

Executive Summary

The Portland Water Bureau Requests a Variance to the Treatment Requirements of the Long Term 2 Enhanced Surface Water Treatment Rule

The City of Portland Water Bureau, public water system OR4100657, is requesting that the Oregon Health Authority Public Health Division, Office of Environmental Public Health Drinking Water Program (OHA-DWP)¹ grant Portland approval for a variance to the surface water treatment requirements of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2 rule). Conventional compliance with the LT2 rule for Portland's Bull Run source would require the installation of an enhanced treatment facility to remove or inactivate the parasite *Cryptosporidium*. Portland's primary basis for seeking a variance, and asserting that no additional treatment for *Cryptosporidium* is necessary for the Bull Run source, is water quality monitoring results that demonstrate that the LT2 rule target level for public health protection has been met. This demonstration establishes that the risk for exposure to infectious *Cryptosporidium* from the Bull Run is at least as low as required for other water systems complying with the LT2 rule through enhanced treatment.

For over a century, the Bull Run watershed has been the primary drinking water supply for the City of Portland and its wholesale customers—a total service area population of approximately 900,000 people. This stringently protected watershed is an unfiltered surface water supply that provides water of excellent quality. Legal protections, public access restrictions, and active preservation of natural ecosystems are the primary safeguards against contamination from *Cryptosporidium* in the Bull Run.

The opportunity for a public water system to seek a variance to a prescribed treatment technique based on the nature of the raw water source is contained in the federal Safe Drinking Water Act (SDWA) Section 1415(a)(1)(B) (U.S. Congress 1974) and Oregon Administrative Rules [OAR 333-061-0045(13)] (Oregon Health Authority 2010). Portland has additionally relied upon the following guideline from the LT2 rule preamble for consideration of a variance:

*"If an unfiltered PWS [public water system] could show a raw water Cryptosporidium level... below 0.075 oocysts/1,000 L... this could demonstrate that no treatment for Cryptosporidium is necessary. The unfiltered PWS would already be achieving public health protection against Cryptosporidium equivalent to filtered PWSs due to the nature of the raw water source."*²

¹ A governor's Executive Order 09-11 (July 7, 2009) required that the State of Oregon Department of Human Services Drinking Water Program change its name to the Oregon Health Authority Public Health Division, Office of Environmental Public Health Drinking Water Program, beginning in the 2011–2013 budget cycle. References to the agency in correspondence and historical documents, therefore, use the older name and the acronym DHS-DWP.

² 71 Fed. Reg. 729. Jan. 5, 2006.

This Portland Water Bureau Request for a Treatment Variance to the Long Term 2 Enhanced Surface Water Treatment Rule (Request for a Treatment Variance) reports in detail Portland's

Cryptosporidium Basics

Cryptosporidium is a protozoan parasite that can be found in surface waters worldwide. Within the environment, *Cryptosporidium* exists as a thick-walled oocyst that can withstand harsh environmental conditions and is resistant to chlorine disinfection. When ingested, certain types of *Cryptosporidium* are known to cause cryptosporidiosis, a gastrointestinal illness that may be severe and sometimes fatal in people with weakened immune systems.

Cryptosporidium lives and reproduces in one host and is excreted in feces. Transmission of cryptosporidiosis to others occurs through direct or indirect contact with infected people or animals or through consumption of food or water contaminated with feces.

Cryptosporidium contamination can come from any source of fecal matter such as domestic animals (e.g., cattle), infected humans, wastewater treatment plant discharges, and wild animals. While many species of *Cryptosporidium* have been documented, only a few are responsible for most human infections: *C. parvum*, which primarily infects humans and cattle, and *C. hominis*, which infects primarily humans. *Cryptosporidium* carried by wildlife are generally less likely to be infectious to humans relative to other sources. In the Bull Run watershed, wildlife is the only potentially significant source of *Cryptosporidium*.

Cryptosporidium monitoring results from the Bull Run raw water intake that meet the LT2 preamble guideline for variance eligibility. In addition, the document details additional monitoring results and investigation of the Bull Run watershed that further demonstrate the low risk of *Cryptosporidium* exposure from the source water. This approach was developed through extensive consultation with the United States Environmental Protection Agency (EPA) on the monitoring process with additional input from several public health and drinking water experts.

