WELLHEAD PROTECTION PROGRAM

Borough of Grove City, Pennsylvania

July 1993

Submitted To:

U.S. Environmental Protection Agency
Region 3

Prepared By:

HORSLEY & WITTEN, INC.
ENVIRONMENTAL SERVICES

WASHINGTON, DC • BARNSTABLE, MA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

member of the Utility Committee and the Borough Manager attended a workshop in Grove City, sponsored by EPA Region 3 on 5 May 1993. Also present were representatives of the Pennsylvania Rural Water Association and the Pennsylvania Department of Environmental Regulation and the EPA. All of these organizations will play key roles in the development and implementation of a wellhead protection program for Grove City.

The Grove City Borough should set up a wellhead protection committee made up of local officials (including water department, planning board, and the Borough Manager), a representative of Pennsylvania DER, and a representative of the Pennsylvania Rural Water Association. Specific duties of each member should be defined by local officials. The Grove City Borough Water Department is responsible for delivering potable water to consumers and it may be the most appropriate lead agency for the wellhead protection program. Technical assistance is available from Pennsylvania Rural Water Association, Pennsylvania Department of Environmental Regulation and the U.S. Environmental Protection Agency.

Step #2 - Delineation of Wellhead Protection Areas

The Borough of Grove City is dependent upon ground water as its source of drinking water. Three wells (#1,2 and 3), located in the downtown area, were abandoned due to trichloroethylene (TCE) contamination. Four new wells (#4, 5, 6 and Memorial Park) currently serve 8,162 Grove City and 890 Pine Township residents. These four wells have a rated maximum pumping capacity of 2.6 million gallons per day (MGD), and an average pumping rate of 1.2 MGD (or 46% of capacity).

Wells #4, #5, and #6 are approximately 350 feet deep and tap the Upper and Lower Connoquenessing Sandstone Aquifer which is confined between layers of low-permeability shale. A great deal of hydrologic information can be obtained from the pumping tests of the Grove City wells, the tests immediately preceded most of the constant pumping rate tests with step tests without sufficient recovery before beginning the constant rate long-term tests.

