

# Source Water Assessment Report

Bull Run Water Supply  
City of Portland Water Bureau  
Portland, Oregon  
PWS #4100657

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Prepared by



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# Executive Summary

The primary water supply for the City of Portland and its wholesale customers is the Bull Run watershed. The watershed is located within the Mt. Hood National Forest in east Multnomah and Clackamas counties, Oregon. The system serves a population of about 831,000. Approximately 57% of water sales are retail customers within the city of Portland; the remaining 43% is supplied to wholesale customers comprised of 22 cities and water districts. The intake for the Bull Run supply system is located at River Mile 6.2 on the Bull Run River, about 26 miles east of downtown Portland. The geographic area providing water to the intake (defined as the “drinking water protection area”) is the 102-square mile watershed of the Bull Run River and its tributaries. The Bull Run is an unfiltered source that complies with all state and federal regulations for source water quality, treatment techniques, and source water monitoring.

The Bull Run watershed has a long history of source water protection, beginning with establishment of the Bull Run Reserve in 1892. The fact that the original Reserve boundary included not only the 102 square mile water-supply drainage, but an additional 117 square miles of land surrounding the drainage illustrates the importance placed on source protection by the founders of the Bull Run supply system. At the request of the City, Congress strengthened protection of the Reserve in 1904 by enacting the Bull Run Trespass Act, which prohibited grazing and other land uses that were not protective of the forest. Public Law 95-200, passed in 1977, modified the boundary of the Reserve, renamed the area as the Bull Run Management Unit, required the Forest Service to establish water quality standards for the source water, and reiterated that the primary purpose of the area was to serve as a source of high-quality, raw water for the City of Portland and its wholesale customers. Amendments to P.L. 95-200 were passed by Congress in 1996 and 2001 that placed a general prohibition on timber management and expanded the size of the Unit to incorporate all federal land that drains to the Bull Run River.

The Bull Run watershed is also afforded extensive protections through administrative rules and policies established by the Forest Service and the City of Portland. Federal land within the watershed is closed to public use under a Forest Service administrative closure order. City-owned land within the Bull Run Management Unit is closed to public entry by City ordinances. The City and the Forest Service have had a long-standing policy for no use of chemicals or fertilizers in the watershed. The City conducts an extensive water quality monitoring program for the reservoirs and tributary streams in order to detect short- and long-term changes in source water quality. The combination of legislative land-use restrictions, administrative protections afforded by the Northwest Forest Plan, the public closure policy, application of best management practices, and monitoring have created a framework that arguably places the Bull Run among the most protected water sources in the nation.

The DEQ/DHS guidance manual for source water assessments recommends that a 1000 foot wide sensitive area be delineated around water bodies associated with the intake and all perennial tributary streams. The Portland Water Bureau has elected to designate the entire 102 square-mile watershed upstream of the Bull Run system intake as a sensitive area.

Because of the stringent protections afforded by past and present legislation, administrative plans, and policies, there are no anthropogenic sources of microbial contaminants, inorganic chemicals, volatile organic chemicals, or synthetic organic chemicals in the Bull Run water source. The only contaminants of concern for the Bull Run source are naturally occurring sources of microbial contaminants such as *Giardia lamblia*, *Cryptosporidium*, fecal coliform bacteria and total coliform bacteria. These organisms are found in virtually all freshwater

ecosystems and are present in the Bull Run supply. Sources of *Giardia* cysts and fecal coliform bacteria in the Bull Run watershed are generally limited to warm blooded wildlife species such as deer, elk, cougar, bobcat, black bear, beaver, and muskrat. Sources of *Cryptosporidium* oocysts include most mammalian wildlife species as well as several bird species. The Water Bureau and its primary partner in the Bull Run source protection program, the Forest Service, have no control over these natural sources of microbial contaminants. Total coliform bacteria are found throughout the terrestrial and aquatic environment and are not associated with any current or previous land uses in the Bull Run. The Bull Run supply has consistently complied with all applicable state and federal regulations for source water under the SDWA, including the 1989 Surface Water Treatment Rule filtration-avoidance criteria.

