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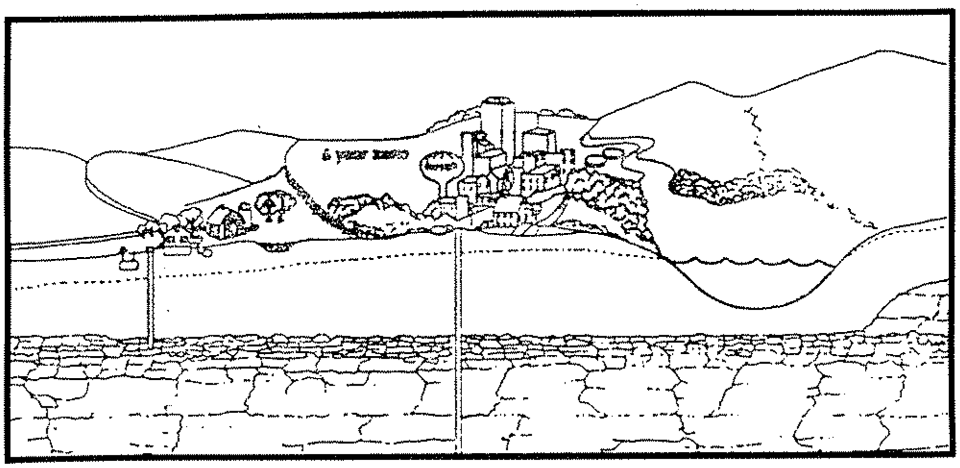
OHIO WELLHEAD PROTECTION PROGRAM



OHIO ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF DRINKING AND GROUND WATERS
1800 WATERMARK DRIVE
COLUMBUS, OHIO

MAY 1992

FOREWORD

The Safe Drinking Water Act Amendments of 1986 mandate that each state develop a wellhead protection program to protect public water supplies which utilize a ground water source. Guidelines were prepared by the United States Environmental Protection Agency, recognizing that each state would develop and tailor a program to suit its own needs.

The Ohio Environmental Protection Agency has been designated by the Governor of Ohio as the lead agency for carrying out the mandates outlined in the Safe Drinking Water Act. The Division of Drinking and Ground Waters has the major responsibility for wellhead protection within Ohio EPA, and has been active in technical program research and developing Ohio's Wellhead Protection Program.

Development of this Program has been funded, in part, with monies from the United States Environmental Protection Agency, under Section 106 of the federal Clean Water Act.

ACKNOWLEDGEMENTS

The Ohio Environmental Protection Agency would like to acknowledge all the individuals who contributed to the successful development of the Ohio Wellhead Protection Program. This includes the many state and local officials, members of the Inter-Agency Ground Water Advisory Council and numerous other citizens who took time out of their busy schedules to review, discuss and make recommendations on the various components of the State's Program. Members of the Inter-Agency Ground Water Advisory Council, particularly the Pollution Prevention Subcommittee, spent the last four years evaluating different aspects of wellhead protection planning and provided invaluable comments and recommendations to the Agency. More than 160 persons attended public hearings and workshops and many more submitted written comments to the Agency. All of these individuals helped produce a more effective Program.

The Agency acknowledges Dr. E. Scott Bair of The Ohio State University, Department of Geological Sciences, and his graduate students, Abe Springer and George Roadcap, for their efforts comparing various wellhead protection area delineation methods. This work proved extremely beneficial in developing the delineation component of the Wellhead Protection Program. The Agency also acknowledges Russell Stein and Dr. Daniel Leavell for their efforts in producing the initial draft of Ohio's Program and for promoting wellhead protection planning throughout Ohio. Special recognition is extended to Michael Baker of Ohio EPA's Division of Drinking and Ground Waters, who had the lead role in producing subsequent drafts and authored the final Ohio Wellhead Protection Program. The secretarial and word processing support provided by Ginger Houk is also greatly appreciated.

Finally, Ohio EPA would like to acknowledge the many purveyors and local officials who have initiated wellhead protection planning in Ohio. Through their efforts, staff at Ohio EPA have learned a great deal about the intricacies of developing and implementing a local wellhead protection plan; this information contributed immeasurably to the final Wellhead Protection Program. The success of Ohio's Wellhead Protection Program depends on the continued support and initiative of Ohio's purveyors, local officials and their communities.

Donald R. Schregardus
Director
Ohio Environmental Protection Agency

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CHAPTER 1

WELLHEAD PROTECTION (WHP) FOR THE STATE OF OHIO

In Ohio, approximately 75 percent of the 1,600 community public water systems rely on ground water for all or a large portion of their water supply. Combined, these systems meet the daily water needs of more than 25 percent of the state's population. More than 8,000 non-community public water systems serving businesses, schools, parks, camps, etc., also rely on ground water for their water needs. As Ohio's urban areas expand, the number of homes, businesses and industries served by public water systems will increase. Ohio's Wellhead Protection (WHP) Program, by specifying even more protection to ground water resources that supply public water wells, helps to ensure the present and future availability of safe, clean water for the users of these systems.

