

GROUNDWATER:

City identified risks, must develop a long-term plan to address them

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P O R T L A N D
CITY AUDITOR
Audit Services



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Groundwater:

City identified risks, must develop a long-term plan to address them

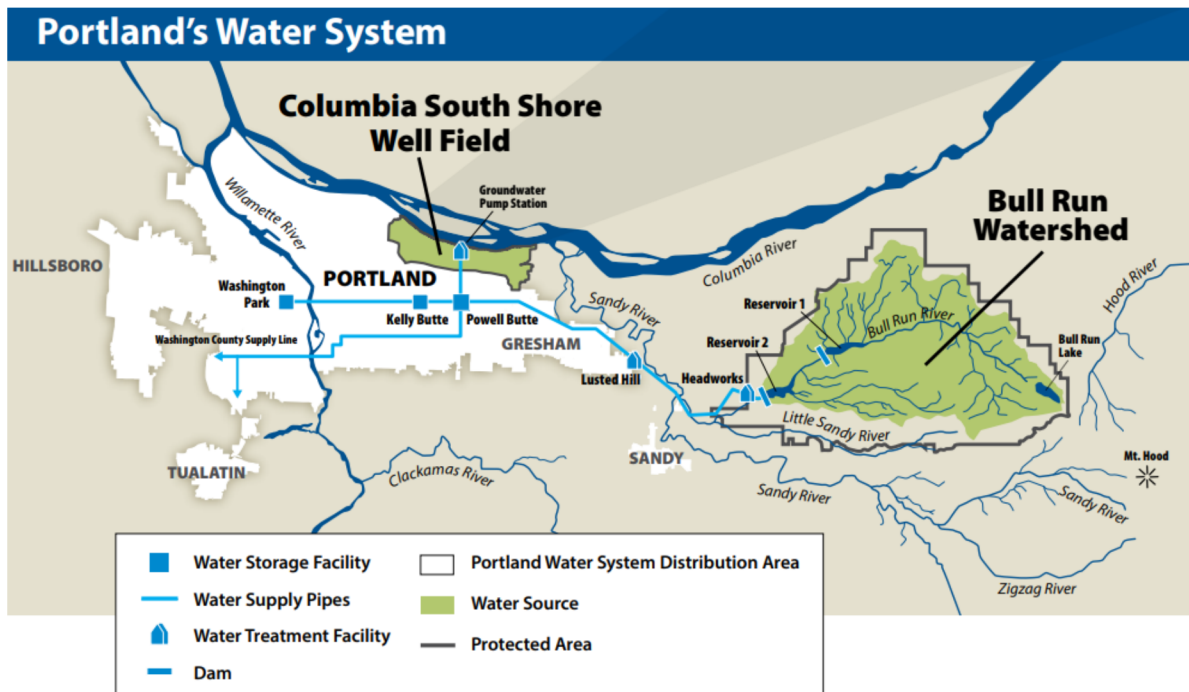
Summary

Portland's Bull Run watershed is often in the news as the City debates how best to protect this pristine water source. But the City's secondary water source, its groundwater system, gets scant attention. Given the time and money spent on protecting Bull Run, this audit asked whether the Water Bureau is managing the groundwater resource to ensure it is available in times of emergency or scarcity.

The Bureau has work underway to meet the groundwater challenges of seismic and emergency preparedness, water quality and capacity planning, and asset management. And groundwater was a priority in the Bureau's recent comprehensive strategic plan, although budget and other priorities may limit implementation of some actions. To ensure this important water source is well-positioned to meet the City's water needs now and in the future, we recommend the Water Bureau formalize its decision-making roles and organizational structure for groundwater management, and develop a long-term plan to prioritize groundwater system need.

