Groundwater Protection Stakeholder Workgroup: Water Wells

Alaska Best Management Practices

CONSTRUCTION OF NON-PUBLIC WATER WELLS

Prepared by private and public stakeholders in conjunction with the authorities of the Alaska Department of Environmental Conservation, the Alaska Department of Natural Resources, and the Alaska Water Well Association.

June 6, 2016

CONSTRUCTION OF NON-PUBLIC WELLS

ALASKA BEST MANAGEMENT PRACTICES FOR THE CONSTRUCTION OF *NON-PUBLIC* WATER WELLS

Foreword

Dear Reader,

As a stakeholder of Alaska's groundwater, we have a responsibility to be good stewards of this shared natural resource. These Best Management Practices (BMPs) were designed for Alaskans who use, provide access to, or otherwise have a vested interest in Alaska's groundwater quality and quantity, with the intent of protecting our shared resource through proper construction, maintenance, and decommissioning of groundwater wells.

In 2012 the DEC began facilitating meetings with participation from representatives of different stakeholder groups to identify and address issues and concerns related to groundwater protection in Alaska. This stakeholder workgroup consisted of water well drillers, pump installers, hydrologists, engineers, state agency (i.e., DEC and DNR) staff, public water system owner/operators, water testing lab professionals, as well as private citizens. Meetings were held on a roughly monthly basis during the relatively slow off season. Minutes and results from the meetings were regularly shared with a broader group through email and a meeting web page.

The stakeholder workgroup thoughtfully developed BMPs over the course of approximately three (3) years taking into account Alaska's unique remoteness and natural conditions. These BMPs are intended to be applied to the construction of all non-public water wells and the maintenance or decommissioning of all wells and boreholes (public and non-public). The BMPs balance protecting groundwater and public health with practices that are economically sustainable and can be applied statewide. An additional outcome of the stakeholder workgroup meetings was a web site containing information compiled from across the state and nation as it relates to private drinking water wells, found at https://dec.alaska.gov/eh/dw/dwp/private-wells/.

The BMPs for maintaining or decommissioning all wells are intended to provide easy access to, and clarify, methods as they apply to Alaska, by serving as an alternate DEC-approved method as described in 18 AAC 80.

Adequate protection of our groundwater resources relies on Alaskans recognizing its importance and can be accomplished through voluntary application of these BMPs.

Sincerely,

The Groundwater Protection and Water Wells Stakeholder Workgroup

CONSTRUCTION OF NON-PUBLIC WELLS

ALASKA BEST MANAGEMENT PRACTICES FOR THE CONSTRUCTION OF *NON-PUBLIC* WATER WELLS

Table of Contents

CONSTRUCTION OF NON-PUBLIC WELLS

1 Purpose

To provide best management practices that ensure non-public water system wells within the state of Alaska are constructed and maintained in such a manner as to provide a safe supply of water for domestic use and to protect the groundwater resource from contamination.

2 Disclaimer

Following these practices does not relieve the person responsible for the work from compliance with any state, federal, or local authorizations which are required for your project. All necessary authorizations/permits should be obtained before proceeding with the project.

3 Scope

These practices apply to construction of non-public water system wells used as sources of water, and associated observation or test wells, within the state of Alaska, except for groundwater monitoring wells that are installed, maintained, and decommissioned in accordance with a work plan approved by the Alaska Department of Environmental Conservation (ADEC) Division of Spill Prevention and Response or the ADEC Solid Waste Program. Water wells constructed prior to the date of establishment of these Best Management Practices should not be reviewed based on the omission of, or failure to perform or meet, any of the recommended practices contained herein, unless at that time, those practices were stated and established in local or State of Alaska regulations.

4 Updates and Alterations

Future changes to this document should be done after review and approval by a committee (similar to the original Groundwater Protection and Water Wells Stakeholder Workgroup) composed of representatives from the public, industry groundwater professionals, and appropriate state agency staffs.

5 Definitions

The words, terms and phrases, used herein have the meanings given to them in "Definitions for 'ALASKA BEST MANAGEMENT PRACTICES FOR MAINTAINING OR DECOMMISSIONING WATER WELLS AND BOREHOLES' and 'ALASKA BEST MANAGEMENT PRACTICES FOR THE CONSTRUCTION OF NON-PUBLIC WATER WELLS'", except where the context clearly indicates a different meaning.

6 Well Site Selection

The location for the well should be considered prior to drilling in order to ensure adequate and sustainable quantity and quality. Due diligence should be applied to ensure the following considerations are taken into account:

A. The well should be located in order to discourage ponding of water and contaminants near the well.

B. The well should be placed in an area that is not susceptible to damage from vehicles and equipment.

6 (Continued)

C. The well should be made visible from a close distance as to avoid damage and to be able to readily identify maintenance issues.

D. Future access to the well by equipment needed for pump service or eventual well repair or decommissioning should be considered in well site selection.

E. The minimum recommended separation distances between non-public water wells and other specified facilities or areas are listed in Table 1, below. When distances differ from federal, state, or local requirements, the greater distance should be used.

Table 1. Minimum Separation Distances

Potential Source of Contamination	Minimum Separation Distance (feet)
Private sewer line (including cleanout)	25*
Curtain drain	25
Petroleum hydrocarbon storage tank	25*
Public sewer system trunk line	75*
Any other source of potential contamination	75
Holding tank – wastewater	75*
Septic disposal field	100*
Public sewer system manhole or cleanout	100*
Septic tank	100*
Animal containment areas	50
Manure/animal excreta storage areas	100
Outhouse or pit privy	100

*Distances based on those provided for "Private" well types in Table 6 of the ADEC's "Installer's Manual for Conventional Onsite Domestic Wastewater Treatment and Disposal Systems" (August 2000).

7 Best Practices: Construction of Non-Public Water Wells

The commercial drilling of a non-public water well and subsequent well rehabilitation, redevelopment, or deepening operation should be performed by a well driller. Any well drilling method used in the construction of a well should meet the following requirements:

A. The ground surface surrounding the well for at least ten (10) feet should be sloped or contoured to allow surface waters and contaminants to drain away from the well.

