
CHAPTER 8

WELLHEAD PROTECTION PROGRAM

The City of Kent's (City) wellhead protection program is designed to protect groundwater resources supplying its water sources used for drinking water. Development of the wellhead protection program is mandated by the 1986 Amendments to the Safe Drinking Water Act and the Washington State Drinking Water Regulations (WAC 246-290-135). The wellhead protection program builds on the South King County Groundwater Management planning process and is an important local tool for protecting groundwater quality. Delineation of wellhead protection areas helps to identify the most important areas of focus for protecting water supplies and the most appropriate areas to focus limited funding resources.

The City's wellhead protection program began in 1991, when the City applied to the Washington State Department of Ecology (Ecology) for a Centennial Fund grant to help fund the program development. Ecology awarded a grant in 1992. At that time, the City conducted program development efforts with the Covington Water District and Water District No. 111, who were simultaneously developing their wellhead protection programs. Coordination efforts occurred through a Project Review Committee set up for review and input to the process, which included representatives from the three purveyors as well as the Seattle/King County Health Department, the State Department of Health (DOH), and Ecology's Water Quality Program.

The City's first WHPP was completed in 1996. Since then, rapid development has been occurring within portions of the wellhead protection areas, which can pose gradually increasing risk to the City's groundwater supply sources, particularly its Clark, Kent, and Armstrong Springs sources which produce from a shallow aquifer system that is susceptible to contamination. However, in this same time period, the City has been implementing the WHPP and has successfully maintained safe and reliable sources of drinking water.

Wellhead protection techniques that have been completed include adoption of the WHPP, established relationships with local jurisdictions to provide comments on proposed land use developments, WHPA roadside signage, notifications to owners/operators of identified potential contaminant sources, and increased educational awareness including a Water Festival and public presentations on the WHPP. Extensive monitoring of the groundwater system has also been implemented.

In 2008, the City updated its WHPP to address the current land uses and incorporate the wellhead protection information and experience that the City has gained over the previous twelve years. The WHPP is divided into two documents: one for the Clark, Kent, and Armstrong Springs supply sources (referred to collectively as the Phase 1 supply sources); and one for the City's deep wells within the City limits, namely the 208th Street, 212th Street, Garrison, O'Brien, East Hill, and Seven Oaks wells (referred to collectively as the

Phase 2 supply sources). Each WHPP document includes the elements required under Washington State DOH wellhead protection planning guidance.

8.1 HYDROGEOLOGY & WELLHEAD PROTECTION AREA DELINEATION

The City's Phase 1 (Springs) and Phase 2 (deep wells) supply sources withdraw groundwater from distinctly different aquifer systems within the regionally extensive Covington Upland. This necessitates developing a thorough understanding (conceptual model) of hydrogeologic conditions controlling groundwater flow for each set of sources. From that conceptual understanding, a three-dimensional numerical groundwater flow model was developed to represent and simulate the groundwater flow system and its response to operation of the supply sources. The numerical groundwater flow model is the tool used to rigorously delineate the wellhead protection area for each water supply source. In accordance with state DOH wellhead protection guidance, the wellhead protection area for each water supply source is divided into Zones 1, 2, and 3, corresponding to the 1-, 5-, and 10-year times of groundwater travel to the source, respectively. A 6-month time of travel zone is also delineated as a subdivision of Zone 1, and is incorporated into the priority ranking of potential contaminant sources within the WHPA. The hydrogeology and wellhead protection area delineation for the Phase 1 and Phase 2 supply sources are outlined below.

8.1.1 Phase 1 Supply Sources

The City's Clark, Kent, and Armstrong Springs sources derive water from shallow glacial outwash (sand and gravel) aquifers without significant protective confining layers between ground surface and the depth of groundwater withdrawal. Infiltration of precipitation is the principal source of recharge to the local groundwater system. Infiltration is high in the permeable outwash sediments that comprise much of the area, particularly in the foothills east of Clark Springs, where the highest annual precipitation falls. The surrounding uplands are generally capped by low permeability glacial till, but provide recharge through overland runoff to the surrounding, highly permeable glacial outwash deposits. Surface water features, such as Lake Sawyer, Ravensdale Lake, and Retreat Lake, appear to provide some additional recharge to the groundwater system.