# Introduction

The Safe Drinking Water Act (SDWA) amendments of 1996, P.L. 104-182, included a requirement for state primacy agencies to develop and implement an EPA-approved source water assessment program (SWAP) for all public water systems in the state. The legislation required that source water protection programs: 1) delineate the boundaries of the assessment areas within the state from provide the source of drinking water for public water systems, and 2) identify the origin of contaminants regulated under the Safe Drinking Water Act (or any unregulated contaminants selected at the discretion of the states, that may present a threat to public health) to determine the susceptibility of public water systems within the delineated areas. The 1996 SDWA amendments require that source water assessments be made available to the public.

EPA developed guidance for implementing source water assessment and protection programs in 1997 (EPA, 1997). The Oregon Department of Environmental Quality (DEQ) and the Department of Human Services (DHS, formerly known as the Oregon Health Division) jointly developed a guidance manual for source water assessments in 1999 (DEQ and DHS, 1999). Oregon's guidance manual for addressing the SWAP requirements was developed with assistance of a 19-member Drinking Water Protection Advisory Committee comprised of representatives from water utilities, local and federal agencies; and non-governmental organizations. A six-member Technical Advisory Team comprised of state and federal agency representatives met in conjunction with the citizens' advisory committee to develop the source water assessment methodology and provide input on resources that can provided by their agencies.

Source water assessments are required for each of the 2,656 public water systems in Oregon. About 90% of these are groundwater systems drawing water from wells or springs, and 10% are surface water systems with intakes on streams, rivers, lakes, and reservoirs. DEQ and DHS will complete source water assessments for most of the systems in the state because the smaller and medium sized systems that comprise most of the 2,656 public water systems generally lack the necessary technical resources to prepare the reports. However, most of the larger systems in the state are preparing their own source water assessments because they have sufficient staff and resources to complete the assessments. The source water assessment for the Bull Run water supply was prepared by the Portland Water Bureau.

The source water assessment methodology developed by DEQ and DHS is tiered to Section 132 of the 1996 Safe Drinking Water Act Amendments and the 1997 EPA guidance document. Oregon's methodology for developing source water protection programs for public water supplies is illustrated in Figure 1. The *source water assessment* represents the first phase of a two-stage process to develop a source protection program. The first step in the source water assessment process is delineation of the "drinking water protection area." The second step consists of an inventory of potential sources of contamination. The third step of the source water assessment is a determination of the water supply's susceptibility to sources of contamination.

The second phase of developing a source protection program is the *protection phase* (Figure 1). These steps are strongly encouraged by EPA and the state, but are not required by the SDWA or state regulations and are therefore considered to be voluntary. The state's recommended approach for the protection phase is to: 1) assemble a drinking water protection team to augment the staff resources of the water utility, 2) develop a drinking water protection plan that defines specific land use controls and best management practices for the source area, 3) obtain certification of the plan by DEQ, and 4) implement the plan.

As noted in the Summary and Recommendations section of the report, the extensive protections provided to the Bull Run source through a combination of federal legislation, administrative plans, and federal and City policies collectively comprise a protection plan that far exceeds the state's recommendations for a voluntary-based source protection program.

## Background

The primary water supply for the City of Portland and its wholesale customers is the Bull Run watershed. The system serves a population of about 831,000 persons. Approximately 57% of the annual demand is retail customers within the city of Portland; the remaining 43% is supplied to wholesale customers comprised of 22 cities and water districts.

The Bull Run water-supply drainage is located within the Mt. Hood National Forest in Multnomah and Clackamas counties (Figure 2). The intake for the Bull Run water supply is the Headworks, located at River Mile 6.2 on the Bull Run River, approximately 26 miles east of downtown Portland. The Bull Run supply is located within the Bull Run/Little Sandy watershed, a "fifth field" watershed (Hydrologic Unit Code 1708000104) that is part of the Sandy River basin in the Western Cascades physiographic province. About 95 percent of the watershed is federally owned and managed by the U.S. Forest Service; four percent of the watershed is owned by the City of Portland, and one percent is federally owned and managed by the Bureau of Land Management (BLM).

