NATURAL RESOURCES CONSERVATION SERVICE
MONTANA CONSERVATION PRACTICE STANDARD

WATER WELL (NUMBER)

CODE 642

DEFINITION

A hole drilled, dug, driven, bored, jetted or otherwise constructed into an aquifer for water supply.

In Montana, excavations and borings 25 feet deep or less are defined as springs and are not included in this standard.

PURPOSE

To provide access to a groundwater supply suitable for livestock watering, fire control, wildlife, and other agricultural uses.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all types of agricultural land where the quality and quantity of underground water is appropriate for the intended purpose.

This practice does not apply to wells constructed solely for domestic or public water supply. It does not apply to wells installed solely for monitoring or observation purposes (use NRCS Conservation Practice Standard (CPS) *Monitoring Well (Code 353)*), injection wells, temporary test wells, or piezometers.

This practice does not apply to pumps, surface supply lines, storage facilities, and related appurtenances.

CRITERIA

Laws and Regulations. The investigation, design, and installation of an agricultural water supply well must comply with all applicable governmental regulations, laws, permits, licenses, and registrations. In particular, federal law requires:

- A proposed well that has a domestic usage component must comply with criteria in *ANSI/AWWA American National Standard, A100-06, 2007*;
- A proposed irrigation well must comply with criteria in *ANSI/ASAE American National Standard, EP400.3, 2007*;
- The well design and installation must follow applicable industry consensus standards.
- **State regulations specify that water wells are to be designed and installed by a Licensed Water Well Contractor.**
- **The design and construction of water wells and rehabilitation of flowing wells is regulated by Montana Code 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.**
- **If the design production flow rate of the well is greater than 35 gpm, or if the well is within a Controlled Ground Water Area, or if the annual use exceeds 10 acre-feet, the land owner must apply for and receive a "Permit to Appropriate Water", Form 600, from the Montana DNRC Water Rights Regional Office before site investigation or drilling.**
- **A Notice of completion of Groundwater Development, DNRC Form 602, shall be completed and filed with the Montana Department of Natural Resources (DNRC) for all wells.**
- **Water well pump criteria can be found in Pumping Plant (Code 533).**

NRCS, MT
February 2016

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

NOTE: This type of font **(AaBbCcDdEe 123..)** indicates NRCS National Standards.
This type of font (AaBbCcDdEe 123..) indicates Montana Supplement.

The landowner is responsible for obtaining all permits and water rights.

Suitability of Site. Use reliable local experience and all available relevant geologic maps, reports, and well records maintained by State and Federal**, Local and Tribal** agencies. Review design, construction, and maintenance records of nearby wells to help determine whether groundwater is available in sufficient quantity and of the desired quality for the intended use. If local hydrogeologic data are limited or if conditions are complex and uncertain, use additional expertise to conduct on-site evaluation and to provide professional recommendations regarding the suitability of the site.

Do not locate the well near overhead and underground utility lines and other safety hazards.

If site conditions allow, locate the well up-gradient from potential sources of surface contamination and away from areas subject to flooding. In determining gradient, consider both pumped and static conditions.

Clear the site of all trees, brush, and obstructions and provide a relatively flat, reasonably dry, working surface for the drill rig and related equipment to ensure a safe and effective working environment.

Wellhead Protection. Divert all surface runoff, precipitation, and drainage away from the wellhead. At the wellhead, compact, mound, and slope earth material away from the wellhead.

Protect the wellhead and associated appurtenances from contamination or damage by wildlife, livestock, farm machinery, vehicle parking, or other harmful human activity.

Locate the well at least 100 feet from potential sources of surface and subsurface pollution. **New wells shall be 50 feet or more from septic tanks, 100 feet or more from drain fields, and 100 feet or more from animal waste storage structures. Montana Department of Environmental Quality General Permit for Concentrated Animal Feeding Operations, specifies a 500-foot separation of new waste storage facilities from existing wells. The larger separation is recommended for new wells.**

Locate the well more than 10 feet from property boundaries.

Grouting and Sealing the Casing. Hard rock formations or physically stable geologic materials may not require casing except for the uppermost 10 feet.

In Montana, the minimum depth for casing (steel) is 25 feet.

If drilling encounters erodible, friable, or otherwise unstable material, install watertight, grouted casing throughout, with the exception of the intake portions.