Groundwater flow in the area is predominantly east to west, from the high recharge area of the eastern foothills, through two principal aquifers: the Vashon Recessional Outwash (Qvr) and the deeper, older Qc(2) glacial deposits. In the western area, low permeability till lies between the recessional outwash and the deeper Qc(2) aquifer in some locations; however, at the City's Kent Springs and Armstrong Springs properties, the till seems to be absent, and these two aquifers are connected. In these areas, the shallow aquifer is more highly susceptible to contamination.

Because of the east to west flow pattern, groundwater withdrawal from the City's Springs sources creates capture zones that extend eastward from the wellheads. The capture zone represents that portion of the aquifer providing flow to the source(s).

The capture zones were delineated through development of a regional groundwater flow model that encompassed the three Springs sources and surrounding area. The groundwater flow model was used to estimate 1-, 5-, and 10-year time-of-travel capture zones, in accordance with the state DOH wellhead protection guidance.

An assessment of uncertainties in delineating the wellhead capture zones, and coordination of management efforts with the neighboring water districts, resulted in development of a composite Kent/Covington wellhead protection area (WHPA). The composite WHPA includes a buffer beyond the modeled aquifer capture zones that encompasses the surrounding surface water basin. Expanding the WHPA out to the local surface water divides provides a measure of conservatism, in recognition that surface water runoff from till-capped and bedrock uplands can infiltrate into the adjacent glacial outwash aquifer tapped by the Springs sources.

8.1.2 Phase 2 Supply Sources

The City's deep well sources (208th Street, 212th Street, Garrison, O'Brien, East Hill, and Seven Oaks wells) derive water from a series of confined aquifer units that occur deeper than the shallow aquifer system tapped by the Springs sources. The East Hill well is completed in the Intermediate Aquifer. The Seven Oaks well is completed in the next underlying aquifer, termed the Sea Level Aquifer. The 208th Street, 212th Street, Garrison Creek, and O'Brien wells are completed in the deepest identified aquifer system, termed the Deep Aquifer. Low permeability confining layers (aquitards) exist above and below each of these aquifer units. Because they withdraw from relatively deep confined aquifers, the Phase 2 supply sources have low susceptibility to surface contamination.

The majority of recharge to the layered aquifer system is derived from infiltration of precipitation; however, additional recharge is derived regionally from Cedar River water imported into the basin. This occurs via leakage from the City of Seattle's Lake Youngs reservoir, as well as return flow (e.g., septic system discharge) from use of the water.

Within the area of the City's Phase 2 supply sources, groundwater flow in each of the aquifers is generally from east to west. Groundwater flow occurs predominantly horizontally within the permeable aquifer units; however, vertical leakage through the intervening confining layers also occurs, allowing groundwater to move slowly downward from shallower to deeper aquifers. Although the rate of downward leakage is small, it can occur over many square miles and therefore represent large volumes of recharge to the deeper aquifer systems.

In the area of the Phase 2 supply sources, groundwater discharges naturally from the deeper aquifers where they intersect the Green River valley on the west edge of the upland. This groundwater discharge can occur as leakage into the valley-fill sediments, springs on the valley walls, or as evapotranspiration. Additional discharge

from these aquifers can also occur as vertical leakage between units, well production, springs becoming stream baseflow, and/or evapotranspiration.

Groundwater withdrawal from the City's Phase 2 wells creates capture zones that extend generally eastward from the wellheads. As conducted for the Phase 1 supply sources, a numerical groundwater flow model was used to estimate 6-month, 1-year, 5-year, and 10-year time-of-travel capture zones for the Phase 2 wells. The WHPA for each well was then established to include a buffer around the modeled 10-year capture zone, to address uncertainties in the capture zone modeling. Because of the proximity of the City's four Deep Aquifer wells, a composite WHPA was established.