The source area for the Bull Run system intake is 102 square miles. The elevation of the source area ranges from 755 feet at the Headworks diversion dam to 4,750 feet at Buck Peak on the watershed's northeastern boundary. The geology of the Bull Run basin is dominated by basalt and andesite. The lowermost rocks exposed in the basin consist of Miocene Columbia River basalt, which are exposed in the bottom of steep inner canyons of the Bull Run River and parts of its major tributaries. In the western half of the watershed, the Columbia River basalt is overlain by pyroclastic flows and mudflow breccias, tuffs, and andesites of the Rhododendron Formation. Flows of Pliocene and Quaternary-age and basaltic and andesite overlie these formations throughout the watershed. Volcanic breccias and minor intrusions are also present, including areas of thick talus in the eastern part of the watershed above 2,500 feet (Beaulieu, 1974). Evidence of glaciation in the watershed is limited to elevations above 2,600 feet and generally on north facing drainages.

Topography varies from low-relief lava flow surfaces to steep walled canyons. Most of the west-dipping lava flows have been incised by down-cutting streams. Only about 12% of the watershed has slope angles greater than 50%. Shultz (1980) mapped landslide areas in the Bull Run and developed a two-tiered hazard rating for shallow landslides (debris slides and debris flows) and deep-seated landslides (slump-earthflows). Areas that were rated as high hazard for either shallow or deep-seated landslides comprise only 1.7 percent of the watershed.

The climate of the Bull Run watershed is typical of the western Oregon Cascades. Seasonal moist, cool storms bring an area-weighted average of 135 inches of precipitation to the basin. Precipitation ranges from 80 inches at Headworks to as much as 170 inches on the northern rim of the watershed. About 70% of the annual precipitation occurs between November and April. The dominant form of precipitation in the Bull Run watershed is rain because of the watershed's low to moderate elevation and west-slope Cascade location. The watershed is densely forested

with evergreen conifers. The dominant tree species in the basin are Douglas fir, western hemlock, western red cedar, Pacific silver fir, and noble fir.

The Bull Run watershed is closed to public entry, has no development, and has a long history of source protection. The inception of the source protection program occurred in 1892 when President Benjamin Harrison signed a proclamation which declared the Bull Run area as a national Forest Reserve. The original Reserve boundary included not only the 102 square mile water-supply drainage, but an additional 117 square miles of land surrounding the drainage – a visionary action that essentially served as both a delineation of the drinking water protection area and an early framework for the source protection program. In 1904, Congress strengthened protection of the Reserve by enacting the Bull Run Trespass Act. The Act clarified that grazing of domestic animals was prohibited in the Reserve and that entry to the area was limited to only employees of the Portland Water Board (the predecessor agency to the Portland Water Bureau), the state, and federal forest managers for protection of the water supply.

Public Law 95-200, enacted in 1977, revised the boundary of the federally protected area for the Bull Run (henceforth designated as the Bull Run Management Unit) to 143 square miles, required the Forest Service to develop ambient-based water quality standards for the basin, and clarified that the primary purpose of the Unit was to provide a source of high quality water for the City of Portland and its wholesale customers. Although about 16% of the watershed was clearcut-logged between 1958 and 1993, stringent controls have always been in place for sanitation, petroleum spill prevention, and erosion control.

In order to strengthen long-term, legislative protections for the Bull Run water supply, Congress included language in the Oregon Resources Conservation Act of 1996 that placed a prohibition on all Forest Service timber harvest in the Bull Run water supply drainage, except for incidental harvest necessary to protect water quality or for construction, maintenance and operation of water supply facilities and hydroelectric facilities. Congress expanded this protection in 2001 through passage of the Little Sandy Protection Act. This legislation expanded the Bull Run Management Unit by approximately four square miles and extended the logging prohibitions to all federal lands within the 143 square-mile Management Unit.