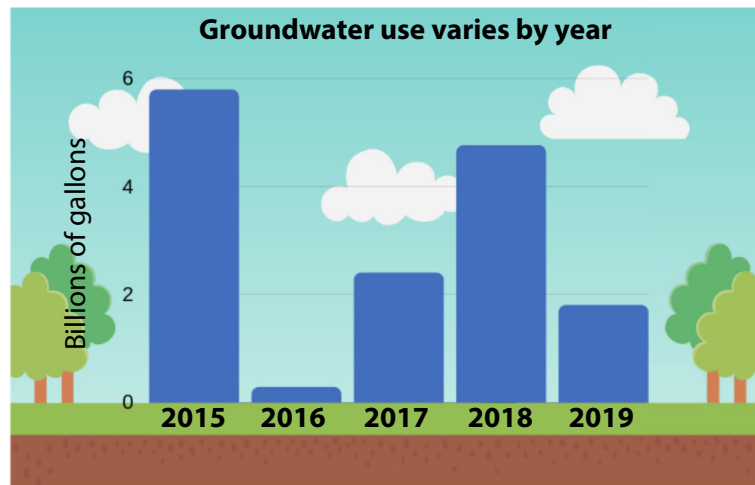
Background

The City began using water from the Bull Run watershed east of Portland in 1895. In the 1980's, floods, landslides, reduced clarity in drinking water reservoirs, and an increased demand for water led the City to start using groundwater found in aquifers along the Columbia River as a secondary water source. The Bureau developed the area, known as the Columbia South Shore Well Field, by drilling wells for pumping water and monitoring water quality. The groundwater system is the second largest water source in Oregon, after Bull Run.



Source: Portland Water Bureau

Groundwater has typically been used for two purposes: meeting summer supplemental water supply needs as determined by the Bureau's planning, and as an alternative to Bull Run water when storms and other natural events make the water in the Bull Run reservoirs too cloudy to safely drink. The term capacity refers to how much water a water source can provide, in accordance with drinking water standards. Groundwater may also be needed if all or part of the Bull Run water supply is unavailable because of emergencies, such as wildfires, landslides, earthquakes, act of vandalism, or terrorism. As a system that is only used occasionally and is less high profile than Bull Run, it hasn't been a priority for either the Bureau or the public, despite its importance.



Source: Portland Water Bureau

Some uses of groundwater are likely to decrease in the coming years. The City plans to build a plant to filter Bull Run water by 2027, which will eliminate the need for groundwater during times of turbidity. And some wholesale water customers who purchase water from the City are planning to stop doing so, meaning more water from both Bull Run and groundwater will be available for Portlanders.

At the same time, strains on the groundwater system are growing. Manganese is infiltrating some of the system's high-producing wells, making their water unpalatable for drinking. And a group of chemicals known as PFAS are considered an emerging contaminant that may eventually be regulated.

PFAS are a group of chemicals that have been manufactured and used in a variety of industries since the 1940's. They can be found in food packaging, carpets, fire-fighting foams, nonstick products such as Teflon, and other products. PFAS have been found in some of the groundwater monitoring wells.

The term **turbidity** refers to how clear a liquid is. Clay, silt, algae, and other organic material can make water turbid. Winter storms are the main cause of turbidity in Bull Run water, which can make it unsafe to drink because turbid water is more likely to contain cryptosporidium or other harmful bacteria.

Manganese is a naturally occurring mineral that at current levels in some wells can make the water unpalatable. It is not yet considered enough of a health issue in drinking water by the U.S. Environmental Protection Agency for it to impose maximum levels. However, that may change, and the Bureau wants to keep its manganese levels low. Canada has established a maximum allowed level and that may also happen in the U.S.

Increasingly warm summers are taxing both of the City's water systems, and that is expected to increase as climate change worsens. Warming summers can increase the conflicts between fish preservation and water use, and there are many mechanical components involved in pumping groundwater, which also consumes a lot of electricity. The components of the City's groundwater system don't reach the end of their useful life as quickly as they might because it is not always in use, but the groundwater system is more than 30 years old.

Audit Results

The Water Bureau's objective for the groundwater system is to invest in infrastructure and staffing to ensure reliable performance and annual availability of the City's groundwater system as a seasonal supplemental source of drinking water and emergency backup. To accomplish this objective, the Bureau would need to:

- Establish a clear organizational structure and assign responsibility and authority;
- Identify and analyze risks; and
- Respond to identified risks.

We found that the Bureau was performing well in these areas but could clarify and document its organizational structure and needs to respond to the risks it faces.

