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# Monitoring and Operational Guidance Handbook for Colorado Public Water Systems Utilizing Hand Pumped Wells Which Do Not Provide Continuous Disinfection

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Colorado Department  
of Public Health  
and Environment

*This guidance handbook is provided by the State of Colorado for Public Water Systems and addresses requirements for the treatment of public water supplies. This handbook offers guidance to systems to ensure compliance Article 9, Treatment of Public Water Supplies, of the Colorado Primary Drinking Water Regulations. ASSOCIATE DOCUMENTS: Colorado Primary Drinking Water Regulations; WQCD Policy DWTR-6; and U.S.D.A. Operation and Maintenance Manual for Hand Pumped Wells-2<sup>nd</sup> Edition.*

# Monitoring and Operational Guidance for Colorado Public Water Systems Utilizing Hand Pumped Wells Which Do Not Provide Continuous Disinfection

- 1.0 Purpose:** To develop an operating procedure that must be used for public water systems that use hand pumps and do not provide continuous disinfection, which will allow their continued operation while protecting the public from microbiological contaminants.
- 2.0 Applicability:** These procedures apply to transient, non-community public water systems using ground water from hand pumped wells that can not provide treatment by means of continuous disinfection and do not meet the Division's "Disinfection Waiver" criteria. Systems operated and maintained in accordance with this guidance will be determined to be in compliance with Article 7.6 of the Colorado Primary Drinking Water Regulations. Failure to follow these procedures is cause for requiring continuous disinfection or closing of the well.
- 3.0 Background:** Hand pumped wells are typically shallow wells that do not have a mechanical means for providing continuous disinfection of the well water. Hand pumped wells are utilized by small, transient non-community public water systems such as campgrounds. Historically, transient non-community water systems have had a microbiological sampling/testing frequency of once per quarter, during the period of time that the system is open to the public. CDPHE water quality records document microbiological MCL violations at many hand pump well systems, indicating that the improved procedures provided by this document are necessary to protect the health of consumers.
- 4.0 Procedures:** Periodic evaluation of water source, proper sampling and testing, and frequent inspections of hand pumped wells, along with appropriate corrective actions, are required to assure the long-term quality and safety of drinking water. All Regulation 100 Operator duties shall be performed by the Operator-in-Responsible Charge (O.R.C.) or by a person trained by and under the supervision of the O.R.C. To avoid monitoring violations CDPHE should be notified whenever a public water system is temporarily or permanently closed.
- 4.1 Source Evaluation**
- 4.1.1 Ground Water Under the Direct Influence of Surface Water (GUDISW):** All wells, and other ground water sources that are constructed with a first draw at a depth of less than 100 feet or are located less than 100 feet from a surface body of water shall have at least one Microscopic Particulate Analysis (MPA) performed on the well water. The MPA testing method shall be in accordance with *WQCD Policy DWTR-6*, with the following modification. Typically, the MPA sampling protocol requires that 1000 gallons of water be filtered thru a 1-micron filter. The 1000-gallon sample size is impractical for the purposes of evaluating hand pumped wells. The sample volume may be reduced to a minimum of 50 gallons provided that the sampler contacts the MPA laboratory and set up special provisions for the 50-gallon sample. The MPA test shall be performed once every three years during the spring, prior to seasonal start-up. If the results of the MPA show the source to be under the direct influence of surface water (high or moderate risk) the source shall not be put into use until the water is properly treated (see CDPHE Policy DWTR-6). The Public Water Supplier may apply for less frequent MPA testing with other evidence that supports the absence of surface water influence.

4.1.2 **Microbiological Quality:** The minimum routine sampling and analysis frequency for sources utilizing hand pumped wells shall be bi-weekly or once every month (see 4.2 below). Microbiological samples must be analyzed by a CDPHE certified laboratory and all routine and repeat sample results must be submitted to the CDPHE in accordance with the Colorado Primary Drinking Water Regulations. For seasonal operations, at least one Special Purpose sample must be taken to ensure it tests total coliform-negative. The sample should be taken after completion of start-up procedures but prior to providing water to consumers. A sample will be considered a Special Purpose sample if it is designated so on the sample form prior to being submitted to the laboratory. The first routine sample of the season shall be taken during the first week that the system is open for public use. Special Purpose sample results do not need to be submitted to CDPHE, but must be available for inspection during a sanitary survey. Repeat monitoring, fecal coliform/E coli testing, analytical requirements, and response to violations shall be in accordance with the Colorado Primary Drinking Water Regulations.

