Source Water Protection

# Wellhead Protection Areas: Protecting Drinking Water

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## Wells in Washington State

Groundwater provides drinking water for about 65 percent of Washington's residents—in some counties it approaches 100 percent. Because groundwater can be vulnerable to contamination, public water systems must take preventative measures to minimize the possibility that land uses will contaminate the groundwater below.

## What are threats facing wells?

There are a number of threats to wells, including:

- Improperly disposed of chemicals.
- Animal wastes.
- Pesticides.
- Human threats.
- Wastes injected underground.
- Naturally-occurring substances.

*(Source: Safe Drinking Water Act.)*

Serious health effects from drinking water contamination have been verified and documented.

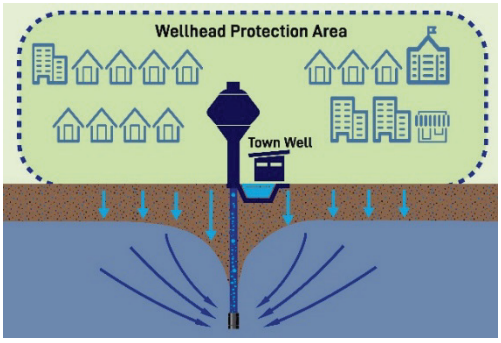
- Cancer.
- Liver, kidney, and nerve problems.
- Birth defects and learning disabilities in children.

*(Source: Arizona Department of Health.)*

## What are the costs of contamination?

Put simply, contamination is very expensive. It is considerably more cost-effective to implement a proactive pollution prevention program to guard against groundwater contamination rather than clean up contamination. Costs for a water system with a contaminated source can include purchase of water while locating an alternate supply, hydrogeologic studies to locate alternate source water, and remediation costs.

On average, cleanup of contaminated groundwater supplies may be 30 to 40 times more costly than prevention. *(Source: EPA.)*




## What are wellhead protection areas?

A wellhead protection area (WHPA) is defined as the surface and subsurface area surrounding a well or wellfield that contaminants are likely to pass through and eventually reach the well(s). Most of the land in any WHPA is not owned or managed by the utility so emphazing good stewardship and local regulations is

important to protect the souce and those who drink those who drink that well water.

WHPA are divided into time periods. Each area represents the length of time it would take a molecule of water to travel from the area boundary to the well.

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| The **sanitary control** area is the area immediately around the wellhead and requires protection from direct contamination. | **1 Year** includes the area that it would take a molecule of water **1 year** or less to reach the well. This area is managed to protect drinking water supplies from viral, microbial, and direct chemical contamination. The 1-year area also includes the six-month time of travel. | **5 years** includes the area it would take a molecule of water **5 years** or less to reach the well. This area is managed to control potential chemical contaminants. | **10 years** includes the area that it would take a molecule of water **10 years** or less to reach the well. This area is managed to recognize the long term source of drinking water and potential contamination of that source. | A **buffer zone** is an area beyond the 10-year area that potentially includes the entire area that contributes water to the well source (zone of contribution). The buffer zone may include non-adjacent critical groundwater recharge areas. |

## Who regulates WHPA?

We develop WHPA through wellhead protection programs. These programs are regulated and mandated by federal, state, and local agencies.

**Federal:** The U.S. Safe Drinking Water Act requires every state to develop a wellhead protection program.

**State:** The Washington State Department of Health (DOH) requires drinking water systems to develop and implement a wellhead protection program.

**Local:** Public water systems must work with local governments, regulatory agencies, and the community to develop and implement their wellhead protection programs.

## What factors influence contamination?

Land use, the well's physical conditions, and surrounding areas influence potential for groundwater contamination.

The well's physical conditions and surrounding area affect the **susceptibility** of the well to contamination. These conditions include well depth, its construction, area geology, pumping rate, source(s) of groundwater recharge, and aquifer material.

The contaminants used or stored in the water supply area affect the **vulnerability** of the water source. These can include presence of fuel or chemical storage tanks, dry cleaners, chemical wholesale operations, and others.

The behavior of a contaminant and the hydrology of an area makes it difficult to accurately predict groundwater pollution from surface exposure.

## How do WHPA affect land use?

Land use planners use WHPA to reduce vulnerability of well contamination. Different protection areas are used to determine where it is appropriate to locate future "high risk" and "medium risk" potential contaminant sources. Government agencies also rely on these areas to determine which potential contaminant sources might pose a risk to safe drinking water and require increased regulatory attention and technical assistance, with emphasis on pollution prevention and risk reduction.

## How are WHPA determined?

There are a few methods of determining boundaries, or delineating, WHPA. Water systems can use any of these methods to ascertain where each WHPA area should be. Each method has various levels of reliability, complexity, and cost.