8.2 POTENTIAL CONTAMINANT SOURCES

Within the defined WHPAs for the Phase 1 and Phase 2 supply sources, the potential groundwater contaminant sources were identified and ranked according to their estimated potential risk to groundwater quality. Potential contaminant sources were identified based on review of land uses within the WHPA, review of regulatory agency database lists and files, and a windshield survey to reconnaissance for other potential land use activities of interest and confirm the regulatory database information.

The priority ranking of potential contaminant sources was performed in accordance with applicable EPA and state DOH guidance. The inventory and ranking methodology was reviewed by the Project Review Committee during preparation of the 1996 WHPP, and the same basic methodology has been retained for the 2008 WHPP. Proximity to the wellhead (which WHPA zone) was the criterion given the highest prioritization. Within a WHPA zone, potential contaminant sources were then further prioritized based on the type of contamination and the severity of the contamination. The identified potential contaminant sources for the Phase 1 and Phase 2 supply sources are summarized below.

8.2.1 Phase 1 Supply Sources

Numerous potential contaminant sources are identified within the Armstrong Springs WHPA. The primary risks occur within the surrounding, relatively high density urban development that occurs within the Zone 1 WHPA. This includes potential for contaminant releases from commercial facilities (e.g., leaking underground storage tanks and other chemicals), as well as residential land use (e.g., infiltration of stormwater potentially containing fertilizers, pesticides, petroleum, and/or metals, on-site septic tanks, and/or home heating oil tanks). Other identified potential contaminant sources within Zone 1 include sites with discharges permitted under the National Pollution Discharge Elimination System (NPDES), transportation corridors (pesticide applications and potential for spills), and sites where hazardous wastes are handled. Similar types of sites occur within Zones 2 and 3, but they are ranked as lower risks due to distance from the supply source. Within Zone 2, Kent Junior High School is the highest ranked potential risk, because it had a leaky underground fuel storage tank and, based on the available data, has petroleum-impacted groundwater.

The highest ranked potential risk within Zone 3 is the current King County regional maintenance facility, where hazardous materials are handled and petroleum cleanup has been conducted. This facility is proposed to be re-located to the east, within the Clark Springs WHPA.

Within the Kent Springs WHPA, the highest ranking potential risks, located in Zone 1, include residential land use (south and west of the supply source), a site that has generated hazardous waste, and transportation corridors. There are no known contaminated sites identified within Zone 1. There are two cleanup sites identified within Zone 2 that warrant tracking of the cleanup process - the Plum Creek/Ravensdale Property and Reserve Silica Corporation sites. Forestry and mining land uses occurring within Zone 2 are ranked 6 and 9, respectively. Also identified within Zone 2 are a RCRA handler of hazardous waste (Kanaskat Drums) and the Lake Retreat Camp and Conference Center with an operational UST (not identified as leaking).

Within the more rural Clark Springs WHPA, the three identified highest-priority risks are contaminated sites in Zone 1, with the Landsburg Mine site ranking as the highest risk to the Clark Springs source. The Safford property and Bremmeyer Logging Company sites rank as 2 and 3, respectively. Residential land use and transportation corridors in Zone 1 rank 4 and 5. Forestry and mining land uses, in Zone 2 and Zone 3, respectively, rank lower. In addition, King County has plans to move its regional maintenance facility, now in Armstrong Springs Zone 3 (described above), to a parcel near the northern edge of the Clark Springs Zone 2 WHPA. Because the facility does not exist, nor is its precise future location known, it represents a potential future risk to keep track of, but is not included in the ranking of current potential risks.

8.2.2 Phase 2 Supply Sources

Potential contaminant sources were also identified and ranked for Phase 2 supply sources; however, because the Phase 2 wells withdraw groundwater from low susceptibility (deeper confined) aquifers, the identified potential contaminant sources represent lower risk than those identified for the Phase 1 Springs sources. In other words, a top-ranked contaminant source for one of the Phase 2 wells is of less concern than a top-ranked contaminant source for one of the Springs sources.