The federal forest plan that includes the Bull Run area provides a second, administrative layer of protections for the watershed that augments the legislative protections. In 1994, the Northwest Forest Plan designated most of the Bull Run water supply drainage as a Late Successional Reserve (LSR) for protection of the spotted owl and other late-successional dependent species. The LSR land-use classification and application of restrictive standards and guidelines for Riparian Reserves (210 ft. buffers bordering lakes, reservoirs, and perennial streams) in the Northwest Forest Plan placed extensive administrative controls on timber harvest and other land uses on federal land in the Bull Run watershed.

## **Delineation of the Protection Area**

The delineation of the source area or the “drinking water protection area” is a fundamental aspect of the assessment of a public water system. A map of the drinking water protection area provides the community with the knowledge of the geographic area that provides the source of water that drains to the intake. Information about the drinking water protection area allows the water supplier and the community they serve to develop management strategies that will have the most impact on protecting the source of their drinking water.

As noted earlier, a protection area for the Bull Run water supply was essentially delineated in 1892 when the Bull Run Reserve was established. For purposes of the source water assessment requirements of the 1996 Safe Drinking Water Act amendments, delineation of the drinking water protection area for the Bull Run is shown in Figure 1. The source area is 102 square miles and ranges from an elevation of 755 ft. at the Headworks diversion dam to 4,750 feet on the northeastern boundary of the watershed. Delineation of the protection area was derived electronically using a Geographic Information System (GIS). The Portland Water Bureau obtained a copy of the GIS file for the Bull Run water supply drainage boundary that was originally developed by the Mt. Hood National Forest for the Bull Run Watershed Analysis (USDA Forest Service, 1997). The watershed boundary was created by digitizing the drainage area from GIS contour layers. Minor modifications were made to the Bull Run watershed GIS file by the Water Bureau in order to correct inaccuracies in the source area boundary in the vicinity of Bull Run Dam No. 2 and Headworks.

## **Identification of Sensitive Areas**

The DEQ/DHS guidance manual for source water assessments recommends that once the entire boundary of the source area is delineated, that “sensitive areas” be also identified and delineated within the watershed. The purpose of the sensitive-area delineation is to prioritize a subset of the watershed for the contaminant inventory and protection strategies in order to focus efforts on the portion of the source area that is most susceptible to contamination.

For purposes of the source water assessment, the Portland Water Bureau has elected to designate the entire 102 square-mile watershed upstream of the intake as a sensitive area. The rationale for this designation is that the entire watershed is considered to be a source area for wildlife-related sources of microbial contaminants.

## **Inventory of Potential Contaminant Sources**

The primary purpose of the inventory is to identify and locate significant potential sources of any of the contaminants of concern within the drinking water protection area. Significant potential sources of contamination can be defined as any facility or activity that stores, uses, or produces the contaminants of concern and has a sufficient likelihood of releasing such contaminants to the environment at levels that could contribute significantly to the concentration of these contaminants in the source waters of the public water supply.

Because of the Bull Run watershed’s long history of protection afforded by stringent legislative



and administrative land-use controls, *there are no past or present anthropogenic sources of microbials, bacteriologicals, inorganic chemicals, volatile organic chemicals, or synthetic organic chemicals in the Bull Run water source.*

In the context of the source water assessment, the only contaminants of concern for the Bull Run source are naturally microbial contaminants such as *Giardia lamblia*, *Cryptosporidium*, fecal coliform bacteria and total coliform bacteria. These organisms are found in virtually all freshwater ecosystems and are present in the Bull Run supply at very low levels. The sources of *Giardia* cysts and fecal coliform bacteria in the Bull Run watershed are limited to warm-blooded wildlife species such as deer, elk, cougar, bobcat, black bear, beaver, and muskrat. Sources of *Cryptosporidium* oocysts include most mammalian wildlife species as well as several bird species. Total coliform bacteria are found throughout the terrestrial and aquatic environment and are not associated with any current or previous land uses in the Bull Run. The Bull Run supply has consistently complied with all applicable state and federal regulations for source water under the SDWA, including the 1989 Surface Water Treatment Rule filtration-avoidance criteria.