B. The well driller should exercise care during excavation or drilling operation to prevent contamination to any aquifer.

C. Drilling fluid may be used only if the fluid is composed of materials and additives which are NSF/ANSI approved.

7 (Continued)

D. Water used in the drilling process should be potable water, if reasonably available, or water that will not result in a contaminated well.

E. Water wells drilled or driven in unconsolidated formations should be cased with non-perforated pipe to a minimum of thirty (30) feet BGS, unless local areal experience has demonstrated that there is no water or no water suitable for potable use at greater depths.

F. A well completed in unconsolidated formations should be constructed so water only enters the well from a single producing zone.

G. Water wells that encounter bedrock shallower than twenty (20) feet BGS should be cased to a minimum of thirty (30) feet BGS and grouted to a minimum of 30 feet BGS per Section 7.K. The local areal experience exception from Section 7.E may apply for use of shallow water.

H. Water wells that encounter bedrock at a depth greater than twenty (20) feet BGS and less than forty (40) feet BGS, should be cased a minimum of ten (10) feet into the bedrock. Where it is necessary to case bedrock, the cased borehole should be grouted in accordance with Section 7.K. The local areal experience exception from Section 7.E may apply for use of shallow water.

I. In bedrock wells that utilize liners, the outer casing should be grouted per Section 7.K. The liner should have a formation packer set a minimum of ten (10) feet below the outer casing drive shoe if it is less than forty (40) feet BGS. The annular space should be grouted, using a high solids bentonite grout slurry (minimum twenty percent (20%) solids content) or granules, up to a minimum of five (5) feet above the outer casing drive shoe.

J. The Federal Housing Administration (FHA) and the U.S. Department of Veteran's Affairs (VA) well construction standards for homes they finance require a minimum of forty (40) feet of well casing.

K. *Grouting*. Grouting the outer annular space is necessary to prevent shallow non-potable groundwater or waters on the land surface from entering into a potable water aquifer. All wells should be grouted with bentonite grout slurry or granules as follows:

1. Using the dry grout method, from the pitless adapter level to at least ten (10) feet below the pitless adapter or, from the surface to a minimum twenty (20) feet BGS.

2. For drive-point water wells, grouting should be done using the dry grout method.

3. If bedrock is encountered as described in Sections 7.G through 7.I, the following grouting procedures should be followed:

7.K.3 (Continued)

a. The permanent well casing should be grouted from the bottom of the borehole up using a high solids bentonite grout slurry (minimum twenty percent (20%) solids content) or granules. The oversized borehole should be stabilized to eliminate caving and sloughing.

b. If the permanent casing is used as a tremie to place the grout by circulating from the bottom up, a minimum one (1) inch annular space from the bottom of the borehole to surface should be used if possible.

c. If a temporary casing is used to stabilize the oversized borehole, it should be removed upon completion of grouting procedures.

L. *Well casing.* All casing should be installed with materials in new or like-new condition, free of pits or breaks.

1. Polyvinyl chloride (PVC) and high-density polyethylene (HDPE) casing should be NSF/ANSI approved.

2. Drive-point water wells should be constructed with steel pipe per Table 2, below.

3. The minimum wall thickness listed in Table 2, below, should be used, and all casing greater than the nominal size of eight (8) inches should have a minimum wall thickness of at least 0.250 inches:

Table 2. Minimum Well Casing Dimensions

Material	Nominal Size: Inside Diameter, I.D., Inches	Outside Diameter, O.D., Inches	Wall Thickness, Inches	Rating
Steel	1-1/4 (drive pipe)	1.66	0.140	Schedule 40
Steel	2 (drive pipe)	2.375	0.154	Schedule 40
Steel	4	4.5	0.237	Schedule 40
Steel	5 (casing)	5.563	0.237	Schedule 40
Steel	5 (liner)	5.563	0.188	Schedule 20
Steel	6	6.625 (6 5/8”)	0.250	Schedule 30
Steel	8	8.625 (8 5/8”)	0.250	Schedule 20
PVC	4	4.5	0.248	Schedule 40
HDPE	4	4.5	0.265	125 psi

4. *Joints.* All casing joints should be screw-coupled, welded, or glued, and should be watertight.

a. Welded joints should be at least as thick as the thickness of the well casing and should consist of a minimum of two (2) welding passes.

7.L.4 (Continued)

b. All glue bonding materials should be NSF/ANSI approved.

5. *Well casing stick up.* All well casing should extend a minimum of two (2) feet above the finished grade, with the ground sloped to drain away from the casing if possible, unless local conditions suggest a different height, less or greater but at least one (1) foot above finished grade, to protect the well from freezing or flooding.

6. *Perforating or slotting.* Perforating or slotting of the casing utilized for the purpose of allowing water to enter the well from producing zones encountered above the bottom of the casing should not extend higher than thirty (30) feet BGS. The local areal experience exception from Section 7.E may apply for use of shallow water.

7. *Drive shoe.* When the casing is driven or otherwise forced into the borehole, the bottom of the casing should be protected from damage by the use of a drive shoe.

M. *Well screen*. Where geologic conditions are such that the well must be completed to draw from a sandy aquifer, or where greater water production is desired, installation of a well screen should be considered to control sand pumping by the production well pump. The commercial installation of well accessories should be performed by a well driller or pump installer and includes the following:

1. Premium quality well screens should consist of v-wire wrapped, welded construction, of stainless steel or plastic.

2. An accessory consisting of slotted PVC, HDPE, or steel pipe may be adequate.

3. The well screen assembly should include a minimum of two (2) feet of equivalent sized riser pipe topped with an appropriate well packer and having a closed bottom.

4. The slot or opening size should be selected to hold back at least the largest 30% to 50% of the aquifer grains, depending on the size uniformity of the aquifer grains.