As Portland has been pursuing alternative compliance through the variance process, it has also moved forward on a separate, parallel track with the engineering design of an ultraviolet (UV) treatment facility. This parallel compliance track ensures that Portland will be able to meet the regulatory deadline of April 1, 2014, for having enhanced treatment operational if the variance request is not granted.

Portland's One-Year Monitoring Program

Collecting Key Data for the Variance Request

The terms for consideration of a variance request have been under discussion and development between Portland Water Bureau staff and regulatory officials since late 2007. In 2008, EPA confirmed that the basis for an unfiltered system such as Portland to attain a variance would be for it to demonstrate that its "raw water *Cryptosporidium* level [is] below 0.000075 oocysts/liter"³ as stated in the LT2 regulation. From July 2008 to November 2009, Portland, in extensive consultation with

EPA, developed a detailed Sampling Plan and Study in Support of a Treatment Variance Request to the Long Term 2 Enhanced Surface Water Treatment Rule (Sampling Plan and Study) featuring a one-year monitoring program to determine the concentration and type of *Cryptosporidium* at the Bull Run raw water intake and further characterize the nature of the raw water source.

³ The ratio "0.000075 oocysts/L" is equivalent to the ratio "0.075 oocysts/1,000 L" used by EPA in the LT2 rule. Both forms were used interchangeably in correspondence between Portland and EPA between 2008 and 2011.

EPA established a core element of the raw water intake monitoring program by indicating that Portland would need to test a minimum of 10,250 liters (L) of raw water (an unprecedented volume of water for a *Cryptosporidium* regulatory monitoring program) and detect zero oocysts in order to establish to a 90% statistical confidence level that the target *Cryptosporidium* concentration level was met. At EPA's direction, the plan also included monitoring locations upstream of the intake described by EPA as potential "hot spots" where *Cryptosporidium* would most likely appear if it were present. The EPA also recommended that Portland pursue adaptation of a specific pathogen budget model to provide supplemental information regarding the nature of the Bull Run source.

With the consent of the EPA, Portland began regularly scheduled monitoring at the raw water intake in December 2009 and at several upstream locations in January 2010. EPA offered additional comments and recommendations that were incorporated into the Sampling Plan and Study in early 2010. EPA's primary recommendations were to increase monitoring at upstream locations during watershed conditions most likely to result in the transport of *Cryptosporidium* oocysts into the source water (such as during significant rainfall events). In March 2010, Portland increased the regularly scheduled monitoring frequency at the upstream locations and began event-based monitoring.

Monitoring Results at the Raw Water Intake: No *Cryptosporidium*

Portland's one-year monitoring at the raw water intake detected no *Cryptosporidium*, thereby demonstrating an arithmetic mean concentration of zero oocysts per L based on 449 samples totaling 10,271 L of water. This monitoring program adhered to the rigorous data quality standards recommended by EPA and exceeded the minimum sampling volume required. The volume of water sampled without detecting *Cryptosporidium* produces statistically significant results to a 90% level of confidence as required by EPA. Moreover, the results establish that Bull Run source water is below the *Cryptosporidium* concentration level stated by EPA to meet the eligibility threshold for a variance. A detailed description of the raw water sampling methods, monitoring results, and conclusions is available as Section 3 of this document.

Data Quality

The one-year monitoring program adhered to data quality standards developed by EPA, described in the LT2 rule, and further specified in multiple communications between Portland and EPA. Portland selected a laboratory (Analytical Services, Inc. [ASI]) approved under EPA's Laboratory Quality Assurance Evaluation Program to perform *Cryptosporidium* analysis and both Portland and ASI adhered to the quality control procedures of the LT2-approved method, EPA Method 1623. All quality control acceptance criteria were met.

Supporting Results from Additional Monitoring at the Raw Water Intake: No *Cryptosporidium*

The zero *Cryptosporidium* concentration found in the one-year variance intake monitoring program is supported by other monitoring results both prior and subsequent to the one-year monitoring period. Under the LT2-compliant method and specifications for monitoring, Portland began monitoring for *Cryptosporidium* on a monthly basis starting in December 2002. Monitoring results from that time through November 2009 also detected no *Cryptosporidium* oocysts. Meanwhile, Portland has also continued monitoring on a weekly basis at the intake since the completion of the one-year variance monitoring program. As of April 30, 2011, no *Cryptosporidium* has been detected.