| | Modeling Methods | | |
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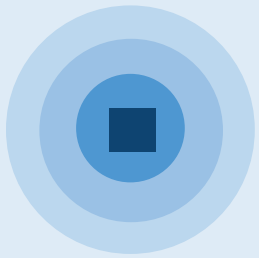
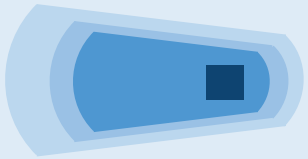
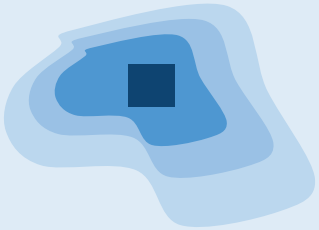
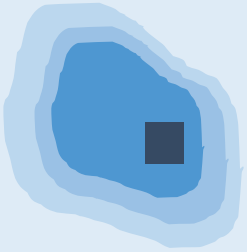
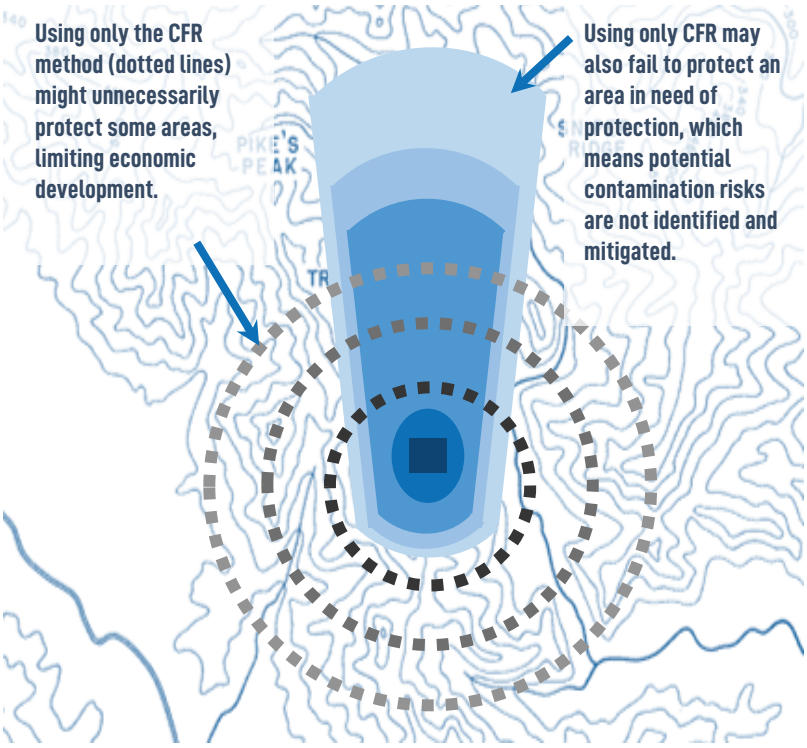
| **Calculated Fixed Radius (CFR)** | **Analytical** | **Hydrogeologic Mapping** | **Numerical Flow/ Transport** |
|  |  |  |  |
| The calculated fixed radius method draws a circular protection area for each protective time period. This delineation method is inexpensive and requires minimal technical expertise. | Analytical methods use simple calculations, graphical methods, or simple analytical solution-based computerized groundwater flow models to delineate WHPA. This method provides reasonable approximation of capture zones for simple groundwater systems, and is relatively inexpensive. | Hydrogeologic maps rely on geologic maps, aquifer water level mapping, aquifer pumping test data, hydrogeological reports and well reports. This method can be highly accurate, good for settings where nearby geologic features strongly control groundwater flow patterns, and is typically much less expensive than numerical modeling. | Numerical flow/transport methods use two and three dimensional computer models that approximate groundwater flow. This method is highly accurate, can be used in all groundwater settings, and can be used for other purposes (such as groundwater management). |

## What limitations are associated with the calculated fixed radius method?

The calculated fixed radius (CFR) method draws circular protection areas for each time period, based on a simple volumetric flow equation. A major drawback to CFR method is that groundwater rarely behaves as simply as this method predicts. As a result, using a CFR method may result in protecting areas that don't need protection, or ignoring areas that might pose a threat (see example, right). The CFR method can be inaccurate and therefore not provide protection where it is needed.

**Calculated Fixed Radius (CFR) Method vs. Analytical Method**




## Choosing the right method for your water system

If you want to increase WHPA reliability in order to safeguard drinking water supplies, consider using a more advanced method (analytical model, hydrogeologic mapping, or numerical flow/transport models) instead of the CFR method. These more advanced methods have the following benefits.

- Reduced chance of water supply contamination.
- Help protect areas that actually need protecting (rather than unnecessarily protecting certain areas).
- Provide greater accuracy, which assists land use regulators in protecting WHPA.
- More appropriate than CFR for most geologic settings in Washington state.
- Help you tell your customers where their water comes from.

The cost of upgrading to analytical modeling, or even hydrogeologic mapping, can be fairly low. Numerical models created by the U.S. Geologic Survey (USGS) already exist for many areas of Washington state. Using USGS models can greatly reduce the cost of switching to a numerical model.

To help you determine which WHPA delineation method is right for your water system use DOH 331-636 *Assessment of Your Wellhead Protection Delineation Method* to evaluate your source(s).

## Resources and information

There are many websites and publications to help you with your wellhead protection program.

### Washington State Department of Health

Our Source Water Protection webpage contains many links and publications to help you with your wellhead protection program, specifically DOH 331-018 *Wellhead Protection Program Guidance Document*.

For more information about wellhead protection programs, please contact the Source Water Protection Program team at SourceWaterProtection@doh.wa.gov.

### U.S. Environmental Protection Agency

Source Water Protection Webpage epa.gov/sourcewaterprotection.

Washington State Department of Health

If you need this publication in an alternative format, call 800.525.0127 (TDD/TTY call 711). This and other publications are available at doh.wa.gov/drinkingwater.