The quantity of ground water available to wells in Ohio is highly variable depending on the local geology. Ohio's principal aquifers are: 1) unconsolidated materials of glacial origin that lie nearest the ground surface and consist of sand, gravel, silt or clay; and, 2) consolidated sedimentary layers of limestone, sandstone, shale, dolomite, coal and fire clay that comprise the underlying bedrock. Almost all of the aquifer systems in Ohio serve as sources of public drinking water. Community or non-community public supplies are found in every Ohio county.

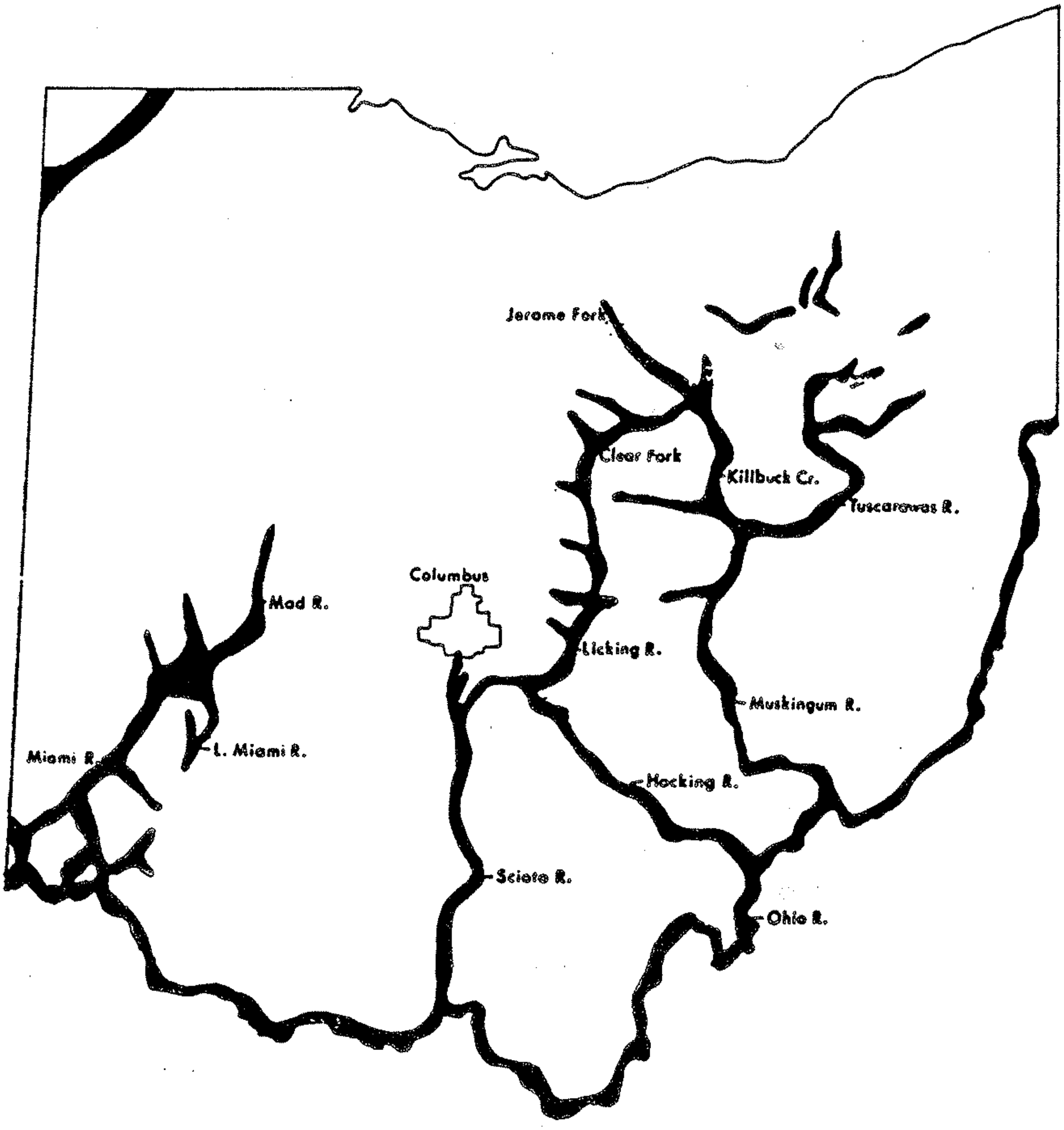
The most productive aquifers are outwash deposits of sand and gravel that were laid down by glacial meltwater. They are found beneath and adjacent to the Ohio River, its major tributaries and certain pre-glacial stream channel segments (Figure 1). Municipal and industrial wells in these areas frequently yield from 500 to 1,000 or more gallons per minute.