The Bull Run supply has naturally occurring, low levels of regulated inorganic ions and metals such as nitrate-N, barium, and fluoride, and unregulated chemicals such as radon and sodium. Concentrations of regulated variables at the raw water intake are well below their respective MCLs. Levels of unregulated contaminants are far below concentrations that pose a health concern. As noted earlier, there are no management-related sources of these or other regulated and unregulated contaminants in the Bull Run watershed.

## Susceptibility Analysis

The state's source water assessment methodology defines *susceptibility determination* as “the potential for a public water system to draw water contaminated by inventoried sources within their drinking water protection area at concentrations that would pose concern” (DEQ and OHD, 1999). Whether or not a particular drinking water source becomes contaminated depends on three major factors: 1) the occurrence of a facility or land use that releases contamination, 2) the location of the release, and 3) the hydrologic and/or soil characteristics in the watershed that allow the transport of the contaminants to the surface water body.

As noted in the Inventory section of the report, the Bull Run source has no facilities or land uses – past or present -- that constitute a source of contaminants to the water supply. Thus, the Bull Run has no susceptibility for anthropogenic sources of contamination. The only contaminants of concern for the Bull Run source are naturally microbial contaminants such as *Giardia*, *Cryptosporidium*, fecal coliform bacteria and total coliform bacteria. Wildlife species such as deer, elk, cougar, bobcat, black bear, beaver, and muskrat are potential source of microbial contaminants. In the mid-1980's, the Water Bureau constructed a fence around the Headworks diversion pool to prevent beaver, muskrat, and other mammalian sources of microbial contaminants from having direct contact with the intake system water body. However, there are no additional steps that the Water Bureau and its partner agencies in the Bull Run source protection program can take to control these natural sources of microbial contaminants.

# Summary and Recommendations

This report fulfills the state and federal regulatory requirements under the 1996 Safe Drinking Water Act to conduct a source water assessment for the Bull Run water source. The delineation section of the report identified that the intake for the Bull Run supply is located at River Mile 6.2 on the Bull Run River, approximately 26 miles east of downtown Portland. The drinking water protection area for the Bull Run water supply is comprised of a 102 square-mile area upstream of the intake. Ownership of the drinking water protection area is comprised of U.S. Forest Service land managed by Mt. Hood National Forest (95%), City of Portland land (4%), and BLM land (1%).

The watershed boundary delineation for the report was performed using GIS methods. The water-supply drainage GIS file was initially developed by the Mt. Hood National Forest and was modified by the Portland Water Bureau to refine the accuracy of the boundary in the vicinity of Bull Run Dam No. 2 and the Headworks. From a practical, historical perspective, a protection boundary for the Bull Run source was essentially first delineated in 1892 when the 219 square-mile Bull Run Reserve was established by a Presidential proclamation. A series of federal administrative and legislative actions since 1892 have modified the name and geographic boundary of the Bull Run protected area to form the current Bull Run Management Unit, a 143 square-mile area is closed to public access and has strict controls on forest land uses. City-owned land within the Bull Run Management Unit is closed to public entry by City ordinances.

The Water Bureau has elected to designate the entire 102 square-mile drainage upstream of the Bull Run supply intake as a sensitive area for purposes of the source water assessment. The only contaminants of concern for the Bull Run source are naturally occurring microbial contaminants such as *Giardia*, *Cryptosporidium*, fecal coliform, and total coliform bacteria. The source of these contaminants are wildlife species that reside in and migrate through the watershed. Because of the protection afforded to the Bull Run by a combination of federal legislation, regulations, administrative plans, and Forest Service/City of Portland policies, there are no human-related sources of regulated or unregulated contaminants of concern. The Bull Run water system has no susceptibility to human sources of regulated or unregulated contaminants of concern and complies with all state and federal requirements for source water quality, treatment techniques, and source water monitoring regulated under the SDWA.

No additional amendments to legislative protections for the Bull Run Management Unit are being proposed at this time. The wide array of protections provided to the Bull Run source by legislation, administrative plans, and federal and City policies collectively comprise a protection plan that far exceeds the state's recommendations for a voluntary-based source protection program. Nevertheless, the City of Portland and the Forest Service continue to strive for incremental improvements in the source protection program for the watershed and have embarked on an effort to update their Memorandum of Understanding. The updated agreement is scheduled for adoption in 2006 and will redefine the roles and responsibilities of the two agencies in an effort to guarantee effective stewardship of this precious resource well into the 21<sup>st</sup> century.