GROVE CITY
WELLHEAD PROTECTION PROGRAM

Introduction

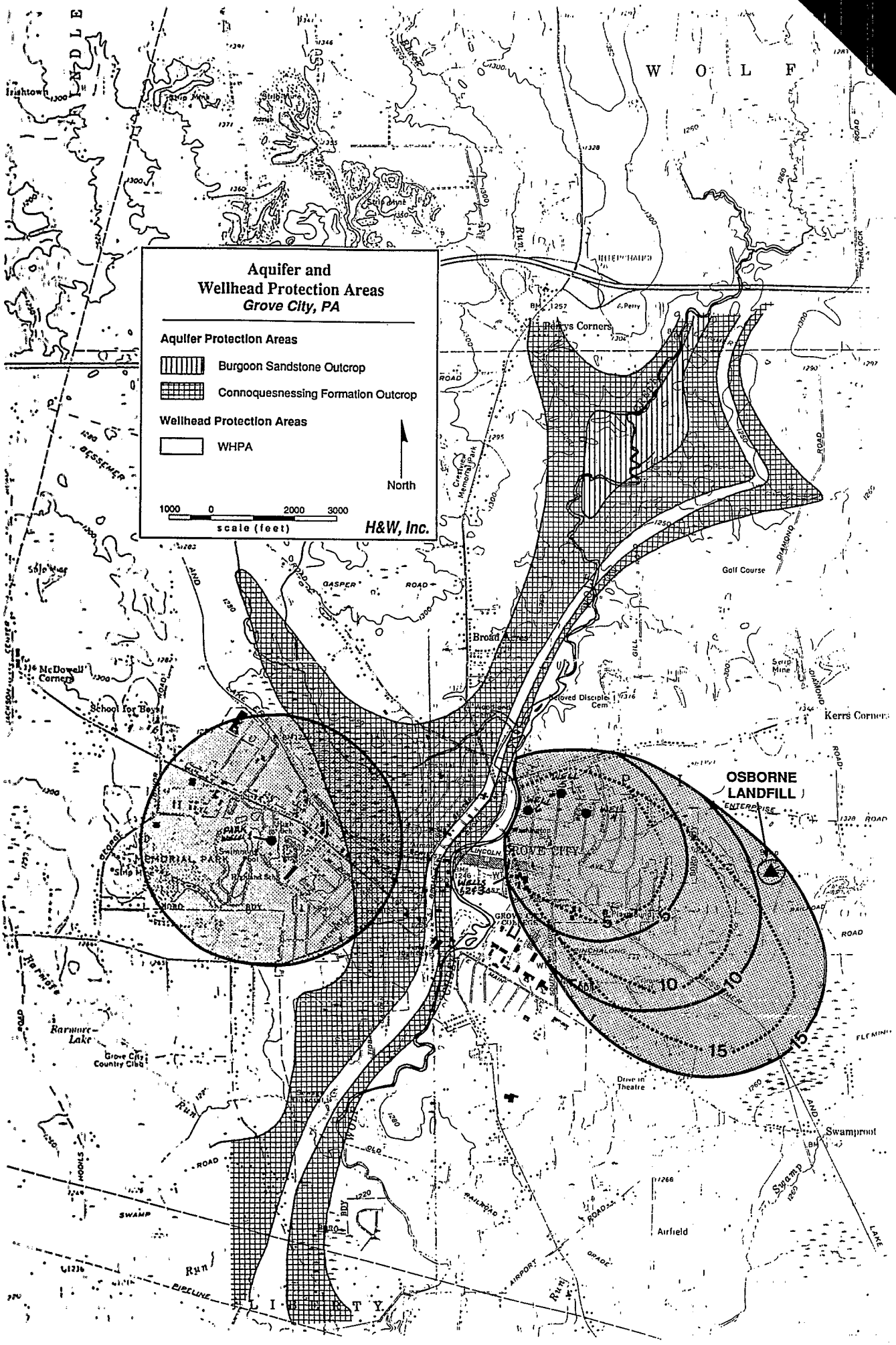
The wellhead protection (WHP) program was established in 1986 after amendments to the Safe Drinking Water Act (SDWA). The WHP program was designed for, and has been extremely successful in, protecting ground water which supplies wells and wellfields that contribute drinking water to public water supply systems. Wellhead protection requires the participation of all levels of government. The foremost responsibility for ensuring that ground water is adequately protected lies at the local government level.

Purpose

Because of their interest in promoting wellhead protection in local communities, Region 3 of the Environmental Protection Agency (EPA) funded a project to provide wellhead protection in two Pennsylvania communities, one of which is Grove City. The purpose of this project was to provide "hands on" training for applying EPA's Wellhead Protection Program. This report summarizes our analysis of background materials, a site visit, and a public meeting coordinated in Grove City, Pennsylvania. It is structured according to the five steps for wellhead protection outlined in the Safe Drinking Water Act Amendments of 1986. The report was prepared by Horsley & Witten, Inc. (H&W) under contract to the EPA Region 3 office in Philadelphia, Pennsylvania. The project was also coordinated with the Pennsylvania Rural Water Association and the Pennsylvania Department of Environmental Resources.