Other productive systems are bedrock formations of limestone, dolomite and sandstone that generally occur in two large regions of Ohio (Figure 2). The limestones and dolomites in the western half of the state reach a total thickness of 300 to 600 feet and are capable of yielding from 100 to over 500 gallons per minute. The sandstone formations in the eastern half of the state occur as a dozen or so distinct layers of variable thickness (and areal extent) separated by layers of shale and other rock formations. Some of the thicker sandstone formations are capable of yielding 50 to several hundred gallons per minute to individual wells.

In other regions, the bedrock units consist of massive shales or varied sequences of thin bedded shales, limestones, sandstone and coals with shales predominating. These regions overall have relatively low potential for ground water production due to the predominance of shales and other impervious rocks. Well yields average less than 10 gallons per minute, and in some areas are less than one gallon per minute.

FIGURE 1

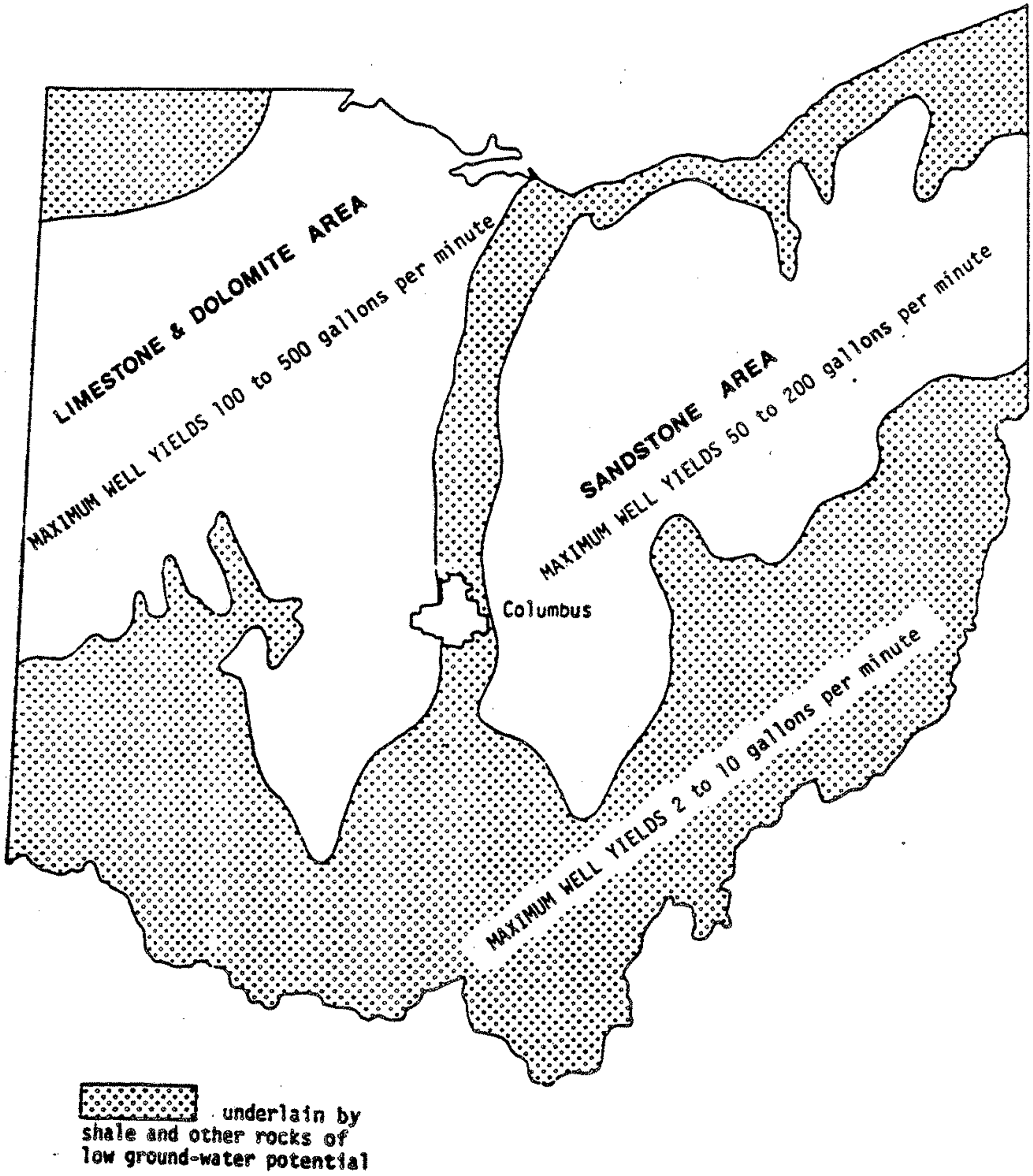
MAJOR UNCONSOLIDATED AQUIFERS



MAXIMUM WELL YIELDS 500 to 1000, or more, gallons per minute

FIGURE 2

MAJOR BEDROCK AQUIFERS



.ound water has long been perceived as a source of pure water, it is now recognized as a very ɘsource susceptible to contamination from many sources. Ohio has a very diverse economy generating range of potential ground water contaminants. Ohio's industries, commercial establishments and ɑces generate significant quantities of solid and liquid wastes which often are applied, stored and disposed ɑe land. Modern agricultural practices involve the handling and application of large amounts and a wide ɑge of fertilizers and pesticides. In parts of Ohio, oil, gas and coal production have degraded the quality of ɔoth surface and ground waters. Other sources of potential contamination include underground storage tanks, septic tanks and miscellaneous leaks and spills.

