D 2996. Tests for long-term cyclic pressure strength, long-term static pressure strength, and short-term rupture strength as required in ASTM D 2996 are not needed because the pipe is to be used for well casing. Joints shall meet requirements specified in section 3.8, ASTM F 480.

Fiberglass pressure pipe, (also called reinforced plastic mortar pipe, RPMP, or fiberglass pipe with aggregate) shall meet or exceed requirements specified in ASTM D 3517.

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. The maximum depth for well casings shall be based on critical collapse pressure as calculated by the Cleideinst Equation in ASTM F 480, appendix X2. Depth as used in this section 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 maximum allowable differential head limitations for polyvinyl chloride (PVC), acrylonitrile-butadiene-styrene (ABS), and styrene-rubber (SR) well casing pipes having different standard dimension ratios and modulus of elasticity.

The term "differential head" applies to the difference in water levels between the inside and outside of the casing. For unconfined aquifers, maximum anticipated differential head is determined by subtracting the depth of maximum anticipated drawdown from the highest anticipated elevation of the water table. For confined aquifers, use the highest potentiometric surface. Refer to the National

Engineering Handbook, Part 631, Chapter 32, Well Design and Spring Development, for further guidance.

Table 1 – Maximum allowable differential head for plastic (SDR-PR) pipe

SDR	Material			
	PVC	ABS	SR and PVC-14333	
	12454	434	533	
Modulus of elasticity (E)				
	400,000	360,000	260,000	320,000
	-----(<i>feet</i>)-----			
13.5	1020	920	665	815
17	495	445	320	395
21	255	230	165	205
26	130	120	85	105
32.5	65	60	40	50

Table 2 and Table 3 gives the dimensions and the maximum differential head for PVC Schedule 40 and Schedule 80 well casing pipe constructed of material having a modulus of elasticity equal to 400,000 lb/in².

Table 2 – Dimensions and differential head limitations for Schedule 40 PVC pipe

Nominal Dia. (in.)	Outside Dia. (in.)	Min. Wall Thickness (in.)	SDR	Max. head (ft.)
2	2.375	0.154	15.4	675
2.5	2.875	0.203	14.2	870
3	3.500	0.216	16.2	575
3.5	4.000	0.226	17.7	435
4	4.500	0.237	19.0	350
5	5.563	0.258	21.6	235
6	6.625	0.280	23.7	175
8	8.625	0.322	26.8	120
10	10.750	0.365	29.5	90
12	12.750	0.406	31.4	70
14	14.00	0.437	32.0	70
16	16.00	0.500	32.0	70

NOTE: For PVC pipe having a modulus of elasticity of 360,000, multiply the head by a factor of 0.9. For those having a modulus of elasticity of 320,000, use a factor of 0.8. A factor of 0.625 can be used for ABS Schedule 40 pipe having a modulus of elasticity of 250,000 lb/in².

Table 3 – Dimensions and differential head limitations for Schedule 80 PVC pipe

Nomin al Dia. (in.)	Outside Dia. (in.)	Min. Wall Thickness (in.)	SDR	Max. head (ft.)
2	2.375	0.218	10.9	2,020
2.5	2.875	0.276	10.4	2,350
3	3.500	0.300	11.7	1,610
3.5	4.000	0.318	12.6	1,270
4	4.500	0.337	13.4	1,045
5	5.563	0.375	14.8	765
6	6.625	0.432	15.3	690
8	8.625	0.500	17.3	470
10	10.750	0.593	18.1	405
12	12.750	0.687	18.6	375
14	14.00	0.750	18.7	369
16	16.00	0.843	19.0	351

NOTE: For PVC pipe having a modulus of elasticity of 360,000, multiply the head by a factor of 0.9. For those having a modulus of elasticity of 320,000, use a factor of 0.8. A factor of 0.625 can be used for ABS Schedule 80 pipe having a modulus of elasticity of 250,000 lb/in².

Table 4 gives the minimum allowable thickness of metal casings. Table 5 gives the differential head limitations for steel casings.

Table 4 - Minimum thickness of metal casings for wells

Diameter (inches)	Minimum Wall Thickness (inches)		
	Steel	Casting	Lightweight Galvanized Casting ¹
² 1		0.133	-
² 1.5		0.145	-
² 2		0.154	-
² 2.5		0.203	-
² 3		0.216	-
² 3.5		0.226	-
4		0.060	0.0322
4.5		0.060	0.0322
5		0.075	0.0382
6		0.105	0.0382
8		0.105	0.0486
10		0.105	0.0486

¹Lightweight galvanized castings shall be used only in areas where local experience has proved them to be satisfactory.
²For driven or drilled wells.

Casing Diameter. Casing diameter shall be adequate to meet the yield capacity of the formation in relation to the nature and extent of the water-bearing area. It 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*, to protect against excessive head loss.