5. Where formation material is extremely fine – too fine for a well screen commonly used in Alaska, a pre-packed well screen or filter pack completion may be necessary. Those options are best utilized under the guidance of a groundwater professional.

6. Drive-point water wells should consist of stainless steel wire-wrapped construction and should be installed in locations as described in Section 6.

N. *Well disinfection.* Wells should be disinfected as follows:

7.N (Continued)

1. *New, rehabilitated, or deepened wells.* Immediately after completion of drilling, rehabilitating, deepening, or servicing a well, the well should be disinfected. After the well is flushed of drill cuttings, apply a chlorine compound proportioned to provide a concentration of at least fifty (50) parts per million (ppm) as free chlorine to the entire volume of water in the well and borehole. The chlorine should be introduced into the well in a manner which should distribute it throughout the entire water depth. Allow the chlorinated water to remain in the well undisturbed for at least six (6) hours.

2. *Hydrofractured (as done by "well fracturing") or redeveloped wells.* While redeveloping or hydrofracturing wells, and when possible, a free chlorine residual in the well of at least five (5) ppm should be maintained.

3. *Flushing.* After the required disinfection time has elapsed, the well should be flushed of all chlorinated water before being placed into service.

O. *Well seal.* If no further work is to be done on the well, the top of the casing should be closed with a sanitary well cap or watertight well seal of a type approved by the State and NSF/ANSI.

P. *Well identification.* All wells should be labeled with a durable form of construction information upon completion. The construction information source should be secured to the well casing and contain the following information:

1. The name of the well driller, pump installer, and business affiliations;
2. The date the well was completed;
3. The total well depth;
4. The total depth of casing;
5. The location and type of well completion;
6. Static water level (SWL) below the top of the casing;
7. Well yield; and
8. Height of casing above finished grade.

Q. *Well log (Record of Construction) and as-built.* The well driller should provide a well log to the owner within thirty (30) days of completion of the well. The well log is an important record that should be carefully filed and kept with other important property documents. To assist, a form is available from the Alaska Department of Natural Resources (ADNR), https://dnr.alaska.gov/, 907-269-8400. The well log should include at least the following pertinent information:

1. The property owner's name;
2. Drilling fluid/circulation method;
3. The legal description and street address;
4. The method of drilling (rotary, cable tool, etc.);

7.Q (Continued)

5. A description, relative depth, and thickness of each formation layer penetrated from the ground surface to total borehole depth;
6. The relative depth and thickness of each water bearing formation layer (aquifer) penetrated;
7. The total depth drilled;
8. Grout depth and description;
9. The length, diameter, wall thickness and type of casing used;
10. A description of the liner (if used) and the length and setting depth;
11. The depth and number of well perforations, (if any) in the casing and/or liner;
12. The type and location of any well screens used;
13. The SWL and drawdown (DD) level;
14. Well development method;
15. The well yield test data and results, including the method of testing;
16. Anticipated use;
17. The dates of commencement and completion of drilling operations;
18. The name and address of the well driller; and
19. A description of the method of disinfection process used upon completion of the well.

8 Best Practices: Installation of Water Pumps for Non-Public Water Wells

A. *Pitless adapters.* Pitless adapters should be installed by a pump installer, a well driller or by an excavator under the supervision of a pump installer or well driller. The burial depth and type of pitless adapter installed should be recorded on the pump install log. When installed, pitless adapters should be one of the types approved by NSF/ANSI.

B. *Well seal.* The top of the casing should be closed with a sanitary well cap or watertight well seal of a type approved by the State and NSF/ANSI.

C. *Pump (aka well pump)*. The pump intake should be located beneath the maximum anticipated water pumping level at the maximum desired pumping rate and the pump should be sized to meet the maximum desired pumping rate and total dynamic head requirement of the water system.

    1. If well capability does not meet the maximum desired pumping rate (which usually occurs during the peak water demand periods of 6:00 AM to 8:00 AM and 6:00 PM to 8:00 PM), additional water storage facilities and/or water use reduction measures should be considered.

D. *Riser pipe.* It should be made of galvanized steel, PVC or HDPE.

E. *Well cable.* It should be rated for water submersion and sized to safely accommodate the voltage, current flow, and distance from the pump motor to the power source. Submersible well cable is not suitable for underground burial.

8 (Continued)

F. *Well yield testing.* Upon completion of a well, if the estimated producing rate assessed during drilling appears to be less than three (3) gallons per minute (GPM), a well yield test of adequate duration should be performed to verify the estimated long-term capacity, taking into account possible fluctuations due to seasonal differences or by other causes. The test should be performed by, or under the direction of, a groundwater professional using one or more of the following practices and by recording the following data measurements:

1. Bailing, air lift, submersible pumping, or recovery rate measurement procedures.

2. Record accurate measurements of the following:

    a. Well production or pumping rate (in GPM);
    b. SWL;
    c. Pumping water level or DD from SWL;
    d. Duration of pumping (elapsed time);
    e. Recovery rate; and
    f. Any other information useful in determining the estimated producing rate.

3. If at the time of the well yield test, the minimum estimated producing rate and/or recovery rate of a well is less than one-hundred and fifty (150) gallons per day (GPD) per bedroom of the household to be supplied, water storage facilities should be considered. If the non-public water well is to be used for purposes other than domestic household support, it is the owner's responsibility to determine the adequacy of the well for its intended use.

G. *Pump work.* Upon completion of pump installation work, a chlorine compound proportioned to provide a concentration of at least fifty (50) ppm as free chlorine to the entire volume of water in the well and borehole should be applied. After chlorine is introduced, water should be circulated in the well so it reaches all parts of the pump equipment, inside and out. The chlorinated water should remain in the well for at least six (6) hours.

H. *Flushing.* After the required disinfection time has expired, the well should be flushed of all chlorinated water before being placed into service.