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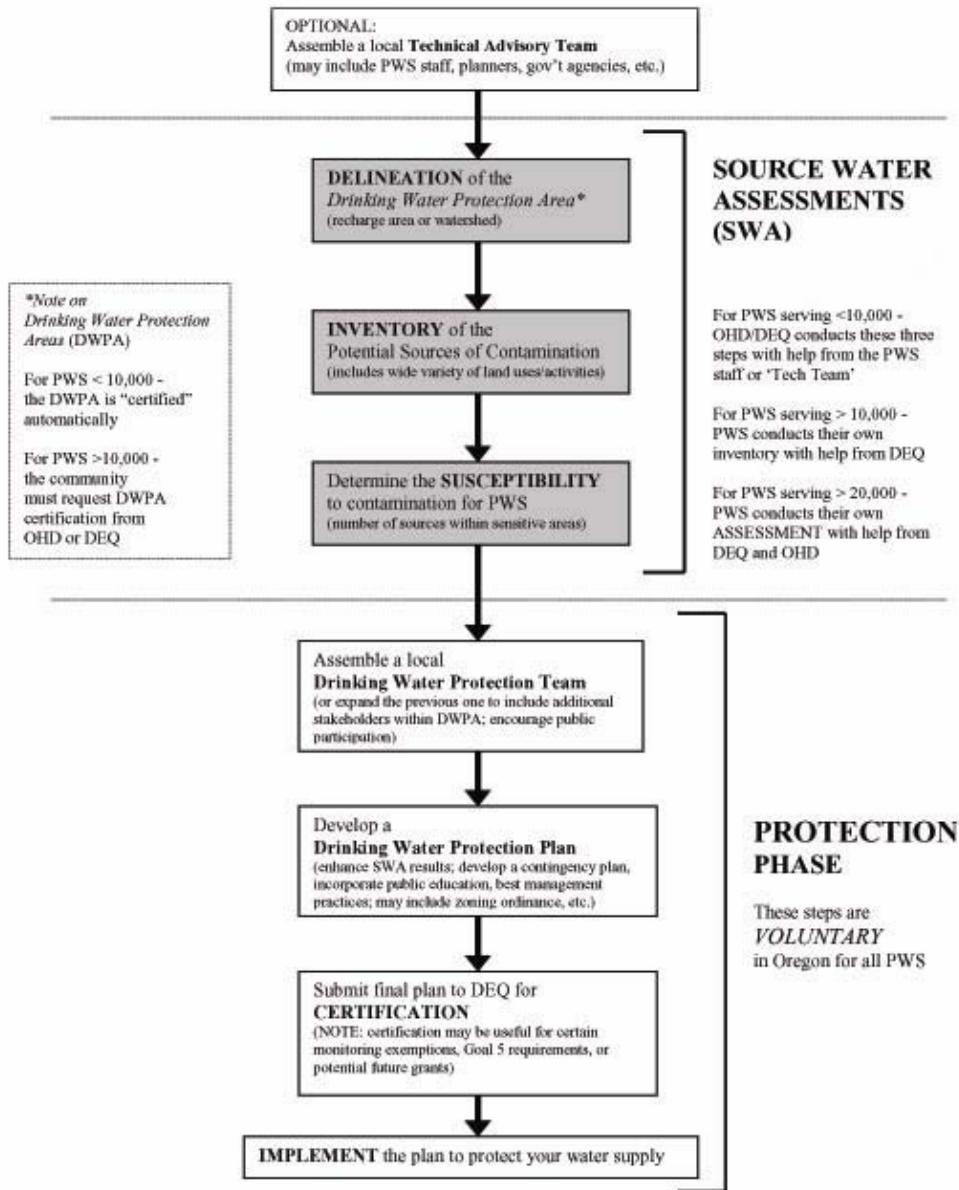
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Figure 1  
**Oregon's  
 Drinking Water Protection Process  
 for Public Water Systems (PWS)**