Step #1 - Identify Duties and Responsibilities

The primary contact for coordination of the wellhead protection program has been the Borough of Grove City. Three members of the Borough Council, a


Aquifer and
Wellhead Protection Areas
Grove City, PA
Aquifer Protection Areas
Burgoon Sandstone Outcrop
Connoquesnessing Formation Outcrop
Wellhead Protection Areas
WHPA
North
1000 0 2000 3000
scale (feet)
H&W, Inc.
OSBORNE
LANDFILL
GROVE CITY
MEMORIAL PARK
Barmore Lake
Grove City Country Club
Drive-in Theatre
Airfield
Golf Course
Kerrs Corners
Broad Acres
McDowell Corners
School for Boys
Berrys Corners
Swampfoot
5
10
15

Analyses for aquifer properties are not possible from these data effected by the step tests. The data also could not be analyzed with the Jacobs equations for distance-drawdown because the more distant observation well (#6 at 900 feet) had a greater drawdown that a closer observation well (#4 at 800 feet). This deviation from expected conditions indicates that the aquifer transmissivity and/or storativity are not homogeneously distributed throughout the aquifer. However, analysis of one test, that of pumping well #6 while observing water levels in well #4, which was not effected by a step test, yields a transmissivity of 55,000 gpd/ft. and an artesian (confined conditions) storativity of 0.0001. Radii of influence calculated with these confined aquifer values would be exceedingly large (about 5 miles after 2 days!). Possible reasons could be that the town overlays deep coal mines and this well could be inducing flow from Wolfe Creek.

All of the semilog plots of drawdown versus time showed boundary conditions were encountered during the tests. Pumping well #4 at 310 gpm showed the development of steady state conditions in which recharge equals discharge after about 14 hours of pumping (no increase of drawdown from 800 to 2,880 minutes). This indicates a nearby recharging boundary contributing 310 gpm. Definite decreases in anticipated drawdown (deviation from the straight line plot) for observations in wells #4, #5 and #6 are shown at about 600, 600, and 560 minutes respectively while pumping well #5. The significance of the times of encounter for these boundaries is uncertain because of the complications created by the effects of the step test, but all three of these deviations represent the presence of a recharging boundary near the three wells and, perhaps, somewhat closer to well #6, the most westerly of the three wells. Indeed, well #6 is closer to Wolf Creek. Well #6 is located between the pumping well and where Wolf Creek crosses the outcrop areas of the sandstone aquifer. It is concluded that where Wolf Creek crosses the aquifer outcrop area, a significant recharge to the aquifer occurs under pumping conditions.

In addition, observations in well #4 during test pumping of well #6 shows the effect of a recharge boundary at about 1,440 minutes, which strongly

suggests that the recharging boundary is on the opposite side of well #6 from well #4. This test of well #6 also showed some deviations toward increasing drawdown at earlier times during this test. These could represent low permeability boundaries or, more likely, other wells pumping in the vicinity.

The 48-hour test of the Memorial Park well, to the west of Wolf Creek, does not reveal any boundary conditions, either because they are too close or too far away. There is no tendency toward stabilization during the 48-hour test on this well. The Burgoon Aquifer, which is tapped by this well, is stratigraphically below and separated by a confining shale bed from the Upper and Lower Connoquenessing Sandstone aquifer tapped by wells #4, #5, and #6, and does not outcrop nearby at Wolf Creek, but outcrops farther to the north of Grove City. Although the engineering report determined a transmissivity of 61,600 gpd/ft. for the aquifer here, observations from the pumping well cannot be analyzed for storage coefficient, except to say that it is small as typical with confined conditions.

Three methods were applied to delineate wellhead protection areas for the Grove City wells. Aquifer recharge areas were mapped utilizing United States Geological Survey and Pennsylvania Geologic Survey bedrock geology maps of the area (reference). Recharge areas were mapped where the producing unit (Connoquenessing for wells 4, 5 & 6 and Burgoon for Memorial Park) were mapped as an outcrop (appearing at the land's surface and therefore susceptible to contamination sources).