Collaborative management structure should be defined and documented

A combination of summer heat and winter storms, as well as the intrusion of contaminants, has added new urgency to the pressures on the City's groundwater system in the past few years. The Water Bureau knows the system cannot provide as much water as it has historically, but is not confident in its understanding of the true capacity. It also does not know what the future demand for groundwater will be. For these reasons the Bureau made the groundwater system a high priority in a comprehensive strategic planning process it recently completed.

Managers in three divisions of the Bureau – Operations, Engineering, and Resource Protections – are responsible for day-to-day management of the groundwater system. Even though system management is largely decentralized, these roles and authority across the divisions have not been documented. The Director of Operations has ultimate authority for the program, but does not supervise the Engineering or Resource Protection managers who work on groundwater. The Director of Operations has a broad range of responsibilities at the Bureau and doesn't function as the coordinator of the groundwater program.

Staff and managers from the three divisions meet periodically as the Groundwater Steering Committee. Bureau management said issues that come before the steering committee have generally already been analyzed, and that the group discusses options for how to best address those issues, however, it isn't clear how decisions are made once presented to the steering committee.

Three divisions have a role in groundwater management:



Groundwater is an interdisciplinary system, and the decentralized approach allows the various areas of expertise in the Bureau to be considered. But the number of people involved, and the lack of a single coordinator for the program, may make decisions take longer than necessary. Some managers said the structure mostly works well, but can be overly focused on operational needs rather than other needs or long-term strategy. Clearly defining roles and decision-making could help move projects along in a system where no one person has all aspects of groundwater management as their sole focus.

The Bureau has identified and analyzed various risks to groundwater

Risks to the groundwater system are similar to risks to the water system as a whole, including seismic preparedness, emergency management, water quality and capacity, and aging infrastructure. The Bureau has incorporated groundwater into its planning and risk assessment for all of these issues, and demonstrated a commitment to fully understanding those risks.

Seismic preparedness

The 2013 Oregon Resilience Plan requires that the State and its cities are ready for a 9.0 magnitude earthquake on the Cascadia Subduction Zone by 2063. The Water Bureau completed a Seismic Study in 2017 and an implementation plan for the actions recommended by the study in 2018. The study and the implementation plan are designed to meet the Oregon Resilience Plan deadlines.

The major risk to the system is that the well field is in a liquefaction zone. Liquefiable soil acts like a liquid when placed under stress, such as during an earthquake. At least half of the wells are expected to fail during a major earthquake. Some work has already been done to seismically prepare the groundwater system, but seismically “hardening” the well field is estimated to cost \$200 million. Hardening of the groundwater system is considered a medium priority because of the costs and other higher priority projects. The top priority is to harden the conduits from Bull Run.

Emergency preparedness

An Emergency Action Plan for groundwater details what actions to take during an emergency, and is part of the Bureau’s larger Emergency Action Plan. As of fall 2019, an update to the plan was in the works. The Bureau conducts Cascadia Subduction Zone earthquake drills at its Emergency Operations Center, and a new earthquake drill is planned for later this year that will include groundwater.

Recently, the Bureau developed a plan for specific actions to take within the first hours after a major earthquake to stabilize the water system, even before the Bureau’s Emergency Operations Center is operational. That plan also describes actions to take soon after the immediate stabilization has taken place, but before the Bureau can implement a more formal response.

Water quality and how much water is available

Drinking water is heavily regulated by the federal and state governments. The Bureau collects and analyzes different types of data both to ensure compliance now and in anticipation of future regulations. The U.S. Environmental Protection Agency requires a drinking water quality report be issued every year. The Bureau's 2019 drinking water report shows both Bull Run and groundwater do not exceed maximum EPA contamination standards.

The well field has about 90 monitoring wells to evaluate aquifer conditions and water quality. The Bureau tracks groundwater use and availability in an annual Well Field Use Report, which includes information going back to 1985 describing each use of groundwater.

Maintenance runs of groundwater help ensure all aspects of the system are working well, including water quality. Other tools track groundwater demand and the number of active wells. The Bureau is in the process of hiring a hydrogeologist to help improve its understanding of how much groundwater the system can provide. Previously, it used a consultant to model the need for and timing of groundwater, using weather, streamflow, and other data.