The risk ranking identified 30 potential contaminant sources within the Deep Aquifer wells WHPA. Five of the potential sources are located within Zone 1, and 24 are located in the buffer zone that was added to the WHPA for conservatism. Within Zone 1, the highest risk identified for the Deep Aquifer wells is potential (hazardous) waste handling practices at commercial facilities, and the immediately adjacent transportation corridors and residential land use. Pilchuck Contractors is the only identified contaminated site (petroleum cleanup) in Zone 1, and is ranked number 1

for risk to the wellhead based on its proximity to the 212th Street wellhead. Stormwater discharge from construction activities was identified as the only potential source of contamination in Zone 2. No potential contaminant sources were identified in Zone 3. The remaining 24 potential contaminant sources identified in the Deep Aquifer wells WHPA are located within the buffer zone. Five of them are listed as contaminated sites (including a LUST). One of the contaminated sites is a dry cleaner, which had chlorinated solvent contamination. Chlorinated solvents, because of their transport behavior (heavier than water so they sink) and toxicity, are contaminants of high concern for protection of the deep wells. Other ranked potential sources in the buffer zone include twelve hazardous waste generators, three UST sites, one metals recycler or solid waste facility, and stormwater runoff.

The largest number of potential contaminant sources (52) are identified within the East Hill WHPA, which is the largest of the Phase 2 well WHPAs. Residential land use (sewered), transportation corridors, a hazardous waste generator (American Power Systems), and a (permitted) construction stormwater discharge are ranked as the top four risks, respectively, within Zone 1. There are no known contaminated sites within Zone 1. Identified potential contaminant sources within the Zone 2 WHPA include six petroleum-contaminated sites, seven generators of hazardous waste (including probable chlorinated solvents), two UST sites, and three potential stormwater runoff sources. Eight sites/land uses were identified within the East Hill Zone 3 WHPA: four petroleum-contaminated sites, residential land use (on septic), a hazardous waste generator, and a UST site. The remaining twenty-two potential sources identified are located within the buffer zone. This includes six petroleum contaminated sites, eleven hazardous waste generators, four UST sites, and one permitted construction stormwater discharge.

The risk ranking identified eleven sites/land uses within the Seven Oaks well WHPA. No contaminated sites are identified in Zones 1 through 3. Residential land use (sewered), a UST site, transportation corridors and a hazardous waste generator are ranked as the next top four risks, respectively, in Zone 1. The hazardous waste generator may use chlorinated solvents as a degreaser or parts cleaner. Stormwater pollution from construction activities was identified as the only potential source of contamination in Zone 2. No potential contaminant sources are identified within Zone 3. Six potential contaminant sources are listed within the buffer zone of the Seven Oaks well WHPA: one petroleum-contaminated site, two UST sites, and three permitted construction stormwater discharges.

8.3 MANAGEMENT STRATEGIES

During preparation of the 1996 WHPP, wellhead protection management tasks were developed based on tasks included in the South King County GWMP, adapted to the specifics of the WHPA for the City's Springs sources. Forty-eight tasks were initially developed in coordination with the Wellhead Protection Project Review Committee. These tasks were

created to help mitigate the identified high priority risks to groundwater quality. Management strategies were then developed, based on the concept of managing the tasks in certain ways to implement the program.

Since that time, the City has been implementing its WHPP, and adapting the wellhead protection management strategies to reflect changes in land use and political jurisdictions within the WHPA. Based on that, the management strategies carried forward for application in the City's WHPA are as follows:

8.3.1 Management and Cooperation Strategies

- Maintain a central point of contact for the City's wellhead protection program.
- Provide current WHPA maps to controlling jurisdictions.
- Send notification letters to owners/operators of identified potential contaminant sources.
- Stay involved with South King County Groundwater Management Committee.
- Encourage best management practices (BMPs) in land management activities.