I. *Pump install log (Record of Commissioning).* The pump install log is an important record that should be carefully filed and kept with other important household documents. The pump installer or well driller should provide a pump install log to the owner within thirty (30) days of completion of the installation of a pump into a water well. The pump install log should include at least the following pertinent information:

1. The property owner's name;
2. The legal description and street address of the property;

8.I (Continued)

3. The date of the pump installation;
4. The manufacturer's name, model, size and voltage of the pump installed;
5. The depth from the top of casing that the pump is installed;
6. The name and address of the pump installer, well driller or excavator; and
7. A description of the method of disinfection used.

9 Initial Water Sampling and Corrective Actions

Water samples should be collected from the well and analyzed in order to establish baseline water quality as well as to identify potential water quality issues prior to putting the well into service. Sampling should be done by, or under the guidance of, a groundwater professional using a water testing State-certified laboratory.

A. *Water quality testing.* Drinking water from the well should be properly sampled and subsequently analyzed for levels of total coliform, other bacteria, arsenic and nitrates. The levels of total coliform and other bacteria should conform to drinking water limits established in Alaska Administrative Code 18 AAC 80. For other contaminants, including arsenic and nitrates, the groundwater professional should use the current United States Environmental Protection Agency (USEPA) public drinking water standards as a guideline to trigger actions deemed necessary to protect public health.

B. *Water quality standards.* Water used for domestic purposes should not contain concentrations exceeding the following ratios:

1. Total coliform – 0 colonies per 100 milliliters (mL).
2. Other bacteria – 10 colonies per 100 mL.
3. Nitrates – 10 milligrams per liter (mg/L)
4. Arsenic – 0.010 mg/L (10 micrograms per liter, µg/L)

C. If sampling results show the nitrate concentration in the well water greater than 10.0 mg/L, the following steps should be taken:

1. A visual inspection of the well and borehole, using a down-hole camera, performed by a groundwater professional should be used to evaluate the integrity of the casing and if the well is cased, without well perforations, to the total well depth or depth of obstruction.

2. An evaluation of the sanitary ground seal in the annular space around the well casing should be performed by a groundwater professional.

3. If producing zones with greater than 10.0 mg/L nitrates are found below the well casing and there are also other producing zones with less than 10.0 mg/L nitrates, the well should be retrofitted to eliminate cross-connection between the producing zones.

9.C (Continued)

4. If the well casing or sanitary ground seal in the annular space around the well casing is determined to be inadequate or unsatisfactory, or if cross-connections between producing zones are found, the well should be repaired or modified to meet current well construction practices or the well should be decommissioned in accordance with the "ALASKA BEST MANAGEMENT PRACTICES FOR MAINTAINING OR DECOMMISSIONING WATER WELLS AND BOREHOLES".

10 Well Decommissioning

Wells should be decommissioned in accordance with the "ALASKA BEST MANAGEMENT PRACTICES FOR MAINTAINING OR DECOMMISSIONING WATER WELLS AND BOREHOLES".

11 Important Considerations

In order to maximize the protection of Alaska's aquifers and drinking water, it is highly recommended any action taken to construct a well follow the best management practices laid out in this document. If you reside in a municipality, borough, or other organized area, please check with your local government for any additional guidance, regulations, or requirements.

A. Do not place, or allow the placement of, any refuse, trash, waste, or contaminated or hazardous substance into any existing or abandoned well or water source, and deter others from doing the same.

B. The location of a well, on-site wastewater disposal system or subsurface drain, either separately or in combination with each other and other wells, on-site wastewater disposal systems or subsurface drains in the vicinity, should not have the effect of prohibiting future use of an adjacent lot or parcel. To ensure that the well is properly located with respect to the surrounding land owners, prior to installation of a well, obtain an agreement and necessary easements with the owner(s) of any affected adjoining property for the sharing of a well or other possible and unforeseeable problems. The agreement should be recorded and carefully filed and kept with other important household documents.

C. Do not cause or allow the construction, installation or use of a cross-connection between a public water system and a non-public water system well, be it active, abandoned, or improperly decommissioned.

D. Well pits should not be used in new construction in order to avoid the possibility of flooding and inadvertently contaminating the aquifer. It is important that existing well pits be properly maintained and have adequate protection against flooding.

E. Free-flowing wells of any kind, whether by surface or underground discharge, cause water to be wasted and should be avoided and/or remediated. A high priority should be

11.E (Continued)

placed on addressing and resolving any problem with free-flowing wells under the guidance of a groundwater professional experienced in the remedy of such conditions.

12 References (the most recent version should be referenced)

Alaska Administrative Code 11 AAC 93, *Water Management*.

Alaska Administrative Code 18 AAC 80, *Drinking Water*.

Alaska Department of Environmental Conservation (ADEC), Division of Spill Prevention and Response, Contaminated Sites Program, *Monitoring Well Guidance*.

Alaska Statute, 46.15 *Water Use Act*.

ANSI/AWWA A100, Water Wells, and Appendix to ANSI/AWWA Standard A100 (*Decommissioning of Test Holes, Partially Completed Wells, and Abandoned Completed Wells*).

Great Lakes – Upper Mississippi River Board (GLUMRB) of State and Provincial Public Health and Environmental Managers, Ten States Standards, *Recommended Standards for Water Works*.

Municipality of Anchorage (MOA), Water and Wastewater System Codes, Chapter 15.55 *Water Wells*.

National Ground Water Association (NGWA), May 2014, ANSI/NGWA-01-14, *Water Well Construction Standard*.

Private Drinking Water Wells & Systems, https://dec.alaska.gov/eh/dw/dwp/private-wells/ web site hosted by Alaska Department of Environmental Conservation (ADEC).

Sterrett, Robert. J., 2007, *Groundwater and Wells*, 3rd ed., Johnson Screens, New Brighton, Minnesota, 812 pp.

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD), Home Ownership Center (HOC), *Appraisal & Property Requirements, Water Systems*.

U.S. DEPARTMENT OF VETERANS AFFAIRS (VA), *Minimum Property Requirements (MPRs), Water Supply and Sanitation Facilities*.