Although available data show that most of Ohio's ground water is of high quality and is suitable for human consumption, more individual cases of ground water contamination are documented each year. Unfortunately, the first indication of ground water contamination often has been through analysis of finished drinking water and a source is not identified easily. Ground water contamination already has caused several public water supply systems to implement costly remediation programs to prevent uptake of contaminants or to provide extensive treatment prior to distribution. According to a five-year study by Ohio EPA, traces of organic contaminants have been found in 12 percent of Ohio's community water systems utilizing ground water. However, concentrations of these chemicals exceeded current health-based standards in only one percent of the systems in Ohio. Additional testing from March 1988 through January 1990 detected pesticides in approximately 3.6 percent of community systems using ground water in Ohio. None of these exceeded the health-based standards.

Because ground water is uniquely vulnerable to contamination and is a critically important resource, Ohio must protect and manage it wisely. Traditionally, ground water protection has been approached through remediation and redesign (or elimination) of the polluting source after ground water contamination has occurred. We now know that prevention is the most effective approach for controlling ground water contamination and safeguarding the health of Ohioans. This is especially true for those resources being used as a source of public drinking water.

The federal Safe Drinking Water Act Amendments of 1986 mandate that each state develop a WHP program to protect public water supplies which utilize a ground water source. Guidelines were prepared by the United States Environmental Protection Agency (U.S. EPA) with the recognition that each state would tailor a program to suit its own needs. These guidelines require that state programs:

- specify the duties of state agencies, local government entities and owners of public water supply systems;

- determine WHP areas using the best available method and best available hydrogeologic data on ground water flow, recharge, discharge and other information;

- specify that within each WHP area all potential anthropogenic sources of contaminants will be inventoried;

- define management approaches to WHP plan development, which include technical assistance, financial assistance toward implementation of pollution control measures, education and training to protect the WHP area;

- require each WHP plan to include a contingency plan for an alternate source of drinking water in case of contamination or loss of production capacity;

- describe techniques for WHP area delineation that apply to all new public water wells; and

- ensure public participation throughout plan development and implementation.

Additional provisions of the Safe Drinking Water Act require that states having more than 2500 active annular disposal wells for the disposal of oil field brine include in their program a certification that a state program exists and is being enforced adequately to protect ground water from contaminants associated with these activities (See Appendix 1).

Ohio has been developing its WHP Program for several years. The Ohio Ground Water Protection and Management Strategy calls for many of the efforts now being incorporated into the state program for wellhead protection. The Strategy recognizes that those aquifers, or portions of aquifers, being used as a source of water for public drinking water systems, deserve a higher priority for ground water protection. Two of the Strategy's six initiatives call for a program to protect wells supplying public water systems.

Summary of Ohio's Wellhead Protection Program

Ohio EPA's mission is *to protect human health and the environment through responsible regulation supported by sound science, effective management, and comprehensive environmental education*. Wellhead protection planning involves all of those components. The objective of wellhead protection is to protect the health of people utilizing public drinking water by providing a focus zone around public wells or wellfields to prevent, detect and remediate ground water contamination. This objective is met through the delineation of WHP areas; identification and management of potential pollution sources; ground water monitoring plans; contingency plans; public vigilance; and public participation and education efforts. Wellhead protection planning can help Ohioans manage the risks associated with activities in or near their wellfields and prevent degradation of ground water resources which might preclude present and future uses.

Public water supplies are owned and operated by municipalities, counties, homeowner associations and private companies. Under Ohio's WHP Program, local WHP plans are to be developed and implemented by these local drinking water purveyors. The Division of Drinking and Ground Waters at Ohio EPA is responsible for providing technical guidance and direct one-on-one technical assistance to purveyors. It also is responsible for reviewing local WHP plans to ensure they adequately address each element of Ohio's WHP Program. Other federal, state and local agencies also provide technical assistance and are instrumental in the development and implementation of effective WHP plans.

Wellhead protection areas are defined as the surface and subsurface areas supplying water to public wells or wellfields through which contaminants are likely to move toward and reach such wells or wellfields. In recognition of the diversity of geologic settings in Ohio and the differing needs and resources of Ohio's communities, a flexible approach to the delineation of WHP areas has been adopted. Local geologic conditions are the primary factors on which the criteria and method for delineating a WHP area are selected; however, consideration must also be given to the availability of technical and financial resources. Certain delineation methods (e.g. numerical modeling) could prove unworkable for many small, public water supplies.

Time-of-travel (TOT), combined with a flow boundary criterion, is the preferred criterion for delineation. Ohio's WHP Program specifies that a five-year TOT be delineated for each public well or wellfield. This is the area surrounding the well or wellfield that will contribute ground water flow to the well(s) within a five-year period of time. Ohio EPA also recommends delineating an inner management zone with approximately a one-year TOT. In some instances, a purveyor also may choose to delineate an additional management zone beyond the five-year area (10 or more years).