8.3.2 Land Use Strategies

- Review pending land use permits.
- Develop an automated notification process for pending land use permits.

8.3.3 Regulatory Strategies

- Track state cleanup sites.
- Participate in future updates to critical aquifer recharge area regulations.

8.3.4 Planning Strategies

- Promote protective stormwater management.
- Obtain notifications of hazardous materials spills.
- Map petroleum pipelines and develop emergency response.
- Encourage use of sewers and develop emergency response measures.
- Encourage farm planning.

8.3.5 Data Management Strategies

- Monitor groundwater.
- Inventory underground storage tanks (within Zone 1 of the WHPA).
- Track the state's inventory of dry wells.

- Track pesticide use.
- Inventory abandoned wells.

8.3.6 Education Strategies

- Target public education programs in the WHPA.

8.4 OTHER WHPP ELEMENTS

The WHPPs also include a Monitoring Plan, Spill Response Plan, and a Water Supply Contingency Plan, as required by the state DOH wellhead protection guidance. These plans are described below.

8.4.1 Monitoring Plan

The Monitoring Plan defines a baseline program for continued water level and water quality monitoring to measure potential water quality degradation, and provide an early warning of changes to groundwater quality or quantity within the WHPA. The monitoring program will be adjusted based on concerns with specific land use or other changes in the WHPA, and/or observed changes in groundwater quality, over time. Because of the unique conditions of the Phase 1 Springs sources relative to the Phase 2 deep well sources, including hydrogeologic conditions and identified potential contaminant sources, the WHPP for each provides a Monitoring Plan tailored to the supply sources and their relative susceptibility.

The Monitoring Plan for the Phase 1 supply sources includes monthly water level and field parameter measurements, and quarterly water quality monitoring for nitrate, at the locations currently being monitored. Nitrate is an important water quality indicator for the urbanizing land uses that are occurring within the WHPA. If nitrate concentrations are observed to increase over time at a location, chloride analysis would be added at that location to help determine the cause of the increasing nitrate (e.g., help differentiate septic from fertilizer influences). Once per year during the dry season, each groundwater location would also be sampled for volatile organic compounds (VOCs), which include a wide range of the generally more mobile contaminants associated with common contaminant releases (e.g., fuels and solvents). In addition, the quarterly groundwater samples from wells located near the Landsburg Mine site will be analyzed for VOCs and petroleum hydrocarbons to monitor for presence of the more mobile contaminants associated with that high priority site.

The Monitoring Plan for the Phase 2 supply sources follows the same water level and water quality monitoring schedule described above for the Phase 1 Springs sources. The Phase 2 monitoring program includes monitoring of existing deep water wells for which well owner permission is obtained.

8.4.2 Spill Response Plan

Spill response planning exists through integrated national, state, and local agencies. However, because most spills are small and require local response, the Spill Response Plan focuses on local response capabilities and needs associated with these local response systems. Depending on the nature and location of the spill incident, the local Fire Department and the State Patrol are normally the first responders for highway-related incidents, and Ecology is the regulatory lead for environmental cleanup following a spill. Locally, the City of Kent is responsible for assisting the local fire districts with Hazardous Material Response within the WHPA. The City has a hazardous material emergency response plan which identifies the personnel and procedures that are used in response to a hazardous materials incident within the WHPA. The Spill Response Plan is the same for the Phase 1 and Phase 2 supply sources.

8.4.3 Water Supply Contingency Plan

The Water Supply Contingency Plan identifies possible steps that could be taken to seek alternate supplies of water if one of the City's key water supply sources becomes contaminated or otherwise unusable. The Contingency Plan for the Phase 1 supply sources assumes loss of Clark Springs. The Contingency Plan for the Phase 2 supply sources assumes loss of the East Hill wellfield. Depending on how long a source is not available, the options include purchasing water via existing interties, treating contaminated groundwater at the source, or exploring for new sources of groundwater.