After higher than normal groundwater use in both 2015 and 2018, the Bureau altered its modeling methodology. The Bureau is studying how much groundwater the City will need in the long term, factoring in climate change and contamination. The model is intended to be conservative, factoring in known issues, such as problems with certain wells, as well as some degree of mechanical failure.

The Bureau is concerned about naturally occurring manganese, which has affected three high-producing wells. It is not considered unsafe to drink but poses aesthetic problems in how it makes water look, smell, and taste. A second contamination issue is on the horizon. PFAS, chemicals used in a wide variety of household products, have been found in locations within or near the well field. They are not yet regulated, but the Environmental Protection Agency has issued health advisories on them, which may be a precursor to eventual regulation. The Bureau is monitoring this issue.

A Groundwater Protection Program, focused on industrial pollutants, has been in place since 1988. Under the program, businesses located in the well field must report their chemical use to the Bureau each year. The Bureau partners with nonprofit organizations to provide technical assistance to businesses and can also exact fines for violations if necessary.

Asset Management Plan

The Bureau is finalizing an asset management plan for the groundwater system, which updates a 2012 plan. Asset management combines engineering, economic, and business considerations to identify the most cost-effective and efficient way to manage assets through maintenance, repair, and replacement. Water Bureau assets include reservoirs, pipes, tanks, valves, and other equipment.

Managers said they generally update their asset management plans every five years. The Bureau said there is now a closer relationship between the Operations division and the asset management staff with the addition of a new staff member who acts as a liaison between the two and helps bring an asset management lens to operational decisions. For example, this staff member looks at work orders to make sure Operations is getting the optimal benefit from scheduled maintenance work rather than just adhering to a pre-defined schedule.

The plan includes known program needs over the next 50 years. Key needs include replacing the groundwater motor control centers and groundwater pump station renewals.

Response to the identified risks has lagged in some area

While it is not realistic for the Bureau to address every groundwater need at the same time, it can do more to formulate a plan to address needs that may end up competing with each other for limited resources. For example, if the Bureau determines it should build a plant to address manganese contamination, how might that interfere with plans to make the system more seismically prepared?

Historically, groundwater has not been as high a priority for the Bureau as the higher profile Bull Run system. By the end of audit fieldwork, the Bureau did not provide us with a work plan for the groundwater program. According to several managers, the view of the groundwater system is shifting. At the same time, the Bureau has several major capital projects either underway or planned for the near future, and additional projects must be weighed against the increase in rates. The City is also facing immediate – and possibly longer-term – financial hardship, as it grapples with the outbreak of the novel coronavirus.

The Bureau recently formed teams, including one for groundwater, to help implement a new Bureau-wide strategic plan. Bureau management told us the groundwater team will focus on mid- to long-term planning for the groundwater system.

Developing a long-term plan that identifies all the needs of the groundwater system would help the Bureau schedule and prioritize improvements. A few of those needs are noted here:

Seismic needs of the groundwater system

Although a few parts of the groundwater system have been seismically hardened, the well field is subject to liquefaction, but there are other risks to the water system from a Cascadia Subduction Zone earthquake. Bureau leadership is focused on its “backbone isolation plan,” which focuses on addressing the most important pipes throughout the whole water system first, and acknowledges there “isn’t enough money on this planet” to replace all the pipes.

The State deadline to complete all seismic preparedness work is 50 years, and other Bureau projects are higher priority than groundwater. Addressing the seismic needs of the groundwater system will be costly.

Water quality issues related to manganese, and possibly PFAS

The Bureau is tracking the intrusion of manganese into one of its aquifers, which is affecting water quality in some high-producing wells. It is also tracking PFAS, which may soon be regulated. The Bureau will need to implement responses to water quality challenges. The Bureau has hired consultants to help explore different options for manganese, the most expensive of which is to build a plant to treat for it. Other options include drilling new wells or injecting clean groundwater into contaminated wells.

Uncertainty around how much groundwater is available and how much will be needed in the future

The capacity of the groundwater system is likely to be an ever-changing picture, as the Bureau adapts to climate change, at the same time it is factoring in the planned filtration plant, the loss of several wholesale customers, and water quality issues. It will be important to have as much data as possible, including from an upcoming Supply System Master Plan, to get a handle on both current and future capacity.