CONSTRUCTION OF NON-PUBLIC WELLS

Appendix

A. Definitions
   See "Definitions for 'ALASKA BEST MANAGEMENT PRACTICES FOR MAINTAINING OR DECOMMISSIONING WATER WELLS AND BOREHOLES' and 'ALASKA BEST MANAGEMENT PRACTICES FOR THE CONSTRUCTION OF NON-PUBLIC WATER WELLS'"

BMP DEFINITIONS

Definitions for
"ALASKA BEST MANAGEMENT PRACTICES FOR MAINTAINING OR DECOMMISSIONING WATER WELLS AND BOREHOLES"
and
"ALASKA BEST MANAGEMENT PRACTICES FOR THE CONSTRUCTION OF NON-PUBLIC WATER WELLS"

1 Purpose

To provide definitions to words, terms, and phrases used in the best management practices in which this document is referenced.

2 Updates and Alterations

Future changes to this document should be done after review and approval by a committee (similar to the original Groundwater Protection and Water Wells Stakeholder Workgroup) composed of representatives from the public, industry groundwater professionals, and appropriate state agency staffs.

3 Definitions

The following words, terms, and phrases have the meanings given to them in this document, except where the context clearly indicates a different meaning.

AAC—Alaska Administrative Code.

Abandoned—a water well or borehole whose use has been discontinued and that has not been properly decommissioned or maintained in accordance with "Alaska Best Management Practices for Maintaining or Decommissioning Water Wells and Boreholes."

ADEC—Alaska Department of Environmental Conservation.

ADNR—Alaska Department of Natural Resources.

Air lift ("airlift")—the use of compressed air to remove (lift) a fluid or material from a borehole or excavation.

Animal containment area—any outdoor enclosure or group of enclosures containing one (1) or more horse, mule, cow, lama, or similar sized animal; four (4) or more dogs, sheep, goats, or swine, or similar sized animals; ten (10) or more rabbits, fowl, ferrets, or other domesticated small animals.

Annular space ("annulus")—the void space between the outside of the well casing and the side wall of the drilled borehole, between two casings or between a casing and a liner.

Annulus ("annular space")—the void space between the outside of the well casing and the side wall of the drilled borehole, between two casings or between a casing and a liner.

ANSI—American National Standards Institute.

BMP DEFINITIONS

Arsenic—a metallic element (heavy metal) that even at low levels over a relatively long period of time can have long-term (chronic) health effects. Arsenic occurs naturally in rocks and soil, but other sources may be from industrial and agricultural uses.

ASTM—American Society for Testing and Materials.

Aquifer—a formation, a group of formations, or part of a formation that is sufficiently saturated and permeable to yield significant quantities of water to wells and springs.

Aquifer—unconfined ("unconfined aquifer")—a condition of the aquifer in which atmospheric pressure is freely communicated to the aquifer and where the aquifer has no upper confining layer. The static water level within the aquifer is at atmospheric pressure and does not rise above the aquifer's upper limit.

Aquifer—unconsolidated ("unconsolidated aquifer")—a type of aquifer that is primarily composed of loose grains of sediment (e.g., silt, sand, gravel, or combinations).

Aquifer—confined ("artesian")—a condition of the aquifer in which it is isolated from the atmosphere by a confining layer or group of confining layers. The static water level in a confined aquifer is generally subject to pressure greater than atmospheric and rises to a level above the aquifer's upper limit.

Aquifer—consolidated ("bedrock")—a type of aquifer that is primarily composed of solidified groups of grains of sediment (e.g., siltstone, sandstone, conglomerate, or combinations), or solid crystalline rock with fractures, cracks, or voids (e.g., limestone, volcanic rock, etc.).

Aquitard ("confining layer")—a layer in the subsurface that may store water but is not permeable, which may include permafrost; and therefore, does not yield water to a well or spring.

Artesian—a confined aquifer condition in which the static water level in a well or borehole is above the aquifer's upper limit; to be differentiated from *flowing* artesian (see definition for "flowing artesian").

Bacteria (*singular*: bacterium)—a microorganism that comes in a variety of shapes. Some bacteria in drinking water can cause short-term (acute) health effects. See also definitions for "coliform bacteria", "fecal coliform", and "total coliform".

Bailing—the use of a cylindrical pipe device (with a bottom valve) suspended on a line to remove fluid or material from a borehole or excavation.

Bentonite—a naturally occurring montmorillonite aluminum silicate clay. As a commercial product bentonite comes in the form of powder, granules (8- to 20-mesh size), chips (¼ inch to ¾ inch size), or pellets (¼ inch to ½ inch size) approved by NSF/ANSI for use as grout in water wells.

BMP DEFINITIONS

Bentonite grout slurry—a high-solids mixture of bentonite particles and water with a consistency of 18 percent to 30 percent solids.

Best Management Practices—Those practices proven effective through research and field applications in Alaska.

BGS—below ground surface; "BLS" is also used, which means "below land surface."

BMP—Best Management Practice.

Borehole ("wellbore")—a hole bored into the ground and intended to be constructed for extraction of water, for water exploration, for cathodic protection, for geotechnical holes and wells, or for a ground source heat pump installation.

Bridge-free—the manner by which sealing materials are placed in a well or borehole, such that individual particles are allowed to settle to the full intended depth without prematurely clumping or sticking.

Casing ("pipe")—pipe made of material herein specified as ASTM A-53 Grade B (ASTM A-53B) steel or NSF/ANSI approved PVC or HDPE installed in a well borehole to prevent sidewall caving, to provide access to an aquifer, and to provide protection from up-hole or surface contamination of the aquifer.

Caving ("sloughing")—to fall or collapse into a borehole.

Certified laboratory—a laboratory certified by the State of Alaska.

Coliform bacteria—a set of bacteria that are found in the digestive systems of warm-blooded animals, in soil, on plants, and in surface water. Some coliform bacteria in drinking water can cause short-term (acute) health effects. See also definitions for "bacteria", "fecal coliform", and "total coliform".