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 screen shall be installed in any earth material likely to produce silt or sand. 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.

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

For graded aquifer materials the screen shall be sized so that 25 to 40 percent of the aquifer material is larger than the screen opening.

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. 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 5 – Differential head limitations for steel casings

Wall Thickness (uncoated) (inches)	Casing Size (inches)									
	4	5	6	8	10	12	14	16	18	24
	Outside diameter (inches)									
	4.500	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	24.000
	----- (feet) -----									

20 ga. (0.036)	60	35	20							
18 ga. (0.048)	140	75	45	20						
16 ga. (0.060)	250	145	90	40	20					
14 ga. (0.075)	460	260	160	80	40	25	20			
12 ga. (0.105)	1040	630	400	200	110	70	50	35		
10 ga. (1.350)	1810	1140	750	390	220	135	105	70	50	
8 ga. (0.164)	2660	1740	1190	640	360	230	180	125	90	
7 ga. (0.179)	3130	2090	1450	790	460	290	230	160	110	
3/16 (0.188)	3415	2300	1610	890	520	330	260	180	130	60
7/32 (0.219)	4430	3070	2200	1260	750	500	390	270	200	90
1/4 (0.250)		3880	2840	1680	1030	690	550	390	290	130
9/32 (0.281)				2140	1350	910	730	520	390	180
5/16 (0.312)				2625	1690	1160	930	680	510	240
11/32 (0.344)					2065	1445	1175	860	650	310
3/8 (0.375)						1970	1420	1055	800	390
7/16 (0.438)								1490	1145	580

Note: Based on the Cleideinst Equation for Critical Collapse Pressure, using Poisson ratio (u) of 0.30 and a modulus of elasticity (E) of 30,000 lb./ in.². $D = (2E / 1 - u^2) \times (2.31 / SDR [SDR - 1]^2)$

Maximum drawdown shall not be permitted below the top of the highest screen or pump intake.

Well screens shall meet the requirements of Chapter 2, Section 2.5.0.0 "Screen" of the "Water Well Rules, Regulations, and Standards of Louisiana".

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 (gravel 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. The pack shall be 3 to 12 in. thick and shall consist of sand or gravel material having a D_{30} grain size 4 to 12 times the D_{30} grain size of the aquifer material. Provisions shall be made for centering the screen / casing in the filter pack.

Filter packs shall meet the requirements of Chapter 2, Section 2.5.7.0 thru 2.5.8.0 of the "Water Well Rules, Regulations, and Standards of Louisiana".

Prepacked Well Screens. For heaving or caving sands, silty or fine-grained aquifers, and for horizontal or angled wells, a commercial prepacked 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.

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. Wells to be completed without a filter pack in unconsolidated granular aquifers shall be developed following guidance provided in ASTM D 5521, "Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers".

The method shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

Well Development shall meet the requirements of Chapter 2, Section 2.7.1.0 thru 2.7.2.2 of the

"Water Well Rules, Regulations, and Standards of Louisiana".

Aquifer Development For massive, unfractured rock formations 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 sealed.

Grouting/Cementing and Sealing shall meet or exceed the requirements of Chapter 2, Section 2.6.0.0, "Methods and Standards for Cementing the Annular Space", of the "Water Well Rules, Regulations, and Standards of Louisiana".

If expansive hydraulic cement is used it must meet ASTM C 845.

If the water is intended for human consumption, the casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 ½ feet from the well in all directions. The top of the casing shall be at least 1 foot above the top of the slab. The annulus surrounding the permanent well casing shall be sealed before the placement of the slab.

Access Port. An access port with a copper air-line, which passes through all seals and down to 1 ft. above the upper bowl, having a minimum diameter of 3/8 inch, with a threaded and capped connector at or above the base flange of the gear drive, shall be installed and secured to the well column to allow for the installation of a pressure gage to measure the shut-in pressure of a flowing well. The length of the copper air-line from the access port down shall be recorded on the as-built report on the 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 Chapter 2, Section 2.7.3.0, "Disinfection of Wells", of the "Water Well Rules, Regulations, and Standards of Louisiana".

Free Flowing Wells. All free flowing wells shall be provided with valves for positive control of the water flow.

Water Quality Testing. 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.

Well Appurtenances. All well appurtenances such as Vent Pipes, Sampling Tap, Concrete Slabs, Sanitary Seals, and Pump/Motor Base shall meet or exceed the requirements of Chapter 2, Section 2.8.0.0, of the "Water Well Rules, Regulations, and Standards of Louisiana".

Erosion Protection. All disturbed areas surrounding the well shall be vegetated according to NRCS Conservation Practice Standard "Critical Area Planting", Code 342.

CONSIDERATIONS

The potential for adverse interference with existing nearby production wells needs 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 uses.

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.