Time-of-travel WHP areas can be delineated by a number of different techniques ranging from simple calculated fixed-radius methods to more sophisticated and data-intensive numerical computer modeling methods. Ohio EPA recommends that the majority of larger public water supplies use a semi-analytical model combined with geologic mapping to delineate a TOT WHP area. Although semi-analytical models require simplifying assumptions about aquifer properties and dimensions (e.g., homogeneous, infinite aquifer), research in Ohio has shown they can provide a relatively high level of accuracy in delineating TOT boundaries. Cities with considerable hydrogeologic information, in complex hydrogeologic settings or with numerous pollution threats may delineate even more accurate WHP areas using a numerical flow model which, with the aid of a computer, can accommodate a significant degree of variation in aquifer material properties and aquifer dynamics. For many of the smaller public water supplies in Ohio, certain types of hydrogeologic information (i.e. hydraulic conductivity and ground water flow direction and velocity) is not readily available and the cost of acquiring it may be prohibitive. In such situations, a simple analytical model or a calculated fixed-radius method, combined with basic hydrogeologic mapping, may be used.

For most community water supplies located in a confined aquifer setting, Ohio EPA recommends using a calculated fixed-radius delineation method. These purveyors, however, may elect or, due to a complex hydrogeologic setting (e.g. multiple aquifers) or multiple sources of potential pollution, be required to use a more scientific method. Systems utilizing confined aquifers also should identify primary recharge areas. If a recharge area is not contiguous with the WHP area surrounding the well or wellfield, a separate "satellite" WHP area should be designated.

Ohio EPA will develop a library of calculated fixed-radius and variably shaped WHP areas as part of a technical guidance document to be completed in 1992. This collection of standardized WHP areas will approximate one-year and five-year TOTs for several generic hydrogeologic settings common to Ohio. They will be generated using calculated fixed-radius and analytical modeling techniques applied to different sets of hydrogeologic parameters (e.g. transmissivity, aquifer thickness and gradient) under varying rates of pumping. Many of the smallest community and non-community systems may be able to apply one of these pre-determined WHP areas to their wellfield by selecting one that matches or has similar hydrogeologic conditions and pumping rates as those found at their wellfield. The cost of applying this delineation method is extremely low and would require limited field information or technical expertise. The technical guidance document also will outline what delineation method should be applied to specific settings of public water supply wellfields.

Another major element of a local WHP plan is an inventory of all potential sources of ground water contamination in and around delineated WHP areas. Purveyors need to report this information as part of their WHP plans. The purpose of the inventory is to identify any past, present or proposed activities or land uses that may pose a threat to existing or proposed public drinking water wells. The inventory is essential to developing the management element of a local WHP plan. Standards and formats for reporting pollution source data to Ohio EPA are contained in a guidance document available from the Division of Drinking and Ground Waters.

The most important element in establishing an effective local WHP planning process is developing and implementing a comprehensive and coordinated management strategy to control existing as well as potential new sources of ground water contamination. Public water systems' WHP plans should include local management initiatives to prevent contamination from existing as well as future potential sources of ground water contamination. Wellhead protection area management builds on information gathered during the delineation process and the pollution source inventory. Management options for controlling specific sources of contamination must consider the degree of risk posed by the source including proximity to the wellfield, hydrogeologic sensitivity and type of activity. The management strategy can include land use controls such as zoning ordinances and building codes, combined with other approaches such as ground water monitoring, building site plan review, engineering and operating standards, spill and accident reporting, emergency planning and public participation. Since the need for wellhead protection is based on conflicting land use practices, it may become necessary to restrict certain activities from WHP areas to protect drinking water supplies.

The management component of a local WHP plan will vary depending on the type of system and the population served. Because privately owned community and non-community water systems have either limited or no authority to control land use or other activities beyond their property boundary, the management component of their WHP plans will be different than that of a government-owned community system. The management strategy of many smaller community systems will be different than that of a larger community system. To facilitate technical assistance to small community and non-community systems, Ohio is considering developing a generic "checklist' or "fill-in-the-blank," model WHP plan. This model plan would aid the small purveyor in selecting and applying appropriate wellhead protection management techniques. By using this model plan in combination with other guidance documents (i.e. those on delineation and conducting a pollution source inventory) even the smallest purveyors should be able to develop and implement a WHP plan that complies with the state's WHP Program.

A ground water monitoring plan also is a key element of an effective WHP plan. Although not all systems may need to install new monitoring wells, all systems will need to prepare an approvable monitoring plan that assesses the need for monitoring which, if required to be put into effect, would provide an early warning of impending contamination. In some instances, an effective ground water monitoring network can be accomplished by testing existing wells on surrounding properties. A purveyor also may request a waiver from ground water monitoring if it can be shown that no major pollution sources have the potential to affect ground water reaching the well or wellfield.