Confined aquifer ("aquifer—confined"; "artesian")—a condition of the aquifer in which it is isolated from the atmosphere by a confining layer or group of confining layers. The static water level in a confined aquifer is generally subject to pressure greater than atmospheric and rises to a level above the aquifer's upper limit.

Confining layer ("aquitard")—a layer in the subsurface that may store water but is not permeable, which may include permafrost; and therefore, does not yield water to a well or spring.

Consolidated aquifer ("aquifer—consolidated"; "bedrock")—a type of aquifer that is primarily composed of solidified groups of grains of sediment (e.g., siltstone, sandstone, conglomerate, or combinations), or solid crystalline rock with fractures, cracks, or voids (e.g., limestone, volcanic rock, etc.).

BMP DEFINITIONS

Contaminant—a physical, chemical, biological, or radiological substance or material in water that, in sufficient quantity, makes water unfit for human consumption.

Contamination—the presence of a contaminant, or group of contaminants.

Cross-connection—joining of two or more zones, areas, or systems.

Cross-contamination—a cross-connection with a contaminated substance.

Cuttings ("drill cuttings")—the loose material derived from the original (in place) material by the drilling process.

DD—drawdown.

Decommission—to fill or plug a well so that it is rendered unproductive and does not produce water or serve as a channel for water movement or for the movement of contaminants.

Discharge—a release, emission, or pouring forth of fluid or material.

Disinfection—a process that inactivates pathogenic organisms in water by chemical oxidants or equivalent agents.

Domestic use—water not used for a public water system.

Drawdown (DD)—the distance between the static water level and the pumping water level in a well or an aquifer; will vary with the pumping rate.

Drill cuttings ("cuttings")—the loose material derived from the original (in place) material by the drilling process.

Drilling fluid—a freshwater or air based liquid used during the drilling operation to circulate materials (cuttings) from the borehole.

Drive-point (also called "sand-point"; "well-point") water well—a shallow (usually less than 50 feet deep) small-diameter water well (1-1/4-inch to 2-inch nominal inside diameter) consisting of coupling-connected pipe fitted with a perforated or screened section and a steel point at the end, and driven into the ground.

Drive shoe—a forged or tempered steel collar with a cutting edge, attached to the lower end of a casing string by threading or welding, to protect the bottom end of the casing as it is driven, rotated, or otherwise forced into the borehole.

Dry grout method—the method of grouting the annular space outside of the casing by keeping bentonite granules (NSF/ANSI approved) pooled around the casing in a cone-shaped depression so they follow the casing as it is driven.

BMP DEFINITIONS

Engineer ("groundwater professional")—a licensed professional civil, mechanical, or environmental engineer registered pursuant to Alaska Statue 8.08. Considered here as a "groundwater professional" when has demonstrated work experience and/or educational background in groundwater issues and construction.

EPA ("USEPA")—United States Environmental Protection Agency.

Fecal coliform—a type of coliform bacteria included in total coliform that originates in feces from warm-blooded animals. Some fecal coliform in drinking water can cause short-term (acute) health effects, such as Escherichia coli (E. coli), and may also be an indicator of the presence of other pathogens. See also definitions for "bacteria", "coliform bacteria", and "total coliform".

FHA—Federal Housing Administration.

Filter pack ("sand pack"; "gravel pack")—the development of a well by the addition of sand or gravel, in the annulus outside of a well screen or a slotted liner, to stop or slow the production of finer material from the aquifer and/or to improve the well production by allowing the use of a larger screen or liner slot size; sometimes placed inside the well casing or liner to stop or slow the production of finer material from the aquifer.

Flowing artesian—a confined aquifer condition in which the static water level in a well or borehole is above the ground surface or the top of well casing; to be differentiated from an artesian condition that is not *flowing* (see definition for "artesian").

Formation—a layer, or group of layers, of sediment or rock within the subsurface that can be unconsolidated, consolidated, or a combination.

Formation packer—a device which prevents water flow within the annular space between the surrounding formation and the well casing or liner.

Free chlorine—a chlorine by itself; as a separate element; not bound with other elements in a compound.

Free chlorine residual—that chlorine remaining after part of the original amount has been removed by the process.

GPD—gallons per day.

GPH—gallons per hour.

GPM—gallons per minute.

Gravel pack ("filter pack")—a type of filter pack.

BMP DEFINITIONS

Groundwater—any water, except capillary moisture, beneath the land surface or beneath the bed of a stream, lake, reservoir, or other body of surface water, regardless of the formation in which the water stands, flows, percolates, or otherwise moves.

Groundwater professional—well drillers, pump installers, hydrogeologists, geologists, and engineers with demonstrated work experience and/or educational background in groundwater issues and water well construction.

Grout—a stable bentonite clay material that is NSF/ANSI approved, in a slurry or granular form impervious to and capable of preventing the vertical movement or migration of water.

Grouting or grouted—the act of installing grout.

Hazardous substance—those substances that, because of quantity, concentration, or physical/chemical/infectious characteristics, may pose a threat to human health or to the environment when treated, handled, stored and transported, and/or disposed of. Hazardous substances include those defined as hazardous under federal, state and municipal laws.

Holding tank—a watertight covered receptacle designed and built to receive and store domestic wastewater for disposal at another location.

Human consumption—the use of water for drinking, bathing, showering, cooking, dishwashing, maintaining oral hygiene, and other similar uses.

Hydrogeologist ("groundwater professional")—a professional geologist, certified and licensed by the State of Alaska pursuant to Alaska Statute 08.02.011, who practices groundwater science.

Intake—opening in a well or pump into which water enters or is drawn.

Liner—casing, of a smaller size, installed inside another casing; may be slotted or perforated adjacent to the water producing zone(s).

Manure/animal excreta—solid waste from domesticated animals, and for the purposes of these practices, shall also mean bedding or other materials contaminated by animal liquid or solid wastes.

Manure/animal excreta storage area—any area where such material is being stored, temporarily or permanently, or being composted.