**Additional Response to Positive Microbiological Result:**

- a) If the routine microbiological sample is total coliform positive, but not fecal coliform or E-coli positive, collect four repeat samples. The first sample should be collected as soon as possible, but no later than 24 hours of receiving notice of a positive result. The remaining samples may be collected on the same day or over a four-day period. If the results of the four repeat samples show absence of bacteria, the well may remain open for public use. If any of the repeat samples are total coliform positive, the well shall be taken out of service by removing the pump handle to prevent public access as soon as possible, but no later than 24 hours after receiving notice of a repeat sample positive result. The well shall be disinfected and retested according to c) below.
- b) If any routine microbiological sample result is fecal coliform or E-coli positive, collect four repeat samples as soon as possible, but no later than 24 hours of receiving notice of a positive result. The well shall be taken out of service by removing the pump handle to prevent public access as soon as possible, but no later than 24 hours of receiving notice of a positive routine microbiological result. The well shall be disinfected and retested according to c) below.
- c) After any fecal coliform/E-coli positive routine sample or positive total coliform repeat sample, the well must be disinfected, flushed and re-tested prior to opening to the public. After disinfecting, the well must be flushed (i.e. pumped) until the free chlorine residual is undetectable. Chlorine residual must be measured with an approved chlorine test kit. Take four (4) repeat samples (or one (1) 400 ml sample) and remove the pump handle until the results are received. If the repeat sample(s) is absent of bacteria, the well may be opened for public use. If any repeat sample is total coliform positive, keep the well closed and request a sanitary survey to identify the source of contamination. Issues identified during the Sanitary Survey must be corrected. Disinfect and flush the well, then take four (4) repeat samples (or one (1) 400 ml sample). If the repeat sample(s) is absent of bacteria, the well may be opened for public use.
- d) If any routine sample is total coliform/E-coli positive take five routine samples during the next month the well provides water to the public with the first routine sample taken within the first week of the month.

4.1.3 **Nitrate and Nitrite Quality:** The minimum routine sampling and analysis frequency for sources utilizing hand pumped wells shall be once per year. Nitrate and nitrite samples must be analyzed by a CDPHE certified laboratory and all routine and confirmation sample results must be submitted to the CDPHE in accordance with the Colorado Primary Drinking Water Regulations. The samples shall be taken prior opening the source for public use, typically during the “Start-Up” process. Repeat monitoring, analytical requirements, and response to violations shall be in accordance with the Colorado Primary Drinking Water Regulations.

## 4.2 **Microbiological Sampling and Testing**

**Routine monitoring:** System monitoring will primarily consist of collecting two samples for routine microbiological monitoring for the first month of the seasonal operation and monthly thereafter throughout the season. The first sample should be taken within the first week of the month and the second sample taken approximately seven days later. If both of the routine samples are coliform negative, the monitoring frequency shall be monthly throughout the remainder of the season. If one or both of the routine samples are coliform positive, repeat samples must be taken in accordance with 4.1.2 above. Additionally, five routine samples would be required to be taken the following month. If all five samples are coliform negative, routine sampling frequency will be monthly.

### 4.2.1 **Sample Collection Procedure**

- a) Flush the well by pumping for approximately five minutes.
- b) Avoid sample contamination by adhering to the following:
  1. The sampling bottle shall be kept unopened until the moment just prior to the bottle is to be filled.
  2. During sampling, do not touch the threads on the cap or the neck of the bottle. Do not touch the inside of the bottle.
  3. Do not place the cap on the ground while taking sample.
- c) Important: Do not rinse the bottle before collecting the sample! Normally, sodium thiosulfate is added to the bottle to neutralize residual chlorine in the water sample.
- d) Hold the bottle near its base, fill the bottle ~4/5 full, and replace the cap immediately.  
**Do not overflow!**
- e) Complete collection form and return form and sample to the laboratory.

