

STATE OF COLORADO

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Dedicated to protecting and improving the health and environment of the people of Colorado

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Colorado Department
of Public Health
and Environment

April 22, 2013

To: Public Water Systems

Subject: Acceptance of natural filtration as an Alternative Filtration Technology for meeting the *Colorado Primary Drinking Water Regulations* (CPDWR) requirements for *Giardia lamblia* and *Cryptosporidium* Removal

To Whom It May Concern;

The Water Quality Control Division (Division), in consultation with the United States Environmental Protection Agency and top industry and academic experts in the field of riverbank filtration and managed aquifer recharge, has reviewed waterborne disease outbreak history, existing riverbank filtration wells outside of Colorado, industry best practices, Long Term 2 Enhanced Surface Water Treatment Rule Toolbox Guidance Manual (April, 2010 http://www.epa.gov/safewater/disinfection/lt2/pdfs/guide_lt2_toolboxguidancemanual.pdf), relevant literature, and related research in order to address requirements of Article 1.11.2 and Article 7 of the *Colorado Primary Drinking Water Regulations* (CPDWR). Additionally, the Division evaluated all documents contained with the literature review for basis and purpose of the Groundwater Under the Direct Influence Policy Revisions.

The Division hereby finds that managed natural filtration can be successfully used to comply with the filtration requirements of Article 7 of the CPDWR. The technology meets or exceeds the requirements of the *State of Colorado Design Criteria for Potable Water Systems* and is accepted for use as an Alternative Filtration Technology subject to the following requirements:

- Conditions outlined in Table 1
- Successful completion of the “Steps to Receive Approval for Managed Natural Filtration” outlined below

This acceptance applies only to the use of natural filtration for compliance with Article 7.1-7.3 of the CPDWR (the surface water treatment rules). It does NOT constitute construction approval for installation or use at individual public water systems. Therefore, public water systems must submit plans for individual review and approval to use this technology. Each submittal will be reviewed for approval on a case-by-case basis by the Division as required by Article 1.11.2 of the CPDWR.

Table 1. Managed Natural Filtration Conditions of Acceptance

Compliance Log-Removal Credit Granted to meet the requirements of the CPDWR *	
<i>Giardia lamblia</i>	2.0 – Log
<i>Cryptosporidium</i>	2.0 – Log
Viruses	no credit granted

Compliance Log-Removal Credit Granted to meet the requirements of the CPDWR *

An alluvial well or well-field, providing it is properly designed and operated, may be used as final filter compliance monitoring locations as part of a multiple treatment barrier approach to meeting SWTR requirements (Article 7, CPDWR).

In addition to the above filtration, the water system **MUST** provide a minimum of **1.0 –Log *Giardia* AND 4.0-Log virus inactivation** by an engineered disinfection process. Also, please note that per Article 7.4.4(d), for bank filtration used as compliance with the SWTR filtration requirements, the LT2 source water monitoring location is the surface water source. The Division will evaluate the filter log removal credit and compliance monitoring criteria for systems that are classified as Bin 2 or higher as part of Article 7.4 of the CPDWR. On a case-by-case basis, the Department will require additional treatment to achieve the required additional *cryptosporidium* removal and/or inactivation credit for Bin 2 or higher systems. Systems receiving the above managed natural filtration credit may **not** apply for the bank filtration credit in the EPA Microbial Toolbox.

* **NOTE:** Compliance credit awarded is merely for meeting minimum requirements of the CDPWR Article 7 (Surface Water Treatment Rules - SWTR) and does NOT reflect demonstrated performance of the natural filtration system. Actual removals in these types of systems could, at times, exceed 2.0 log removal based on testing surrogates. The Division is taking this conservative approach in granting credit to systems utilizing natural filtration in order to protect public health. Systems may not request additional credit based upon CPDWR 7.4.16 (c) for the natural filtration.

Steps to Receive Approval for Managed Natural Filtration:

In order for a well or group of wells to be considered for riverbank/natural filtration credit to comply with Articles 7.1 – 7.3 of the CPDWR, the Public Water System (the System) must establish that the well conforms with certain design requirements, passes water quality criteria during a demonstration of performance study, and continuously meets monitoring requirements as the compliance filtration barrier. These steps are summarized as follows:

Step 1: Establish that the well meets the Design Criteria outlined in Table 2 and gain preliminary approval for Demonstration of Performance

Step 2: Execute an 18-month Demonstration of Performance (DOP) Study as outlined in Table 3 and submit report for final approval of natural filtration credit

Step 3: Operate wells in accordance with performance criteria and continue routine monitoring of performance outlined in Table 4

Step 1: Preliminary Design Approval:

Prior to being approved for a Demonstration of Performance Study, public water systems seeking natural filtration credit must submit and receive preliminary approval from the Division in order to establish that the well(s) in question meets the Design Criteria outlined in Table 2. These criteria have been developed based on industry best practice in order to ensure that the alluvial wells in question will consistently and reliably achieve the compliance credit granted in Table 1. The approval letter of the preliminary design will outline the requirements for monitoring in order for the system to execute a Demonstration of Performance Study.