Microorganism ("microbe")—a small (often microscopic) life form such as bacteria, algae, diatoms, parasites, plankton, and fungi. Some may cause disease.

Monitoring well ("observation well")—an existing or abandoned water well, or a newly cased excavation or opening into the ground constructed by digging, boring, drilling, driving, jetting or other methods for the purpose of determining the physical, chemical, biological, or radiological properties of groundwater.

BMP DEFINITIONS

Nitrate—a chemical compound that, for very young children, taking in high levels in drinking water over a relatively short period of time can cause serious health effects. Sources of nitrates may be natural, but may also include fertilizers, animal feed lots, manures, sewage, septic systems, industrial wastewater, sanitary landfills, and garbage dumps.

Non-public water [system] well—a water well that does not meet the definition given for a "public water system well". This includes wells used for the following purposes: private or domestic water supply; livestock or irrigation; recreational purposes; ground source heat pump return, injection, or vertical loops; industrial process water, or machine or process cooling water; dewatering wells; or dam or levee relief wells.

NSF—National Sanitation Foundation.

Observation well ("monitoring well")—an existing or abandoned water well, or a newly cased excavation or opening into the ground constructed by digging, boring, drilling, driving, jetting or other methods for the purpose of determining the physical, chemical, biological, or radiological properties of groundwater.

On-site wastewater disposal system—any wastewater storage, treatment, or disposal system that serves a facility located on a lot which is not connected to a public sewer.

Pathogen—an infectious biological agent, such as a virus or bacterium, that causes disease or illness.

PPM—parts per million.

Pipe ("casing")—the steel pipe made of material herein specified as ASTM A-53 Grade B (ASTM A-53B) and NSF/ANSI approved PVC or HDPE installed in a well borehole to prevent sidewall caving, to provide access to an aquifer, and to provide protection from up-hole or surface contamination of the aquifer.

Pitless adapter—an NSF/ANSI approved device attached to the well casing, constructed to permit the flow of water from the well casing.

Permafrost—a thick subsurface layer of soil that remains frozen throughout the year.

Permeable—describes the ability for fluids to pass through an aquifer or soils.

Permeability—a measure of a rock or soil's ability to transmit fluid which is a function of porosity, surface area and tortuosity or connectedness of pore space(s).

Potable water—water suitable for human consumption.

Producing zone ("water zone")—the zone of the aquifer that yields water to the well, and is an interval which is usually open to the aquifer (e.g., uncased, screened, perforated, slotted, etc.).

BMP DEFINITIONS

Production (producing) rate—the volume per unit of time (usually GPM) at which a water well gives/yields/produces water.

Protective well radius ("setback"; "separation distance")—a set of prescribed horizontal distances around a water well in which there should be no potential sources of contamination; separation distances may vary depending on the potential source of contamination.

Public sewer system—a sewer system as defined in Alaska Statute 46.03.900, and operated by a public utility as defined in Alaska Statute 42.05.990.

Public water system (PWS)—a water system as defined by ADEC regulations 18 AAC 80, and does not include a private or domestic (non-public) water system.

Public water system (PWS) well—a water well constructed for the purpose of providing water to a "public water system".

Pump ("well pump")—a mechanical device used to recover water from a well or water collection system.

Pump install log ("Record of Commissioning")—a written report or completed form showing all pertinent information and data on pump installation, replacement, repair, or service as specified herein; see ADNR for suggested format.

Pump installer ("groundwater professional")—a contractor, licensed as a construction contractor pursuant to Alaska Statues, or an employee thereof, who works on well pump installation and service; may also be a well driller. Considered here as a "groundwater professional" when has demonstrated work experience and/or educational background in groundwater issues and construction.

Record of Decommissioning ("well decommissioning log")—a written report or completed form showing all pertinent information and data on the decommissioning of the well or borehole as specified herein; see ADNR for suggested format.

Record of Commissioning ("pump install log")—a written report or completed form showing all pertinent information and data on pump installation, replacement, repair, or service as specified herein; see ADNR for suggested format.

Record of Construction ("well log")—a written report or completed form showing pertinent information and data relative to the drilling and completion of the well as specified herein; see ADNR for suggested format.

Recovery—the ability of the water in a well to return to its static level after being drawn down during a period of pumping.

BMP DEFINITIONS

Riser ("riser pipe")—the pipe extending from the well pump to the point of discharge from the well casing.

Sand pack ("filter pack")—a type of filter pack.

Sand pumping—the movement of sand from a formation into the wellbore during water production/flow or well development.

Sanitary ground seal—a subsurface grout seal between the well casing and the borehole wall or surrounding material.

Sanitary well cap ("well seal")—a securely fastened and vented well cap with a gasket, attached to the top of a well casing or pipe sleeve, that prevents insects, dirt, or incidental water or other liquid from entering the well under normal conditions, that allows air to flow in and out of the well, and that is NSF/ANSI approved.

Sealing or sealed—the act of providing a watertight seal between the casing and the borehole, or surrounding material, by means of installing an impervious grout material.

Septic disposal field—an absorption bed, deep or shallow absorption trench, seepage pit, or mound system.

Septic tank—the water tight receptacle designed to receive domestic wastewater and allow the clarified liquids to be discharged into a subsurface soil absorption system.

Separation distance ("setback"; "protective well radius")—a set of prescribed horizontal distances around a water well in which there should be no potential sources of contamination; separation distances may vary depending on the potential source of contamination.

Setback ("separation distance"; "protective well radius")—a set of prescribed horizontal distances around a water well in which there should be no potential sources of contamination; separation distances may vary depending on the potential source of contamination.

Sloughing ("caving")—to fall or collapse into a borehole.

Static water level (SWL)—the level relative to a measuring point (i.e. the top of well casing or ground surface) at which the water stands in or above the well when no pumping or flow is occurring, or has recently occurred.

Stick up—the portion of a well's casing extending above the surface of the ground or floor.