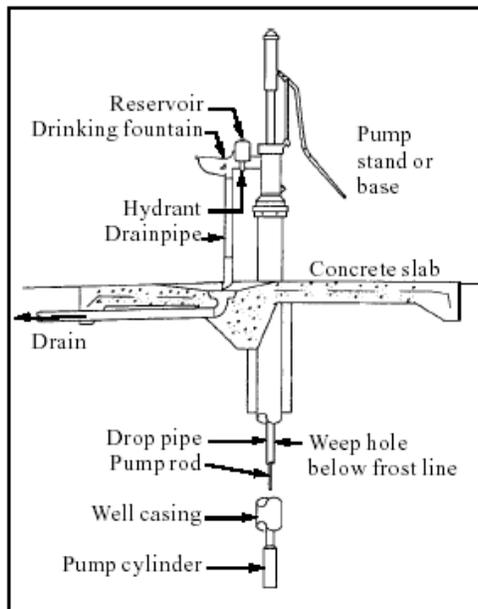
## 4.3 **Wellhead Inspection, Start-up and Shut-down**

4.3.1 **Wellhead Inspection:** A Wellhead Inspection shall be performed on each hand pump installation before system start-up and after the system is shut-down. Year-round sites that have hand pumps shall have a Wellhead Inspection performed at least once a year. A Wellhead Inspection is simply a physical inspection of the hand pump, well seal, and surrounding well area. Minimum items to be checked on a wellhead inspection are summarized below.

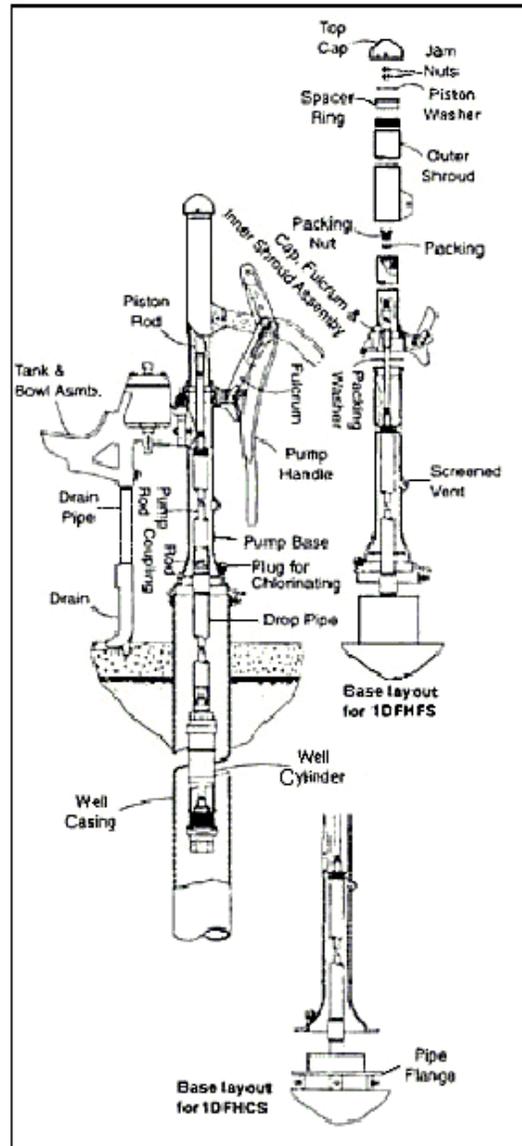
- a. Drainage system should be clear of any debris and functioning properly.
- b. The sanitary well seal must be secure, in place, and watertight.
- c. Concrete slab should not be cracked and any burrows under this slab must be filled. Ensure a tight seal (no gaps) between wellhead and concrete slab.
- d. Nuts and bolts tight, gaskets intact at watertight joints.
- e. Pump stand and major components not cracked or broken.
- f. Packing nut and packing checked for wear; hole in packing nut not worn oblong; packing nut not bottomed out because packing worn out. Check condition of the upper piston guide on models with such appurtenances (e.g. 1DFHF and 1DFHC pumps).

- g. Weep hole open.
- h. Area around the well is clear of potential sources of contamination.

Note: Performing a Wellhead Inspection in the fall after the system has been shut-down is useful in identifying maintenance items that must be corrected before the system is opened for the next season. Materials can be ordered during the winter to be on hand for installation early next season. A Wellhead Inspection performed before system start-up can determine if any additional damage has occurred during the winter from vandalism, frost action, etc.