Table 2. Design Requirements for Natural Filtration Credit

Parameter	Requirement
Surface Water Source	Identify and locate surface water source – wells without an identifiable surface water source are not eligible for this credit, they are either GW or GWUDI.
Time-of-Travel (through the managed natural filter)	10 days minimum – See Item 2 under “Additional Criteria” below
Well Type	Vertical only
Soil characterization	At least 10% of the grains <1 mm diameter for full well depth for 90% of depth intervals (* See EPA Guidance Document section 4.4.3) http://www.epa.gov/safewater/disinfection/lt2/pdfs/guide_lt2_toolbox_guidancemanual.pdf
Minimum Depth of Alluvial Wells	20 feet to the top of the first screened interval
Additional Criteria	
<ol style="list-style-type: none"> 1. Bypass piping to divert water around the natural filtration will not be approved. 2. Evidence of >10-day time of travel established through either <ol style="list-style-type: none"> a. Hydrogeologic modeling b. Conservative tracer study performed during peak water use month (usually summer) c. A Division approved alternative or combination – sections 4.5.2.3 and 4.5.2.4 of the EPA Guidance discuss several options for determination of the edge of the waterway. In any case, the water system must discuss why and how a particular distance was chosen and justify calculations to demonstrate >10 days time of travel. 3. A means to restrict or control flow in each natural filtration well shall be provided (to ensure >10 days time of travel). (Variable frequency drive well pumps are acceptable as a flow control device.) 4. A means to measure and record the flow pumped from each natural filtration well shall be provided. 5. Systems shall provide a copy of their wellhead protection plan to ensure water quality in their natural filtration system. 6. Systems shall provide a standard operating procedure indicating how they will respond in the event that any of the failure criteria described in this acceptance are triggered. 	

Step 2: Demonstration of Performance:

Once approved to proceed with a Demonstration of Performance (DOP) Study, systems seeking natural filtration credit must prepare a proposed study plan and provide that to the Division for authorization, in order to not run the risk of insufficient or inadequate data collection during the monitoring period. During this period, the system will also conduct Routine Monitoring of Natural Filtration (Step 3 below) as well as complete other monthly reporting requirements of the CPDWR as if the DOP study will be successful. The DOP study must be based upon the discussions and requirements which are laid out in Section 4.7 of the Long Term 2 Enhanced Surface Water Treatment Rule Toolbox Guidance Manual. At a minimum, the demonstration of performance must conform with the requirements in Table 3 and must continue for a period of 18 months. After authorization and then execution of the DOP study, the system must prepare a report showing the monitoring data and summarizing the results obtained during the study. Additionally, periodic progress reviews during the study period between the system and the Division are advised in order to discern if there are issues which will result in a denial of filtration credit. In the event filtration credit is denied, the system may be required to discontinue use of the water source, installed properly

designed and engineered filtration, implement interim measures, and/or face additional public notice, violations, and/or enforcement actions.

Table 3: Demonstration of Performance (DOP) Requirements

Parameter	Location	Frequency	Potential Failure Criteria
Flowrate and pumping regime of well	Well	1X Day	Pumping greater than the approved rate for >10-day TOT.
Turbidity	Paired sample with well and surface water	1X Day	Well water < 1 NTU 95% of the time Not to exceed 5 NTU
Conductivity, Temperature	Paired sample with well and surface water	2X per 7-day week	N/A
Total Aerobic Spores *	Paired sample with well and surface water	2X per Month (approx every two weeks)	Less than 2.0 Log Removal of spores along with presence of diatoms in the well (during concurrent 3 months of MPA samples)
Total Organic Carbon (TOC)	Paired sample with well and surface water	1X Month	N/A
Microscopic Particulate Analysis	Paired sample with well and surface water	1X Month	Diatom presence in well water in conjunction with <2.0 Log aerobic spore removal
Total Coliform Analysis (with <i>E.coli</i> MPN enumeration)	Paired sample with well and surface water	1X Month	Less than 2.0 Log Removal – if sufficient concentrations in source and well water
<i>Giardia-Cryptosporidium</i>	Paired sample with well and surface water	1X Quarter	Using EPA method 1622/1623 – presence in the well