Submersible pump—a complete well pump and motor assembly placed under the water level to pump water up the well to the discharge point.

Surface water—any persistent natural or man-made source of water that is not directly attributable to a single rainfall or snowmelt event. Surface waters include all lakes, ponds,

streams, springs, intermittent or seasonal flows, natural and artificial bodies of water and all of the water of the State of Alaska as defined in Alaska Statue 46.03.900.

SWL—static water level.

Test well—a well constructed for the purpose of testing the viability of an aquifer, such as yield, specific capacity, and quality, to be used for water supply. A test well may be converted to a water well.

TOC—top of casing.

Total coliform—a measure of the presence of coliform bacteria that is used as an indicator of the possible presence of harmful coliform bacteria, such as fecal coliform. See also definitions for "bacteria", "coliform bacteria", and "fecal coliform".

Total dynamic head—the head (pressure) produced by a well pump usually described in feet.

Tremie—

1. (*noun*) A three-part equipment assemblage consisting of a hopper, pipe, and lifting apparatus used for the purpose of installing material such as filter pack, backfill, or grout into an excavated space, borehole, well, or annular space;
2. (*verb*) To install material through a tremie pipe.

Unconfined aquifer ("aquifer—unconfined")—a condition of the aquifer in which atmospheric pressure is freely communicated to the aquifer and where the aquifer has no upper confining layer. The static water level within the aquifer is at atmospheric pressure and does not rise above the aquifer's upper limit.

Unconsolidated aquifer ("aquifer—unconsolidated")—a type of aquifer that is primarily composed of loose grains of sediment (e.g., silt, sand, gravel, or combinations).

USEPA ("EPA")—United States Environmental Protection Agency.

VA—United States Department of Veteran's Affairs.

Wastewater—water containing human excreta, food waste, wash water and other wastes commonly discharged into a water-carried sewage disposal system, and such diluting water as may have entered the waste disposal system. Wastewater does not mean liquids containing hazardous wastes as defined by federal, state, or municipal law.

Water storage facilities—includes water storage tank(s), pumps and piping used in the storage of potable water.

Water storage tank—a watertight covered receptacle designed and built to receive and store clean and/or potable water.

BMP DEFINITIONS

Water table—a groundwater surface within an unconfined aquifer where the water pressure is equal to atmospheric pressure.

Water well ("well")—an excavation, opening, shaft, or hole constructed for the purpose of water extraction.

Water well driller ("well driller"; "groundwater professional")—a contractor, licensed as a construction contractor per Alaska Statutes, or an employee thereof, who works on the construction of water wells; may also perform pump installation and service work.

Water zone ("producing zone")—the zone of the aquifer that yields water to the well, and is an interval which is usually open to the aquifer (e.g., uncased, screened, perforated, slotted, etc.).

Watertight well seal ("well seal")—a device that is securely attached to the top of a well casing or pipe sleeve that prevents the entrance of water even when submerged, such as by flood water.

Well ("water well")—an excavation, opening, shaft, or hole constructed for the purpose of water extraction.

Well cable—the electrical cable extending from the submerged well pump that passes through the well seal and is attached to the surface electrical source.

Well decommissioning log ("Record of Decommissioning")—a written report or completed form showing all pertinent information and data on the decommissioning of the well or borehole as specified herein; see ADNR form for suggested format.

Well depth—the depth of the completed well as measured from the top of casing, unless specified otherwise.

Well driller ("water well driller"; "groundwater professional")—a contractor, licensed as a construction contractor per Alaska Statutes, or an employee thereof, who works on the construction of water wells; may also perform pump installation and service work.

Well fracturing—a water well stimulation technique used to improve the flow of water into a low-yield well by injecting potable water under pressure into the well (also called "hydraulic fracturing", "hydrofracturing", "hydrofracking, or "fracking"), or using explosives in a well (also called "explosive fracturing", "explofracturing", "explofracking", "well shooting", or "well blasting"), to open fractures in the surrounding bedrock aquifer.

Well log ("Record of Construction")—a written report or completed form showing all pertinent information and data relative to the drilling and completion of the well as specified herein; see ADNR for suggested format.

Well packer—a device attached to a liner, drop pipe, or well screen riser to prevent flow within the annular space.

BMP DEFINITIONS

Well perforation(s) (casing, pipe or liner perforation)—a slot(s) cut into the casing to allow water to move through the well, or to allow seal material to fill the annular space; before-wellbore-installation slot cutting methods include gas torch, plasma arc, and machine milling; after-wellbore-installation slot cutting methods include using a downhole perforation tool and explosive perforation charges.

Well pit—an excavation, opening, shaft or hole surrounding a well.

Well pump ("pump")—a mechanical device used to recover water from a well or water collection system.

Well redevelopment—subsurface well work designed to improve well yield; example procedures include: surging (air or mechanical surge block), over-pumping ("rawhiding"); back-flush/rawhide cycling, jetting (air or water), chemical treatments, and well fracking.

Well rehabilitation—subsurface well work designed to repair, improve and/or rejuvenate the physical features of a well; examples include: perforations, lining, swaging, re-drilling, scraping and cleanouts, install screens, pull and reinstall screens, install and filter-pack smaller screens inside existing screens or perforations, chemical treatments and well fracking.

Well screen(s)—a filtering device(s) installed in a well to prevent excess sediment from entering and allow water to move through the well while keeping out most sand and gravel; most commonly used types are V-wire wrapped continuous slot, pipebased, and shutter screens.

Well seal—a "watertight well seal" or "sanitary well cap".

Well yield test ("pump test")—a test to determine the producing capability of the well, drawdown and recovery rate/time of the well.

Well yield—the producing rate of a well on a given date as determined by a well test; often described as a rate in gallons per minute (GPM) with the amount of drawdown (DD) at that rate.

Wellbore ("borehole")—a hole bored into the ground and intended to be constructed for extraction of water, for water exploration, for cathodic protection, for geotechnical holes and wells, or for a ground source heat pump installation.