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

- Provide water for livestock, wildlife, irrigation, human, and other uses.
- Provide for general water needs of farming/ranching operations.
- Facilitate proper use of vegetation on rangeland, pastures and wildlife areas.

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**, and where the ground water can be economically developed**.

This practice applies only to **new** production wells **and existing flowing 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

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, **which may include** including test well drilling, is conducted on-site, **and in the office** as needed, prior to well construction to determine site-specific hydrogeologic conditions.

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

The design and installation of water wells and rehabilitation of flowing wells in Montana is regulated by Montana Codes Annotated (MCA), Title 37, Chapter 43, and Administrative Rules of Montana (ARM), Title 36, Chapter 21. This Montana practice standard is written to conform to these regulations and is to be construed to do so.

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 and shall comply with requirements of all applicable state or local regulations or construction codes. **New wells shall be 50 feet or more from drain fields and 100 feet or more from septic tanks and 500 feet or more from animal waste storage ponds.**

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

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard contact the Natural Resources Conservation Service.

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This type of font (AaBbCcDdEe 123..) indicates Montana Supplement.

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 materials may not require casing. **Pumps shall not be installed below the end of the casing. It is recommended that the full length of the hole be cased to prevent pump installation below 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, to protect against excessive head loss.

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. **In Montana, outer casings shall be made of steel and extend a minimum of 18 inches above the local finished ground elevation or at least 18 inches above the local runoff level or established 100-year flood plain elevation and extend to a minimum depth of 18 feet. Outer casing on a flood plain may be capped with a watertight seal and be vented above flood plain. Inner casing may be Steel or Polyvinyl Chloride (PVC) Plastic Pipe.**

Steel well casings shall 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 conform to material, dimensional and quality requirements specified in ASTM F 480. **In Montana, plastic casings shall be PVC and shall conform to 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. **This material is not allowed in Montana.**

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. **This material is not allowed in Montana.**

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 33, Investigations for Ground Water Resources 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**, depending on aquifer lithology**.

The screen shall be constructed with the slot width determined from aquifer samples (Part 631, NEH, Chapter 33). 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 open area percentages 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 to less than or equal to 0.1 foot per second (Part 631, NEH, Chapter 33, Example 33-2).

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.

Field perforated casing is allowed only for wells completed in stable aquifers composed of clean, coarse gravel or well consolidated rock or rock-like material.

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.

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. **Surface or outer** casing shall extend from **1-1/2 feet** above the ground surface down **to a minimum depth of 18 feet and shall be made of steel. Casing shall extend** 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 **1-1/2 feet**) above the ground surface to prevent entry of surface and near-surface water. **No casing is to be cut off below the ground surface except in the case of plugging and abandonment of the well.**

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 to 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.

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 C 845), or bentonite-based grout. The length of the grout seal shall be no less than 10 feet and not less than the minimum specified in state or locally applicable construction codes. **Montana regulations specify a minimum of 18 feet.**

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 feet in all directions.

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 all local or state requirements.

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. **Production: Wells shall include provision for the conservation of ground water and other natural resources (flowing wells will be controlled by valves, pumped wells will be controlled by float valves or timers, etc.). Flowing wells with valves shall be protected from freezing.**

REHABILITATION OF EXISTING FLOWING WELLS: There are many existing flowing wells that require rehabilitation to protect and conserve natural resources. These wells commonly have no or inoperable control valves and/or leaking casings. Design and installation of rehabilitation procedures for these wells must be done by a Montana Licensed Water Well Contractor.

CONSIDERATIONS

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

The potential for ground water overdraft and the long-term safe yield of the aquifer shall 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 shall be considered.

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

Frost Pits: Frost pits (valve pits, man holes, etc.) are not recommended for use with flowing wells or wells that produce gases. Frost pits are not recommended for other wells and pipelines. Pits are a confined space as defined by OSHA and require special entry procedures commonly not practiced by inexperienced and non-qualified personnel. Frost pits can be hazardous due to the potential of flammable and/or asphyxiating gas accumulations from certain geological formations. They also may facilitate entry of contamination into the well and aquifer, and/or they may provide exposure to electrical and biological hazards. It is recommended that direct burial pressure tanks, street valves, and other direct burial devices be used instead of pits. Closed cell foam or pressurized rubber bladder inserts can be inserted into flowing wells to provide expansion room and prevent frost damage to casing.

If frost pits are used, several options are available to reduce the risks involved. Pits should be installed as far from the well as good engineering practice and local topography and obstacles allow, commonly 30 to 50 feet. Ventilation pipes can be installed between the well and the pit to reduce the potential for gasses to migrate from the well bore to the pit. A well compacted length of trench can be used between the vent and the pit to restrict the flow path from the well to the pit. The bottom of pits can be sealed to the sides and pipe entry/exits with concrete. Fans or compressed air can be used to ventilate the pits prior to entry. Various types of air analysis devices can be used to test air quality in pits prior to entry. Spark-proof switches are available for use with wells that produce combustible gasses. Air release and three-way valves can be placed outside of the pit. Entry ladders should be permanently fixed to the walls of the pit. Pits should be mouse proof to reduce Hanta Virus exposure and to prevent trapping other wildlife. Close inspection of the pit should be made prior to entry to check for spiders, centipedes, scorpions, or other venomous animals. Water-proof electrical equipment can be used to reduce the electrical shock hazard. The top of the pit walls should extend above the local grade surface to reduce the potential for flooding from runoff. Adjacent sections of trenches should be well compacted to reduce the potential for surface runoff to follow the trench into the pit and cause

flooding. The lid or closure should be strong enough to resist accidental traffic by domestic and wild animals. For vertical ladders, appropriate staunchias will be extended to four feet above the height of the access opening.

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.

All water wells and rehabilitation procedures for existing flowing wells are to be completed in accordance with the above noted Montana State regulations (ARM and MCA) and as local practices and the water well contractor's drilling experience indicates. Water Well Contractors' are licensed professionals, designated by the State of Montana to be qualified to design and complete water wells and rehabilitate existing flowing wells in accordance with Montana State regulations. No one else is licensed to do so.

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. **If wells fail to perform properly, it is the operator's responsibility to contact the driller to properly address the problems. If the water well contractor fails to correct any deficiencies, then the State Board of Water Well Contractors is authorized to perform the appropriate work at the contractor's expense.**

MONTANA REGULATIONS

Water well installation is regulated by the Board of Water Well Contractors under Title 37, Chapter 43, Montana Codes Annotated, and Title 36, Chapter 21, Administrative Rules of Montana. These regulations stipulate who can design and install water wells and indicate the appropriate well designs for different hydrogeologic conditions. Water well contractors are tested, licensed, and bonded by the State of Montana to insure compliance with State regulations and to protect the consumer from improper well design and completion practices. Appropriate well designs are included in the above noted regulations, see Title 36, Chapter 21, ARM. State regulations, licensing procedures, and bonding provide adequate protection for groundwater resources and consumers so that further design stipulations are not required by the NRCS.

Excavations and borings less than 25 feet deep are defined as springs and not included in this standard.

Concerning the availability of additional appropriations for groundwater, the landowner must apply for and receive "Permit to Appropriate Water" Form 600, from the Montana DNRC Water Rights Regional Office before site investigations or drilling begins, if anticipated well yield is greater than 35 gpm, or if the proposed well site is within a Controlled Groundwater Area.

REFERENCES

National Engineering Handbook, Part 631, Chapter 33, Investigations for Ground Water Resources Development.