* Total Aerobic Spore analysis is commercially available - consult with the Division to determine acceptable labs that demonstrate appropriate detection limits

Step 3: Routine Monitoring of Managed Natural Filtration:

Once a Demonstration of Performance Study has been completed and a report submitted to the Division, the Division will review results and either approve or deny the credit proposed for managed natural filtration. During the DOP Study and continuing beyond, the System will be required to continuously monitor the performance of the managed natural filtration system, in addition to the regular SWTR monitoring and monthly reporting required by Articles 7.1-7.3 for Alternative Filtration. Table 4 presents the routine monitoring requirements for managed natural filtration systems. Systems are expected to maintain records of the monitoring requirements for review during a Sanitary Survey. If the approved managed natural filtration system fails based on the failure criteria in Table 4, the system may be issued violations of the CPDWR as well as face installing engineered filtration and possible enforcement actions.

Table 4: Routine Monitoring Requirements

Parameter	Location	Frequency	Potential Failure Criteria
Flowrate and pumping regime of well	Well	1X Day	Pumping greater than the approved rate for >10-day TOT.

Parameter	Location	Frequency	Potential Failure Criteria
Turbidity	Well	1X Day ⁺⁺	Well water < 1 NTU 95% of the time Not to exceed 5 NTU
Total Aerobic Spores* [§]	Paired sample with well and surface water	1X Month	Less than 2.0 Log Removal of spores along with presence of diatoms in the well (during concurrent 3 months of MPA samples)
Total Organic Carbon (TOC)	Paired sample with well and surface water	1X Month	N/A
Microscopic Particulate Analysis [§]	Well	1X Month	Diatom presence in well water in conjunction with <2.0 Log aerobic spore removal
<i>Giardia-Cryptosporidium</i>	Paired sample with well and surface water	1X Year – sampling period determined by Division	Using EPA method 1622/1623 – presence in the well

* Total Aerobic Spore analysis is commercially available - consult with the Division to determine acceptable labs achieving appropriate detection limits

++ Turbidity may be required on a continuous basis depending on population served, the Division will determine this on a case-by-case basis

§ Total aerobic spores and MPA testing must be performed during the same sampling period

Evaluating the removal performance ≤ 2.0 log:

The water system must calculate the log removal achieved through the managed natural filtration system with total aerobic spores. In the event the total aerobic spores calculation indicates that filtration is achieving less than 2.0 log removal of the surrogate organisms and diatoms are present in the well water during the concurrent 3 months of sampling, the water system must re-run the paired total aerobic spore and well MPA test within one calendar week and notify the Division within 72 hours of receiving those retest results.

In the event that the repeat test also shows less than 2.0 log removal of the indicator organisms is being achieved through managed natural filtration, the water system must analyze the data from both the raw and filtered for the last 12 months in order to determine if the overall log removal is due to increasing numbers in the well effluent or due to low raw water counts. The result of the analysis must be reported to the Division within 1 week of receiving the results of the required re-testing:

- If the well has increasing numbers of indicator organisms in the effluent of the managed natural filtration system, this will be considered as triggering the failure criteria and the criteria below must be met
- If the cause of the low removals is a decrease in raw water counts, the system may continue routine monitoring and has not triggered the failure criteria.
- If the performance monitoring of the managed natural filtration system indicates less than 2.0 log removal for three consecutive months, this constitutes triggering the failure criteria and the water system must meet the criteria in the section below.

Wells which have triggered the failure criteria:

In the event that the routine monitoring indicates a presence of *Giardia or Cryptosporidium*, a turbidity failure, or the demonstrated log removal has triggered the failure criteria as outlined above, the system must investigate the failure and notify the Division within 24 hours of detecting the failure. The Division will evaluate the appropriate response at that time, but at a minimum the system must:

- Launch an investigation into the cause of the event

- Determine necessary steps to mitigate the contamination or improve the performance of the managed natural filtration system
- Submit a report summarizing the above two items within 30 calendar days of the event occurring
- Implement appropriate improvements as required by the Division
- In a case by case basis as directed by the Division, the system must issue public notice of the failure of the natural filtration system and/or implement disinfection to achieve 3.0 log inactivation of *Giardia* and 4.0 log inactivation of viruses.

In the event a water system is unable to identify or successfully rectify a failure event with their managed natural filtration system, the Division may revoke the credit granted for natural filtration and require the public water system to install an engineered filtration system. The system may receive an enforcement order from the Division in such a case and be required to do additional public notice at that time.

Please direct any further correspondence regarding this acceptance to:

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Water Quality Control Division
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If you have any questions or comments, please call Tyson Ingels at 303-692-3002.

Sincerely,



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Lead Drinking Water Engineer
Engineering Section
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