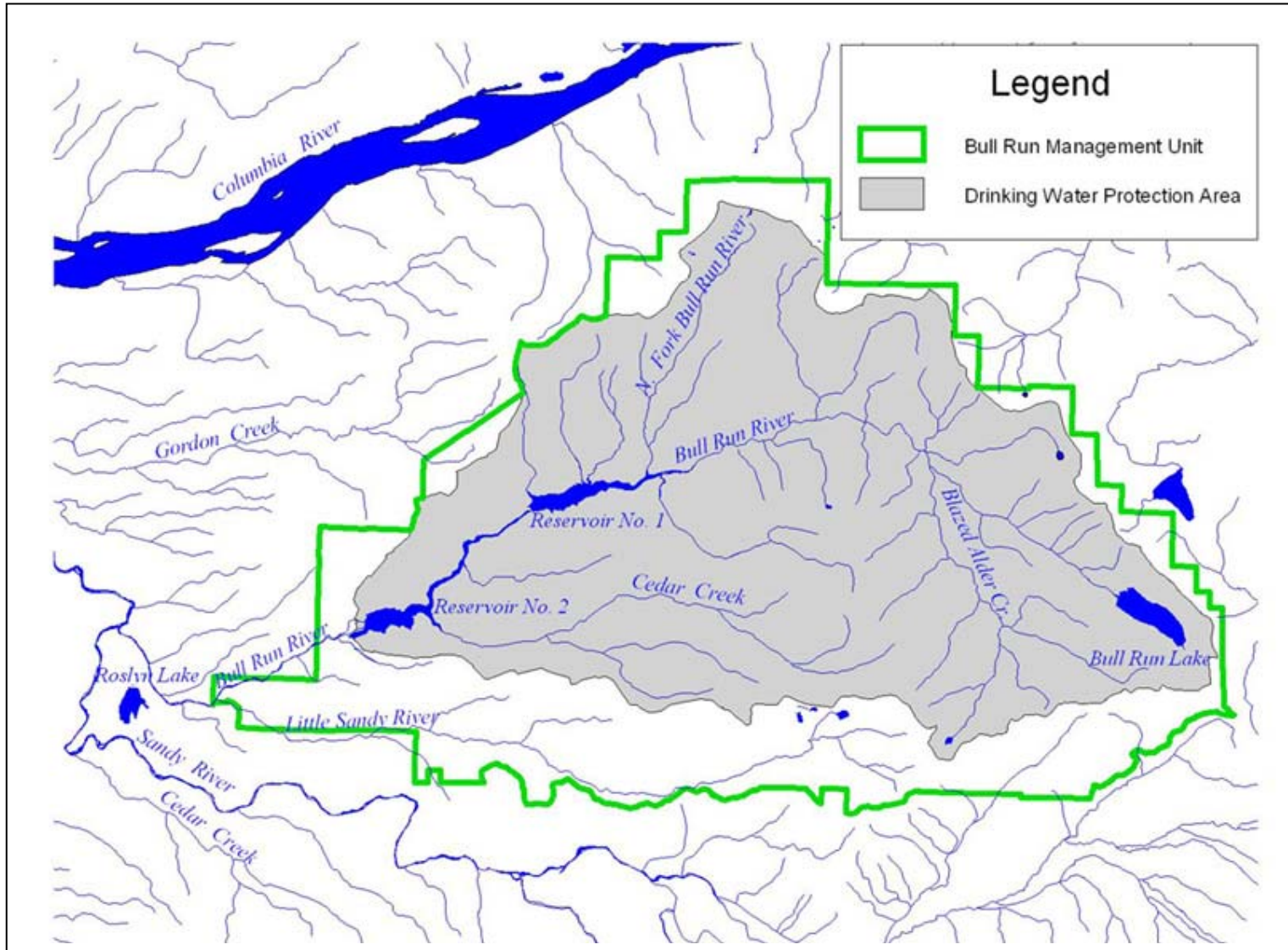


Figure 2. Drinking Water Protection Area for the Bull Run Water Supply.