Provide a watertight seal in the annulus of all well casing. Acceptable sealants include mortar containing expansive hydraulic cement, bentonite-based grout, bentonite chips and pellets, sand-cement grout, neat cement, or concrete.

If one or more zones are encountered that produce water of unacceptable quality, use grout or packers to prevent comingling of waters or cross-contamination of aquifers.

Provide a packer, or similar retaining device, or a small quantity of sealant between the casing and the less pervious material overlying the aquifer of artesian wells. Provide a similar positive seal to separate water bearing zones where co-mingling of waters is undesirable.

For artesian conditions, seal the confining geologic units directly above and below the aquifer in such a manner as to retain its confining pressure.

If casing extends to the bottom of the drill hole, install a watertight end cap or grout seal to prevent entry of geologic material into the well from the bottom.

When the design requires telescoped screen assemblies, install one or more sand-tight seals between the top of the telescoped screen assembly and the casing.

Do not design maximum drawdown to reach the top of the highest screen or pump intake.

Upon completion, provide a suitably threaded, flanged, or welded cap or compression seal to prevent entry of contaminants into the well.

Pumps shall not be installed below the end of the casing. The full length of the hole shall be cased. Casing of wells producing gas shall be vented to the atmosphere in a manner that disperses the gas away from frost pits, surface structures, and any enclosed spaces.

Casing Materials. Acceptable materials for casing include steel, iron, stainless steel, copper alloys, plastic, fiberglass, concrete or other material of equivalent strength and which has sufficient chemical resistance to the groundwater for the design life of the well. To prevent galvanic corrosion, do not join dissimilar metals. **Outer casing shall be 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 (25 feet for domestic wells). Outer casing on a flood plain may be capped with a watertight seal and be vented above the flood plain elevation.**

No casing is to be cut off below the ground surface except in the case of plugging and abandonment of the well.

Use only steel pipe casing in driven wells.

Select a casing diameter to permit satisfactory installation and efficient operation of a submersible pump, if used.

Select casing material that can withstand all anticipated static and dynamic pressures imposed on the casing during installation, well development, and use throughout the design life of the well. Refer to NEH 631.3200, Water Well Design, for guidance in determining proper differential head limitations for approved casing materials.

Ensure well casing joints have adequate strength to carry the weight of casing throughout its length while maintaining a watertight seal. If needed, mechanically support the casing during installation to maintain joint integrity. Terminate mechanically supported casings on material that can adequately support the casing weight.

Inner casing may be steel, or Polyvinyl Chloride (PVC) plastic pipe. All steel casing shall conform to ASTM A53. It shall have a wall thickness of at least 0.188 inch. PVC casing conforming to ASTM F480-81.

Screen and Filter Pack. Use a screen and filter pack (also called gravel pack) if any of the following conditions exist:

- Presence of a poorly graded, fine sand aquifer or heaving or caving sands;
- Presence of a highly variable aquifer, such as alternating sand and clay layers;
- Presence of a poorly cemented sandstone or other loosely compacted material;
- Requirement for maximum yield from a low-yielding aquifer;
- Holes drilled by reverse circulation.

If acceptable filter materials are unavailable, use a commercially manufactured, pre-packed well screen. A pre-packed well screen consists of inner and outer screens that contain the engineered filter material. The material must meet the following quality criteria:

- Less than five percent fines (the proportion that passes the number 200 sieve);
- Predominantly rounded, dense, siliceous materials;
- No angular particles, such as crushed rock, or flat particles, such as mica;
- No earthy or soft materials, such as clay, shale, silt, gypsum, or anhydrite;
- No organic matter, no other impurities or metallic substances;
- No material soluble in hydrochloric acid, such as limestone.

Use a pre-packed well screen for horizontal or angled wells.

Position the well screen according to the depth of the water-bearing zone(s) below the ground surface and the thickness of the water-bearing zone penetrated by the drill hole. Install a conventional filter pack from the bottom up and place in a manner that avoids segregation and bridging of particles.

Screen perforation by any method is allowable with the following provisions:

- For uniform size aquifer material, screen openings are smaller than the average diameter of aquifer material;
- For non-uniform aquifer material, screen openings are smaller than 60 percent of the aquifer material;
- Screen openings, for filter/gravel pack must exclude at least 85 percent of the filter pack material;

- Size the length and open area of the screen to keep entrance velocity or shear stress below the threshold for erosion of filter pack particles and transport into the well;

- Casing must not be functionally weakened or deformed.