Emergency and contingency planning is an essential element of a local plan. In spite of a good management strategy, ground water contamination can still occur. Purveyors must be prepared for emergencies and be ready to provide alternative sources of water. Ohio regulations (OAC 3745-86-5) include requirements for community water system owners to develop and maintain contingency plans for providing safe drinking water to their service areas under emergency conditions. Ohio's WHP Program expands the current emergency planning requirements. It calls for owners to amend their contingency plans to identify temporary and long-term alternate drinking water supplies in the event of wellfield contamination. Ohio's non-community systems also should develop contingency plans as part of their WHP plans.

Ohio's Program also directs communities to establish protection zones and pollution source controls for land areas around proposed new wells or wellfields. Ohio EPA already has some regulatory authority to require WHP planning for new wells as a condition of plan approval (OAC 3745-91).

Implementation

Central to implementation of WHP planning in Ohio was introduction of a comprehensive legislative bill in the 118th Ohio General Assembly (May 1990). Ohio's Safe Drinking Water Bill was designed to establish a program structure and time frame for development of rules and program guidance. It also identified a program funding mechanism and a schedule for local WHP plan development. Many of the provisions in the Safe Drinking Water Bill proposed in 1990 are part of Ohio's WHP Program. However, there are distinct differences between the two. For example, the bill would have required all public water supplies serving a population of 500 or more and utilizing ground water to develop WHP plans. The WHP Program reflects federal Safe Drinking Water Act language and requirements by prescribing WHP planning for all public water systems. Although the bill was not acted on in 1990, Ohio EPA continues its support of wellhead protection legislation.

Due to the lack of specific enabling legislation, Ohio's WHP Program relies largely on voluntary actions by public water purveyors and community officials. Ohio EPA, however, is committed to fully implementing the state's WHP Program in accordance with requirements of the federal Safe Drinking Water Act. Until specific legislation is enacted, Ohio continues to pursue and encourage local WHP planning through existing regulatory authority, possible rule amendments, agency policies and technical guidance documents, public outreach efforts and voluntary compliance.

As outlined in Chapter 2, Ohio has a complex array of specific regulatory authorities to provide ground water protection. Ohio utilizes these existing authorities to promote WHP planning whenever possible. For example, the public drinking water plan approval in Ohio Administrative Code 3745-91 requires well site approval and approval of detailed plans by Ohio EPA for all new public water supply wells. The Division of Drinking and Ground Waters can and has required WHP planning under this rule as a condition of plan approval. The Division of Drinking and Ground Waters also can require WHP planning through notices of violation where health-based standards are violated, and routinely recommends WHP planning when conducting evaluations of public water supply systems.

Regulatory authorities of Ohio EPA and other state agencies can be strengthened to promote WHP planning by incorporating more specific wellhead protection provisions through existing rule amendments. As discussed in Chapter 5, several programs are already in place which allow for differential management and adoption of more stringent pollution controls within a WHP area. For example, Ohio's solid waste rules (OAC 3745-27) prohibit the siting of new landfills within a five-year TOT boundary of a public water supply well. Other options for differential management of potential pollution sources within WHP areas will be considered for adoption by the State Coordinating Committee on Ground Water during 1992 and 1993.

A primary focus of Ohio EPA in promoting and implementing wellhead protection is to provide effective guidance and education to the regulated community and the public through seminars, technical guidance documents, training, newsletters, demonstration projects and various other reports for technical or general distribution. Since 1988, numerous educational seminars have been conducted or sponsored by Ohio EPA throughout the state. Nearly 20 wellhead protection presentations were given to regional planning groups, water purveyors and professional associations during 1991. These presentations are an excellent way to promote Ohio's WHP Program to individuals directly responsible for developing and implementing local WHP plans.

Additional educational seminars and workshops are planned. The Division of Drinking and Ground Waters will conduct a series of wellhead protection workshops during 1992. The workshops will be used to solicit comments and recommendations from selected individuals on what criteria Ohio EPA should use to evaluate local WHP plans for the various types of public water systems. Additional workshops will be sponsored to identify reasonable WHP area management options for Ohio's various types of public water systems. Ohio EPA will use information generated in these workshops to develop policies and technical guidance documents in 1992 and 1993.

To assists purveyors in developing WHP plans, the Division of Drinking and Ground Waters has prepared or funded several reports and technical guidance documents. Partial funding was provided by a U.S. EPA grant to The Ohio State University to support studies on the applicability of various WHP area delineation techniques. The University also developed an analytical flow model and supporting user's manual to assists purveyors in delineating WHP areas. The Division of Drinking and Ground Waters conducted research into the technical aspects of WHP planning at the Springfield, Ohio wellfield. A report on that project was completed in September 1990. The Division also completed guidance on conducting a pollution source inventory in November 1991.