Typical hand pumped well installation



Hand pumped well assembly components

**Problems noted during the Wellhead Inspection are considered to be sanitary defects. These defects are to be corrected prior to any further public use. Correction of the sanitary defects must be noted in the O&M records.**

#### 4.3.2 Start-up:

- A. Perform Wellhead Inspection.
- B. Complete necessary maintenance and repairs.
- C. Install pump handle.
- D. Loosen and readjust packing nuts as necessary (e.g. Monitor 1DFHC and 1DFHF pump stands). Add packing if necessary.
- E. Flush well by pumping until discharge is clear of rust, sediment, etc.
- F. Take a special purpose sample water for microbiological contaminants (see 4.2.2 above) and routine nitrate/nitrite analyses (see 4.1.3). Remove pump handle.
- G. Obtain test result from laboratory.
- H. If the microbiological test is unsatisfactory (coliform present), disinfect the well in accordance to 4.3.3 below, and let it stand for a minimum of twelve hours. Flush the well by pumping until chlorine residual is undetectable. Repeat special purpose sample (see 4.1.2 above).
- I. Request a sanitary survey if subsequent microbiological samples continue to show contamination. The well must be taken out of service until the problem has been fixed, the well has been disinfected and flushed, and the repeat samples show no contamination.
- J. If microbiological test is satisfactory (coliform absent), the water system may be opened for use. The first routine sample shall be taken within the first week that the system is open for public use.
- K. Maintain records to demonstrate that the procedures were followed.

**4.3.3 Disinfection of the Well**—The well water, pump and piping should be disinfected whenever the pump stand is raised or removed for maintenance, or as described in 4.1.2 above. The procedure is described below.

- a. Wash the exterior surface of the drop pipe and pump cylinder with a 100-mg/L-chlorine solution as they are lowered into the well. **NOTE:** 1 cup of 5-1/4 percent household bleach per five gallons of water is approximately a 100-mg/L-chlorine solution.
- b. Pour chlorine solution into well just before installing pump cylinder and drop pipe assembly. Chlorine solution shall be made by adding one cup of 5-1/4 percent chlorine bleach to 5 gallons of clear water. Add 5 gallons of this solution into the well for each 20 feet of standing water, e.g. 15 gal for 60 feet of standing water. Disperse chlorine evenly through the well by pouring chlorine solution through a disinfected hose or pipe that is moved up or down in the well while the chlorine solution is added.
- c. After installation of the hand pump is complete, operate the hand pump until the distinct odor of chlorine is detected in the discharge.
- d. Remove the pump handle and allow the chlorine solution to remain in the well for a minimum of 12 hours, preferably 24 hours.
- e. After disinfecting, reinstall the pump handle and flush the well until the free chlorine residual is undetectable. Deliver or mail the water sample for microbiological testing to a certified laboratory. Remove pump handle. If the microbiological sample result is negative the water system may be opened for use. If the microbiological test is unsatisfactory (coliform present), request a sanitary survey.

**4.3.4 Well Cleaning or Flushing**—Some wells are not adequately cleaned at the low pumping rate of hand pumps. Accumulations of sediment, rust particles, etc., eventually may affect the physical quality of the well water. At some sites, periodic cleaning of the well can be beneficial.

The Operator-in-Responsible Charge should consult with facilities engineers on specific installations.

#### **4.3.5 Shut-down:**

- A. Perform Wellhead Inspection (see 4.3.1)
- B. Inspect packing nut on pump stands for tightness, where applicable, so packing forms a watertight seal while the hand pump is shut down for the season.
- C. Remove pump handle.

#### **4.3.6 Record Keeping:**

Keep accurate records of analytical results, Wellhead Inspections, operations, maintenance and any specific problems for each system in official water system file. Each public water system shall retain on the system's premises or at a convenient location near such premises the following records:

- (a) Records of bacteriological analyses for not less than five years.
- (b) Records of chemical analyses for not less than ten years.
- (c) For each violation of the Colorado Primary Drinking Water Regulations, the records of action taken by the public water system to correct the violation for not less than three years after the date on which the last action was taken with respect to the particular violation involved.
- (d) Copies of any written reports, summaries or communications relating to sanitary surveys for not less than ten years after completion of the sanitary survey.
- (e) All records pertaining to the monitoring and operation of a public water system under this Guidance shall be kept for not less than ten years.