This additional monitoring included a severe storm in January 2011 following the conclusion of the one-year variance monitoring program. Intense rainfall and record tributary inflows created the most likely hydrologic conditions for mobilizing *Cryptosporidium* and highly turbid conditions in the reservoirs. Portland increased its intake monitoring frequency to daily during the event. While both *E. coli* and *Giardia* concentrations increased slightly, reflecting the anticipated flushing of fecal pathogens by the storm, there was no *Cryptosporidium* detected, even during this significant event.

Supporting Results from Upstream Monitoring in the Watershed: No *Cryptosporidium*

At EPA's request, Portland undertook additional monitoring in the watershed to help characterize the nature of the raw water source. This supplementary program included monitoring at nine upstream watershed locations that EPA anticipated would be potential "hot spots" for wildlife fecal contamination. The schedule included regular weekly monitoring at four major reservoir tributaries and event-triggered monitoring during storm events that had a high likelihood of mobilizing *Cryptosporidium*, if present, into the reservoirs. The upstream monitoring program analyzed 3,384 L of water and showed no detection of *Cryptosporidium* at any of the upstream locations. Monitoring of the four tributary locations during the January 2011 storm also resulted in no *Cryptosporidium* detected despite record inflows.

Supporting Results from Scat Monitoring and Model Development

Portland also collected and analyzed wildlife scat in the watershed to search for *Cryptosporidium* in the only potentially significant source. A total of 307 fecal samples were collected from 11 different wildlife species over a period of 20 months leading up to, during, and after the one-year monitoring period. The results show extremely low occurrence of *Cryptosporidium* (only one sample tested positive with only two oocysts found). This scat analysis work was conducted as part of the attempt to adapt the EPA-recommended pathogen budget model to simulate the fate and transport of pathogens in the watershed. While adapting the model has provided limited value so far in terms of evaluating *Cryptosporidium* concentrations at the Bull Run intake, it has led to meaningful data collection, analysis, and findings, such as the evidence

of the very low level of *Cryptosporidium* in wildlife, the only potentially significant source of the pathogen in the watershed.

The Bull Run Watershed: Unique Characteristics Support the Monitoring Results

The results from the one-year monitoring program demonstrate the low risk presented by Bull Run source water for exposure to infectious *Cryptosporidium*. To provide context and assurance that the data results are explained and supported by the basic underlying conditions of the watershed, an explanation of the overall circumstances of the Bull Run watershed is a critical element of the variance request submission.

The natural correlation between a highly protected watershed and high quality source water is powerfully represented by Portland's Bull Run watershed and source water. In the Bull Run, an array of natural and institutional features contributes to the overall result demonstrated in the one-year monitoring program—a very low risk of *Cryptosporidium* entering Portland's drinking water supply. These matters are treated in more detail in Sections 2 and 4 and include:

- Exclusion and control of humans and human activity in the watershed, a combined result of long-standing, highly protective legal constraints and rigorous watershed stewardship efforts by the Portland Water Bureau and its federal land management partners.
- No presence of domestic or farm livestock, the carriers of human-infectious species of *Cryptosporidium*, in the watershed.
- Relatively small populations and low densities of wildlife, the only potentially significant source of *Cryptosporidium* in the watershed, as a result of the watershed's topography and vegetation.
- Features of climate and precipitation, topography, and vegetation patterns that combine with permeable soils to minimize the likelihood that *Cryptosporidium*, if introduced to the watershed by wildlife, would be transported to the raw water intake.

These features of the watershed have long been generally understood and credited with contributing to the very high quality of Portland's raw drinking water source. In recent years, Portland's interest in the LT2 rule and how it might be applied to Portland have led it to improve its understanding of the watershed and manage it more effectively. This in turn, reinforces the likelihood that the consistent results of low risk from *Cryptosporidium* will be continued and enhanced into the future.

Public Health Perspective on the Variance

Since the purpose of the LT2 rule is grounded in reducing the risk of drinking water as a pathway of infectious *Cryptosporidium*, there has naturally been a high level of mutual interest, discussion, and cooperation between Portland and local public health professionals.

A key indicator of the ongoing public health status of Bull Run water is the annual watershed survey conducted by the OHA-DWP to determine compliance of the Bull Run watershed with the conditions of its filtration exemption. One condition is the absence of any waterborne disease outbreaks attributed to the drinking water source. The most recent survey, completed in October 2010, was consistent with all previous State findings since the Surface Water Treatment Rule went into effect in 1991 that the Bull Run watershed has not been the source of any waterborne disease outbreak and continues to meet all other criteria for an exemption to filtration.