More demonstration projects, technical guidance documents and policies will be developed over the next several years. The Division of Drinking and Ground Waters, in cooperation with selected individuals from other state and local agencies or organizations, academia and consulting firms, will complete a technical guidance document to address the delineation of local WHP areas in 1992. The delineation technical guidance will present the selection and application of WHP area delineation methods based on hydrogeologic setting, amount of ground water pumpage, population served, potential contaminant sources and other relevant factors (to be determined). It also will contain a library of calculated fixed-radius and variably shaped WHP areas for several generic hydrogeologic settings common to Ohio. Many of the smallest community and non-community systems will be able to apply one of these pre-determined WHP areas to their wellfield by selecting one that matches or has similar hydrogeologic conditions and pumping rates as those found at their wellfield.

The Division of Drinking and Ground Waters will conduct a geographic information system /wellhead protection demonstration project during 1992 and 1993. The primary purpose of this project, being funded in part by U.S. EPA, is to bring the Division's relational data base management system and geographic information system "on-line." When completed, this system will greatly enhance the Division's ability to provide technical assistance to communities developing local WHP plans.

Ohio EPA currently uses the data management system to record the status of WHP planning activities in Ohio. When completed, this system will allow specific information to be recorded on WHP area delineations, pollution source inventories, and management strategies. The Division of Drinking and Ground Waters then will be able to track compliance with Ohio's WHP Program and report this information to U.S. EPA. This tracking system also will allow Ohio EPA to promote WHP planning in those communities where little or no activity is occurring.

Other WHP demonstration projects are being conducted in Ohio. They include a WHP data management project being conducted by the City of Dayton and WHP implementation project by the City of Kent. Both of these projects are being funded in part by grants from U.S. EPA.

Finally, the overall success of implementing WHP planning in Ohio depends on the cooperation of local water purveyors and public officials. Under Ohio's WHP Program, local WHP plans are to be developed and implemented by local drinking water purveyors. Because most ground water contamination is directly related to land use, Ohio's counties, townships and municipalities, with their direct authority to control local land uses, are in the best position to prevent ground water contamination from occurring. Although the state regulates most contaminant sources, even the strongest state regulatory program is likely to fail if inappropriate land development occurs near a public wellfield. When ground water becomes contaminated, purveyors also bear the primary responsibility for either developing alternative sources of water or providing a higher level of treatment. It is certainly in their best interest for purveyors to prevent ground water contamination rather than being forced to implement these costly alternatives when it occurs.

There is currently considerable local support for wellhead protection in Ohio. Nearly 100 communities from all areas of the state have expressed interest or have initiated WHP planning. Many of these have made significant progress in implementing WHP plans. Dayton and Columbus have WHP plans and ordinances in place. Ohio EPA will continue to promote WHP planning to ensure that this interests continues to grow and that, eventually, Ohio's WHP Program is fully implemented in accordance with the federal Safe Drinking Water Act. Initially, efforts to promote WHP planning will focus primarily on community water systems. Ohio hopes that the majority of these systems will have fully implemented WHP plans by the year 2000. Ohio will continue to promote WHP planning for non-community public water purveyors as resources allow.

Wellhead Protection Plan Submittal and Review Process

Ohio's WHP Program calls for each public water system to submit a WHP plan to Ohio EPA for its review. These plans must address each element of the Ohio's Program. Some systems may chose to submit portions of their plan as they are completed to help ensure they comply with the state's Program. For example, a public water system may submit a preliminary WHP area delineation and the pollution source inventory to Ohio EPA for review and comment, prior to completing the remaining elements of the local plan. Purveyors who choose to make partial submittal for Ohio EPA's review, still need to submit a final WHP plan that includes all elements of the state's Program.

Upon receipt of a complete WHP plan, the Division of Drinking and Ground Waters is responsible for ensuring it complies with the state Program. Specific criteria that Ohio EPA will use when assessing the adequacy of local WHP plans will be finalized through the public workshops to be conducted in 1992. In general, however, a WHP plan must address each element as described in Ohio's WHP Program. This includes:

- a WHP area delineated using the method most applicable to the type, setting and resources of the public water system;

- a pollution source inventory that identifies all past, present and proposed land use activities in or around the WHP area that may pose a potential threat to the well or wellfield;

- a management strategy that establishes policies and procedures to prevent contamination from all potential sources of ground water contamination identified in the pollution source inventory for all existing and new water supply wells;

- a ground water monitoring plan that adequately assesses the need for ground water monitoring based upon the inventory, and that if put into effect, will provide an early warning of impending contamination;

- modified contingency plans which ensure timely and appropriate emergency response, and also identify short-term and long-term alternate water sources in the event of ground water contamination; and,

- a public involvement/education program that informs people living and working in the WHP area are about WHP planning efforts and provides an opportunity to be involved.

If a WHP plan does not adequately addresse each element of Ohio's WHP Program, Ohio EPA will send a letter to the owner of the public water system identifying all deficiencies and making recommendations. The purveyor then can revise the plan and resubmit it for further review. When the plan is judged to comply with Ohio's WHP Program, the Division of Drinking and Ground Waters will send a letter to the purveyor indicating that the WHP plan adequately addresses all elements of Ohio's WHP Program. It also will be noted in the Division's WHP data base and tracking system.