Field perforated casing (saw cut slots, torch cut slots, Mills Knife, etc.) is allowed only for wells completed in stable aquifers composed of clean, coarse gravel or well consolidated rock or rock-like material.

For a screened well cased to the bottom of the well, install several extra feet of blank screen or casing at the bottom of the well to accommodate sediment that passes through the well screens and settles to the bottom of the well.

Access Port. Install an access port with a minimum diameter of 0.5 inch to allow for unobstructed measurement of depth of the water surface, or for the installation of a pressure gage for measuring shut-in pressure of a flowing well.

Seal or cap access ports, pressure gages, and all other openings in the well cover to prevent entry of unwanted materials and to discourage tampering. A removable cap is acceptable for an access port.

Well Development. After completion of well construction, ensure that the well is developed. Well development is required regardless of whether the well is finished in unconsolidated materials or hard rock aquifers. Use one or more development techniques to effectively loosen and remove silt, fine sand, drill cuttings, drilling muds, or additives deposited by the drilling operation on the uncased borehole face and in adjacent portions of the aquifer. For screened zones, the development technique must collapse sand bridges and remove fines outside the screen. Following the development process, remove accumulated sediment at the bottom of the well bore by bailing or pumping.

Pump the well at approximately 120 percent of the anticipated normal production rate until suspended sediment and associated turbidity clears. Do not use the permanent pump to conduct any well development work.

Refer to NEH 631.32 for guidance on various well development techniques.

Well Performance Testing. After completion of well construction and the water level is stable, a pumping test shall be performed to determine the drawdown level for the design production flow rate. The pumping test shall follow Construction Specification, Pumping Test for Water Wells (MT-642).

A pumping test is not required for wells less than 50 feet deep and capable of producing more than 20 gpm.

Well Water Testing. If local water quality conditions are unknown or questionable, test the well water using parameters that pertain to well performance or the suitability of the water for its intended usage. Test well water according to NRCS CPS *Groundwater Testing (Code 355)*.

Disinfection. Prior to final chemical disinfection, remove foreign substances, such as grease, soil, sediment, joint dope, and scum from the well and near the wellhead. Clean all pump parts before placing them into the well. Disinfect the well using a chlorine compound at a concentration of no less than 100 mg/L (100 ppm) available chlorine in solution to treat the entire well.

For wells that might be used for domestic purposes, a back flow prevention device shall be placed in the delivery system to prevent contamination of the well/aquifer (see NEM, Part 503, Subpart A).

Production: Wells shall include provisions for the conservation of groundwater 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 Wells. There are many existing flowing wells that require rehabilitation to protect and conserve natural resources. These wells are addressed in Montana (Interim) practice standard, Controlling Existing Flowing Wells (Code 800) dated September 2014.

CONSIDERATIONS

Consider evaluating the potential for adverse interference with existing nearby production wells when planning and designing the water well.

In planning, consider the potential for groundwater overdraft and the long-term safe yield of the aquifer.

Some important aquifers in Montana produce various gasses. Formations known to produce gasses include the Fort Union Formation, Judith River Formation, Eagle Sandstone, and Kootenai Formation. These gasses may be toxic (hydrogen sulfide), explosive (methane), or asphixiants (carbon dioxide, nitrogen). Wells producing gasses need to be vented to the atmosphere from the casing and/or production tubing. The vent shall be at an elevation above ground level sufficient to disperse the gas in a non-hazardous manner. Gasses should also be vented at water storage tanks.

Wells producing more than 2 cubic feet of gas per minute should not be developed for use as stock water wells. Vents shall be terminated with a closed return and screened to exclude animals and debris.

Frost Pits. Frost pits shall not be placed around a well. Frost pit shall be placed a minimum of 25 feet from a well and the connecting trench filled with thoroughly compacted clay soil.

Frost pits can be a confined space as defined by OSHA and require special entry procedures not commonly practiced by in-experienced and non-qualified personnel. Frost pits can be hazardous due to the accumulation of flammable and/or asphyxiating gases from certain geological formations. It is recommended that variable-speed pumps, pitless adapters, pump houses, direct burial tanks, street valves, and other direct burial devices be used instead of pits.