A semi-analytic model developed by U.S. Environmental Protection Agency (EPA) known as the WHPA Code (MWCAP Module) was utilized to map the area which contributes to the #4, 5 & 6 wells. This method was selected because sufficient data was available and it incorporates ground water flow direction. Aquifer properties (hydraulic conductivity and aquifer thickness) were determined from the pump test data and boring logs as discussed above. Ground water flow direction was assumed to be northwesterly toward Wolfe Creek as indicated in the mapping of piezometric surfaces at the Osborne landfill. A hydraulic gradient of 0.0036 was utilized based upon piezometric

measurements in the Connoquenessing Formation at the Osborne landfill site. Wolfe Creek was modeled as a stream boundary recharge zone because the Connoquenessing Formation has been mapped to coincide with the stream. Five-, ten-, and fifteen-years time of travel was selected for use in the model. Two pumping rates (average and maximum rated) were modeled.

A calculated fixed radius method was employed to determine the WHPA for the Memorial Park well. This method calculates that portion of the aquifer which contributes water to the pumping well over a specified time period (10 years was modeled). In this case, because no information about ground water flow was available, a flat water table was assumed with ground water flowing into the pumping well radially from all directions.

The mapping of both aquifer and wellhead protection areas for the Grove City wells is appropriate due to their unique hydrogeologic setting. All of the wells draw water from aquifers which are overlain by low permeability strata (shale) resulting in a semi-confined condition. For this reason the outcrop areas were mapped showing were water enters these aquifers. However, the confining shale layers are likely to be fractured allowing the pumping wells to draw ground water downward from overlying aquifers and ultimately from the overlying land's surface. The WHPAs show those land areas where water may be induced downward through the semi-permeable shale layers and into the producing aquifer.

Step #3 - Identification of Potential Contamination Sources

Potential sources of contamination within the delineated wellhead protection areas to the two existing wells and the proposed well were determined from USGS topographic maps and from information supplied by the Grove City Municipal Waterworks. The delineated WHPAs contain two sites where ground water contaminants have been reported in the past. First, the Osborne Landfill site is located to the southeast of the wellfield and at the 15 year time of travel boundary when the wells are pumping at maximum capacity. Two considerations make this source unlikely to actually impact the

wells: a) the wells have never been pumped at this rate for extended periods of time, and b) ground water contamination at the site is reported to be limited to the upper aquifer and not in the deeper Connoquesnessing and Burgoon formations where Grove City's wells are screened.

The second potential source is the industries which reportedly caused the contamination of wells 1, 2 and 3 located to the south of the current wellfield (4, 5 and 6). The WHPA delineation shows that these industries are located to the south of the wellfield. The delineations suggest that the industries would not impact the wells at lower pumping rates (whereby the WHPA does not extend as far southwesterly). Furthermore, even if contaminants from this site enter the WHPA, sufficient dilution may occur between the contamination source and the wellfield to prevent concentrations in excess of drinking water standards.

The numerous coal mines (commonly 40 feet in depth) throughout the delineated WHPAs are a potential source of contamination which were noted during the 5 May workshop . These mine shafts may serve as direct conduits from the land surface to the producing aquifers making the ground water more vulnerable to surface-derived contamination sources such as road runoff and accidental spills. These mine sites should be inventoried and evaluated as potential sources (or conduits) of contamination.

Numerous small businesses along Main Street and South Madison Avenue may utilize hazardous materials and may generate hazardous wastes. While the quantities may be small, they may represent a serious threat to the ground water quality. A door-to-door inventory of these land uses may be the most effective method of evaluating these potential sources. An example of a successful volunteer inventory of this type is the City of El Paso, Texas who utilized retired senior citizens to complete such an inventory. This case study is documented in guidance materials available from USEPA.

The modelling of the wellfield shows that a significant amount of water is likely to be induced from Wolfe Creek under pumping conditions. This

being the case, additional potential sources upstream must be considered in the wellhead protection program. Extensive farmlands and Interstate 84 represent potential contamination threats in these areas. Farmlands may generate pesticides and fertilizer runoff which could find its way into Wolfe Creek and be induced by the pumping wells. Stormwater drainage from Interstate 84 may contain metals, oils, greases and de-icing chemicals.