Unmet asset management needs

The draft asset management plan for groundwater identifies a short-term funding gap of \$2.7 million, and a long-term gap of \$17.6 million in 2019 dollars. Capital spending on groundwater is included at a constant rate of \$600,000 per year in the plan. The author of the plan said his calculations showed the amount was sufficient to meet most needs, and that other needs are generally included in capital budgets on a one-time basis as they arise.

Recommendations To ensure the groundwater system is managed optimally, we recommend the Portland Water Bureau:

1. Clarify and document the decision-making roles and organizational structure of the groundwater program to help ensure issues are addressed in a timely and complete manner.
2. Document all identified needs for groundwater system improvement. Develop a consolidated, long-term plan to prioritize actions within limited resources.

**Objective,
Scope,
and
Methodology**

Our audit objective was to determine if the Water Bureau effectively manages groundwater. The scope of our review included determining whether the Bureau had established a clear organizational structure and assigned responsibility and authority, had identified and analyzed risks, and had responded to identified risks.

To accomplish our objectives, we:

- Interviewed managers and staff from the Portland Water Bureau, City Budget Office, City Attorney's Office, a staff member for a City Commissioner, a Water Bureau wholesale customer, a member of the Oregon Citizens' Utility Board, members of the Portland Utility Board, the director of the Columbia Slough Watershed Council, the director of the Columbia Corridor Association, and a staff member from the City of Gresham's Water Division.
- Attended a meeting of the Groundwater Steering Committee and a meeting of the Portland Utility Board.
- Conducted Water Bureau site visits at Groundwater Facilities, the Emergency Operations Center, Powell Butte, Bull Run, Washington Park, and Mt. Tabor.
- Reviewed documents related to groundwater best practices.
- Reviewed relevant audits.
- Reviewed Water Bureau documents related to asset management, seismic preparedness, water quality, water capacity, emergency preparedness, capital planning, and strategic plan.
- Reviewed non-Bureau documents related to seismic preparedness, water quality, and water conservation.
- Reviewed capital and operating budgets for groundwater.

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

RESPONSE TO THE AUDIT



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To: Martha Prinz

From: Amanda Fritz, Commissioner-in-Charge, Portland Water Bureau
Michael Stuhr, Director, Portland Water Bureau

Re: Response to Groundwater Management Audit

Date: June 24, 2020

MS 6/25/2020

Thank you for the opportunity to respond to the recommendations outlined in your comprehensive and thoughtful audit of the bureau's Groundwater system.

We note that the audit states that "And some wholesale water customers who purchase water from the City are planning to stop doing so, meaning more water from both Bull Run and groundwater will be available for Portlanders." and "The capacity of the groundwater system is likely to be an ever-changing picture, as the Bureau adapts to climate change, at the same time it is factoring in the planned filtration plant, the loss of several wholesale customers, and water quality issues." At this time, we know of only one wholesale customer, Tualatin Valley Water District (TVWD), that plans to terminate their current wholesale agreement with Portland as early as July 2026.

Overall the bureau agrees with your assessments and is in the process of clarifying roles, responsibilities and defining an appropriate organizational structure to ensure that the Groundwater system will continue to perform as a major asset to the bureau in both the short and long term.

We also agree that we need to address the capital and maintenance needs of the Groundwater system in a structured manner. Through both the Strategic Plan Groundwater Scoping Team and direction to the Groundwater Steering Committee, the bureau will develop a workplan that ensures that our valuable Groundwater system remains a complement to the Bull Run system for generations to follow.



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Auditor's response to the Commissioner's and Portland Water Bureau Director's memo:

The Commissioner in charge of the Water Bureau notes that only one wholesale customer has shared plans to terminate its contract with the City. Interviews with people both in and outside the Water Bureau showed that more than one wholesale customer was expected to leave the system in the future. This was sufficient evidence for us to include the information in the audit report as a future risk.



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Report #527, June 2020

Audit Team: Martha Prinz, Bob MacKay,
Andrea Truong

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