In March 2011, a panel of public health experts convened in Portland to review the one-year monitoring data, local public health data, and other information relating to consideration of the variance. The panel included public health experts from around the country. The panel, after its review, issued a consensus statement including the following points (see Section 5):

- The data collection effort conducted by the Portland Water Bureau has been extremely thorough.
- Based on scientific data for Multnomah County, there is no information that would suggest that drinking water has been a source of cryptosporidiosis.
- The Bull Run watershed is unique among watersheds, well protected in ways that surpass the other watersheds in the United States known to the panel, including those of other unfiltered utilities.
- Based on the collected data, the probability of exposure to *Cryptosporidium* via consuming Bull Run water is expected to be low. Adding additional treatment is not likely to result in measurable improvement to public health.

Monitoring and Ongoing Management of the Bull Run Watershed

As required by the SDWA and to ensure ongoing public health protection, Portland will continue a program of raw water monitoring as a condition to any variance granted by OHA-DWP. Additionally, Portland will maintain and enhance its watershed control, research, and stewardship efforts as needed to support the long-term operation of the Bull Run water system under a variance to *Cryptosporidium* treatment.

Having convened a monitoring panel of utility, regulatory, and microbiology experts to examine and evaluate monitoring program options and other actions to support public health, Portland

proposes the following regulatory monitoring program elements as a condition to obtaining a treatment variance to the LT2 rule:

- Monitoring for *Cryptosporidium* twice weekly at the raw water intake;
- Maintaining the 0.075 oocysts/1,000 L *Cryptosporidium* concentration threshold suggested by EPA for evaluating Portland's ongoing concentration level;
- Implementing intensive monitoring (four times a week) at the raw water intake if the *Cryptosporidium* concentration threshold is exceeded after confirmation and DNA analysis of positive samples;
- Determination by OHA-DWP of whether a variance will continue if two subsequent confirmed detections of *Cryptosporidium* following DNA analysis occur during intensive monitoring, and after discussion of these results and other relevant factors occurs between Portland and OHA-DWP; and
- Transition to compliance with the LT2 rule through the construction of a UV treatment plant according to a schedule agreed to by Portland and OHA-DWP, should a variance be discontinued.

In addition to this proposed regulatory monitoring program, Portland will develop the capacity to conduct in-house *Cryptosporidium* laboratory testing should a variance be granted providing an anticipated 8 to 12-hour turnaround for monitoring results and greatly enhancing the opportunity to respond effectively to any detections. Portland will also continue upstream sampling during watershed conditions most conducive to the transport of *Cryptosporidium* into the drinking water. These proposed monitoring programs and operational improvements, continued coordination with state and local public health officials, and the maintenance and enhancement of current watershed control, research, and stewardship programs will ensure that Portland drinking water customers benefit from a monitoring system for *Cryptosporidium* that far exceeds the requirements of the LT2 rule.

Conclusion: Due to the Nature of the Raw Water Source, Treatment for *Cryptosporidium* is Not Necessary to Protect Public Health

The circumstances of the Bull Run water source—stringent protections, a natural environment that limits contamination, low likelihood of *Cryptosporidium* occurrence from wildlife, the only potentially significant source—strongly demonstrate that the Bull Run has a low risk of *Cryptosporidium* occurrence. The results from Portland's monitoring program—featuring rigorous measures for data quality and control, high volumes of water tested, monitoring at multiple locations and under conditions when the watershed would be most vulnerable to contamination by *Cryptosporidium*—provide direct evidence confirming the effectiveness of the watershed at limiting the risk of *Cryptosporidium* exposure. More specifically, the results demonstrate that Bull Run source water achieves the technical concentration target supplied by

EPA for variance eligibility and the underlying public health intentions described in the LT2 rule. The support of the public health community, based on epidemiological evidence from the Portland drinking water service area showing minimal endemic rates, underscores the case. Through the combined body of evidence, Portland has established that Bull Run source water has an exceptionally low risk from *Cryptosporidium*. Under a variance, the watershed conditions that give rise to this situation will continue to be monitored and documented so that protection of public health and delivery of the highest quality water continues into the foreseeable future.

On all these grounds, and with the support of the details included in this document, Portland respectfully asserts that a treatment technique for *Cryptosporidium* is not necessary to protect public health due to the nature of Bull Run raw water source and that a variance to the treatment requirements of the LT2 rule is justified for the Portland water system.