Step #4 - Management Tools

Management approaches to wellhead protection can include both regulatory and non-regulatory measures. Regulatory resources include zoning, subdivision, and health ordinances. The Pennsylvania State Enabling Legislation provides extensive authority to local governments to protect water resources. Non-regulatory measures include monitoring and public education. Table 1 provides a summary of potential wellhead protection measures.

Several non-regulatory tools may be appropriate in beginning Grove City's wellhead protection program. Several of the potential contamination sources identified in the preceding section of this report could be further evaluated (and possibly managed) with non-regulatory techniques such as public education and monitoring. It will be important to educate business owners within the delineated WHPAs who utilize hazardous materials that even small quantities of these materials must be handled carefully. Monitoring of water quality at the abandoned wellfield (1,2 and 3) may be important in evaluating the potential movement of contaminants toward the new wellfield. Similarly, monitoring at the Osborne landfill site should be coordinated with Grove City's wellhead protection efforts. Horsley & Witten, Inc. has made the initial contact with EPA's Superfund site manager for this facility. Additional contacts should be made by the municipality to encourage the sharing of information.

Table 1. SUMMARY OF WELLHEAD PROTECTION TOOLS

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Regulatory: Zoning				
Overlay GW Protection Districts	Used to map WHPA's. Provides for identification of sensitive areas for protection. Used in conjunction with other tools that follow.	Community identifies WHPA's on practical base/zoning map.	Well accepted method of identifying sensitive areas. May face legal challenges if WHPA boundaries are based solely on artibrary delineation.	Requires staff to develop overlay map. Inherent nature of zoning provides "grandfather" protection to pre-existing uses and structures
Prohibition of Various Land Uses	Used within mapped WHPA's to prohibit known ground-water contaminants and uses that generate contaminants.	Commuity adopts prohibited uses list within their zoning ordinance.	Well recognized function of zoning. Appropriate technique to protect natural resources from contamination.	Requires amendment to zoning ordinance. Requires enforcement by both visual inspection and on-site investigations.
Special Permitting	Used to restrict uses within WHPA's that may cause ground-water contamination if left unregulated.	Community adopts special permit "thresholds" for various uses and structures within WHPA's. Community grants special permits for "threshold" uses only if ground water quality will not be compromised.	Well recognized method of segregating land uses within critical resource areas such as WHPA's. Requires case-by-case analysis to ensure equal treatment of applicants.	Requires detailed understanding of WHPA sensitivity by local permit granting authority. Requires enforcement of special permit requirements and on-site investigations.
Large-Lot Zoning	Used to reduce impacts of residential development by limiting numbers of units within WHPA's.	Community "down zones" to increase minimum acreage needed for residential development.	Well recognized perogative of local government. Requires rational connection between minimum lot size selected and resource protection goals. Arbitrary large lot zones have been struck down without logical connection to Master Plan or WHPA program.	Requires amendment to zoning ordinance.
Transfer of Development Rights	Used to transfer development from WHPA's to locations outside WHPA's.	Community offers transfer option within zoning ordinance. Community identifies areas where development is to be transferred "from" and "to".	Accepted land use planning tool.	Cumbersome administrative requirements. Not well suited for small communities without significant administrative resources.