Air release, three-way valves, and ventilation pipes can be installed between the well and the pit to reduce the potential for gases to migrate from the well bore to the pit. A well compacted length of trench installed between the vent/well head and the pit will restrict the flow path of leaking gases. Fans or compressed air can be used to ventilate the pit 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 could produce combustible gases.

Entry ladders should be permanently mounted to the side of the pit and have vertical grab bars that extend at least 42 inches above the lip of the entry opening. Pits should be mouse proof to reduce Hanta Virus exposure and to avoid trapping other wildlife. Close inspection of the pit should be made prior to entry to check for spiders, centipedes, scorpions, or other venomous animals.

The top of the pit walls should extend at least 18 inches above the local ground surface or flooding surface, whichever is greater, to reduce the potential for flooding of the pit by runoff. Sections of trenches adjacent to the pit should be well compacted to reduce the potential for surface runoff to follow the trench into the pit and cause flooding. Waterproof electrical equipment can be used to reduce the electrical shock hazard. The lid or closure should be strong enough to resist accidental traffic by domestic and wild animals. Do not install frost pits in areas of permanent or seasonal high water tables.

PLANS AND SPECIFICATIONS

Develop plans and specifications that clearly describe requirements for applying the practice to achieve its intended purpose(s). If not already specified in the documentation required by the State regulatory authority, record the following information in the installation record:

- Location of water well by Global Positioning System (GPS) coordinates or in a sufficiently detailed narrative description to readily locate the well
- Name of well owner
- Type of casing material or schedule, and whether new or used
- Height of casing extending above ground surface
- Static water level measured from top edge of casing or from ground surface
- Notification of whether aquifer is artesian or non-artesian. If well is flowing artesian, provide flow rate and pressure
- Well development method(s) used
- Results of pump test including length of test, stability of water level, pumping rate, and specific capacity after water level had stabilized, if needed.
- Driller's log
- If water quality was tested, record the parameters and test results, date of sampling, name of person who took sample, and name of laboratory that conducted tests.

OPERATION AND MAINTENANCE

Prepare a plan for operation and maintenance of the water well. The owner is responsible for

keeping and maintaining well construction records with the maintenance plan. The owner must ensure periodic inspection of the well for proper functioning and water quality.

Ensure no agricultural chemicals, such as fertilizers and pesticides, are stored or mixed or containers rinsed within a 100 ft. radius of the wellhead.

The inspection must include conditions that affect well performance as designed for the water use. As a minimum, these conditions include:

- Declines in discharge, static level, maximum pumping level, and pressure (for artesian wells) that are outside acceptable limits for the well design;
- Appearance of sediment that may damage the well, pump, or appurtenances;
- Changes in water quality including odor, color, taste, and chemistry;
- Presence of algae or iron bacteria.

For screen wells that have blank casing installed at the bottom, periodically bail or flush the well to remove excessive, accumulated sediment.

In the maintenance record, include statements describing identified problems, corrective action taken and date, and specific capacity of well before and after corrective action. The owner must remedy unacceptable conditions in a timely manner.

In the event the well becomes unserviceable, it may be decommissioned according to NRCS CPS *Well Decommissioning (Code 351)*.

If wells fail to perform as indicated by the water well contractor, it is the operator's responsibility to contact the water well contractor to properly address the problem(s). 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.

REFERENCES

USDA, NRCS, Conservation Engineering Division, National Engineering Handbook, Geology, 631.32, Water Well Design.

USDA, NRCS, Conservation Engineering Division, Agricultural Waste Management Field Handbook 651.01, Laws, Regulations, Policy, and Water Quality Criteria.

ANSI/ASAE American National Standard *EP400.3, 2007, Designing and Constructing Irrigation Wells*.

ANSI/AWWA American National Standard, *A100-06, 2007, Standard for Water Wells*.

Administrative Rules of Montana, Chapter 36.21, Board of Water Well Contractors.

Montana Code Annotated 2014, Chapter 43, Water Well Contractors.

General Permit for Concentrated Animal Feeding Operations, Montana Department of Environmental Quality, https://deq.mt.gov/Water/WPB/MPDES/CAFO.