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Cluster/PUD Design	Used to guide residential development outside of WHPA's. Allows for "point source" discharges that are more easily monitored.	Community offers cluster/PUD as development option within zoning ordinance. Community identifies areas where cluster/PUD is allowed (i.e. within WHPA's).	Well accepted option for residential land development.	Slightly more complicated to administer than traditional "grid" subdivision. Enforcement/inspection requirements are similar to "grid" subdivision.
Growth Controls/Timing	Used to time the occurence of development within WHPA's. Allows communities the opportunity to plan for wellhead deline-ation and protection.	Community imposes growth controls in the form of building caps, subdivision phasing or other limitation tied to planning concerns.	Well accepted option for communities facing development pressures within sensitive resource areas. Growth controls may be challenged if they are imposed without a rational connection to the resource being protected.	Generally complicated administrative process. Requires administrative staff to issue permits and enforcement growth control ordinances.
Performance Standards	Used to regulate development within WHPA's by enforcing predetermined standards for water quality. Allows for aggressive protection of WHPA's by limiting development within WHPA's to an accepted level.	Community identifies WHPA's and establishes "thresholds" for water quality.	Adoption of specific WHPA performance standards requires sound technical support. Performance standards must be enforced on a case-by-case basis.	Complex administrative requirements to evaluate impacts of land development within WHPA's.
Regulatory: Subdivision Control				
Drainage Requirements	Used to ensure that subdivision road drainage is directed outside of WHPA's. Used to employ advanced engineering designs of subdivision roads within WHPA's.	Community adopts stringent subdivision rules and regulations to regulate road drainage/runoff in subdivisions within WHPA's.	Well accepted purpose of subdivision control.	Requires moderate level of inspection and enforcement by administrative staff.

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Regulatory: Health Regulations				
Underground Fuel Storage Systems	Used to prohibit underground fuel storage systems (UST) within WHPA's. Used to regulate UST's within WHPA's.	Community adopts health/zoning ordinance prohibiting UST's within WHPA's Community adopts special permit or performance standards for use of UST's within WHPA's.	Well accepted regulatory option for local government.	Prohibition of UST's require little administrative support. Regulating UST's require moderate amounts of administrative support for inspection follow-up and enforcement.
Privately-Owned Wastewater Treatment Plants (Small Sewage Treatment Plants)	Used to prohibit Small Sewage Treatment Plants (SSTP) within WHPA's.	Community adopts health/zoning ordinance prohibiting SSTP's within WHPA's. Community adopts special permit or performance standards for use of SSTP's within WHPA's.	Well accepted regulatory option for local government.	Prohibition of SSTP's require little administrative support. Regulating SSTP's require moderate amount of administrative support for inspection followup and enforcement.
Septic Cleaner Ban	Used to prohibit the application of certain solvent septic cleaners within WHPA's, a known ground water contaminant.	Community adopts health/zoning ordinance prohibiting the use of septic cleaners containing 1,1,1-Trichloroethane or other solvent compounds within WHPA's.	Well accepted method of protecting ground water quality.	Difficult regulation to enforce even with sufficient administrative support.
Septic System Upgrades	Used to require periodic inspection and upgrading of septic systems.	Community adopts health/zoning ordinance requiring inspection and, if necessary, upgrading of septic systems on a time basis (i.e. every 2 years) or upon title/property transfer.	Well accepted purview of government to ensure protection of ground water.	Significant administrative resources required for this option to be successful.
Toxic and Hazardous Materials Handling Regulations	Used to ensure proper handling and disposal of toxic materials/waste.	Community adopts health/zoning ordinance requiring registration and inspection of all businesses within WHPA using toxic/hazardous materials above certain quantities.	Well accepted purview of government to ensure protection of ground water.	Requires administrative support and on-site inspections.

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Private Well Protection	Used to protect private on-site water supply wells.	Community adopts health/zoning ordinance to require permits for new private wells and to ensure appropriate well to septic system setbacks. Also requires pump and water quality testing.	Well accepted purview of government to ensure protection of ground water.	Requires administrative support and review of applications.
Non-Regulatory: Land Transfer and Voluntary Restrictions				
Sale/Donation	Land acquired by a community within WHPA's, either by purchase or donation. Provides broad protection to the ground water supply.	As non-regulatory technique, communities generally work in partnership with non-profit land conservation organizations.	There are many legal consequences of accepting land for donation or sale from the private sector, mostly involving liability.	There are few administrative requirements involved in accepting donations or sales of land from the private sector. Administrative requirements for maintenance of land accepted or purchased may be substantial, particularly if the community does not have a program for open space maintenance.
Conservation Easements	Can be used to limit development within WHPA's.	Similar to sales/donations, conservation easements are generally obtained with the assistance of non-profit land conservation organization.	Same as above.	Same as above.
Limited Development	As the title implies, this technique limits development to portions of a land parcel outside of WHPA's.	Land developers work with community as part of a cluster/PUD to develop limited portions of a site and restrict other portions, particularly those within WHPA's.	Similar to those noted in cluster/PUD under zoning.	Similar to those noted in cluster/PUD under zoning.
Non-Regulatory: Monitoring	Used to monitor ground water quality within WHPA's.	Communities establish ground water monitoring program within WHPA. Communities require developers within WHPA's to monitor ground water quality downgradient from their development.	Accepted method of ensuring ground water quality.	Requires moderate administrative staffing to ensure routine sampling and response if sampling indicates contamination.

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Contingency Plans	Used to ensure appropriate response in cases of contaminant release or other emergencies. within WHPA.	Community prepares a contingency plan involving wide range of municipal/county officials.	None	Requires significant up-front planning to anticipate and be prepared for emergencies.
Hazardous Waste Collection	Used to reduce accumulation of hazardous materials within WHPA's and the community at large.	Communities, in cooperation with the state, regional planning commission, or other entity, sponsor a "hazardous waste collection day" several times per year.	There are several legal issues raised by the collection, transport and disposal of hazardous waste.	Hazardous waste collection programs are generally sponsored by government agencies, but administered by a private contractor.
Non-Regulatory: Public Education	Used to inform community residents of the connection between land use within WHPA's and drinking water quality.	Communities can employ a variety of public education techniques ranging from brochures detailing their WHPA program to seminars to involvement in events such as hazardous waste collection days.	No outstanding legal considerations.	Requires some degree of administrative support for programs such as brochure mailing to more intensive support for seminars and hazardous waste collection days.
Legislative:				
Regional WHPA Districts	Used to protect regional aquifer systems by establishing new legislative districts that often transcend existing corporate boundaries.	Requires state legislative action to create a new legislative authority.	Well accepted method of protecting regional ground water resources.	Administrative requirements will vary depending on the goal of the regional district. Mapping of the regional WHPA's requires moderate administrative support while creating land use controls within the WHPA will require significant administrative personnel and support.
Land Banking	Used to acquire and protect land within WHPA's.	Land banks are usually accomplished with a transfer tax established by state government empowering local government to impose a tax on the transfer of land from one party to another.	Land banks can be subject to legal challenge as an unjust tax, but have been accepted as a legitimate method of raising revenue for resource protection.	Land banks require significant administrative support if they are to function effectively.

Watershed protection efforts for the Wolfe Creek may also play a key role in Grove City's wellhead protection program. Stormwater management activities related to Interstate 84 by the Pennsylvania Department of Public Works should be coordinated with the objective of water quality protection of Wolfe Creek. Best management practices should be encouraged by the farmers within this watershed (upgradient of Grove City).

Step #5 - Public Education

A public meeting was held on 5 May 1993, in the Borough of Grove City. This preliminary wellhead protection plan was presented and discussed. Approximately twelve citizens and local officials attended. Future public meetings and workshops are recommended to ensure implementation of the wellhead protection plan. To ensure full development implementation of Grove City's wellhead protection program, a Committee should be formulated. The Committee should meet at least quarterly and preferably monthly (to ensure better continuity). Regular agenda items to be discussed could include water quality monitoring data, progress at the Osborne landfill site, well pumping information, review of proposed development projects, and public education efforts.

The posting of "Wellhead Protection Area" signs would serve as an effective public education tool. Such signage would alert truck drivers carrying hazardous cargo that they are entering a sensitive environmental resource area. They would also serve to remind citizens that they live on top of their drinking water supply and therefore need to take preventative actions to protect it.