Protection of public water supplies for the future requires ongoing vigilance and continued evaluation of both the ground water resource and potential pollution sources. Wellhead protection areas are delineated at a set time under a unique set of hydraulic and land use conditions. Because the needs of a water system change, pumping rates change, and land uses change, it will be necessary to review the WHP area, update and verify the pollution source inventory, and assess the effectiveness of the management strategy on a periodic basis. Ohio EPA recommends that public water systems re-evaluate and update their WHP plans at least every 10 years. This comprehensive update will help assure that information needed to support local decisions accurately represents current conditions and helps ensure adequate protection of the wellfield. Where a purveyor has established routine mechanisms to update the inventory and assess the effectiveness of the WHP plan, or where conditions in the WHP area have remained relatively unchanged, this update should require a minimum amount of time and resources. Some systems may, under certain conditions, be required by Ohio EPA to re-assess their WHP plans more frequently.

Updated WHP plans should be submitted to Ohio EPA, where they will be evaluated to assure they still adequately address each element of Ohio's WHP Program. The Agency will use the same review process outlined above and record any new information in the wellhead protection Data Base and Tracking System.

CHAPTER 2

STATUTORY AUTHORITIES, ROLES AND RESPONSIBILITIES

Ground water protection in Ohio is accomplished through a complex array of rules, regulations and responsibilities. A number of local, state and federal agencies have regulatory responsibilities and/or carry out activities that affect ground water. Most of these agencies also have a role in Ohio's WHP Program.

While public water purveyors have the primary responsibility for developing and implementing local WHP plans, many other agencies and programs, at all levels of government, are essential to the success of those plans. For example, numerous local, state and federal agencies are responsible for providing technical information and assistance needed to delineate WHP areas and complete a detailed inventory of potential pollution sources. In addition, many potential sources of ground water contamination fall under the regulatory authority of state agencies, and in some instances federal agencies. A WHP plan must build on these existing authorities to ensure protection of the public water supply.

Purveyors and Local Governments

As discussed in Chapter 1, local WHP plans are to be developed and implemented by public water supply purveyors. This includes delineating the WHP area, conducting an inventory of potential sources of ground water contamination, and preparing a strategy to manage potential threats in the WHP area. Other responsibilities of the purveyor include preparing, implementing and updating a contingency plan, designing and operating a ground water monitoring system, conducting public outreach and education efforts, and possibly developing WHP ordinances. Purveyors need to secure adequate financial and technical resources to develop, implement and sustain a long-term commitment to a WHP plan that helps ensure a safe, adequate and reliable drinking water supply in the future.

Public water supplies are owned and operated by municipalities, counties, homeowner associations and private companies. These different types of owner/operators have varying authority to implement WHP management strategies. For example, Ohio's counties, townships and municipalities have significant authority to protect ground water by exercising their powers to protect public health, safety and welfare; adopt land use controls; enforce building standards; and provide drinking water, sewage and solid waste treatment and disposal services. Privately owned systems, however, may have limited authority to implement certain management options beyond their property boundary, and will have to work cooperatively with the local political jurisdiction to ensure adequate protection of their well(s).

Municipalities

In Ohio, municipalities provide services generally associated with local government, including fire and police protection; sanitation; utilities including water supply; zoning regulation; and traffic control to protect the health, safety, and general welfare of the public. The powers and duties of Ohio's municipalities are outlined in Article XVIII of the Constitution of the State of Ohio, (also known as the "Home Rule" Amendments) and Title 7 of the Ohio Revised Code. Municipal corporations in Ohio have the constitutional option of adopting a home rule charter whereby the "municipality may operate, within constitutional limits, independently of the legislative authority of the state in the areas of organization, powers and processes." The Municipal Code is the law for those that have not adopted a home rule charter.

The greatest power a municipality has to protect ground waters being used as a source of public water is its authority to control land use. The legislative authority of a village or city may divide all or any portion of the municipal corporation into zones or districts "...in the interest of the public health, safety, convenience, comfort, prosperity, or general welfare..." Having established such districts, "regulations may be imposed for each of such districts, designating the kinds of classes of trades, industries, residences, or other purposes for which buildings or other structures or premises may be permitted to be erected, altered, or used subject to special regulations" (ORC Chapter 713.06).

In addition to zoning, municipalities also have authority to review site plans and subdivisions; control traffic; and adopt local ordinances or resolutions. Many local agencies are instrumental in providing services or enforcing state laws that protect ground water. These include municipal fire departments, emergency response and planning agencies and health departments.

Counties

The county is the major local subdivision of the state, and was created to serve as an agency for administration of state laws and policies. The powers and duties of counties are outlined in Article X of the Constitution of the State of Ohio and Title 3 of the Ohio Revised Code. A three-member Board of County Commissioners is provided by statute, while a petition by voters may raise this to five, seven or nine. The Board shares responsibility for administration of state law with eight other independent county officers: auditor, clerk of courts, coroner, engineer, prosecuting attorney, recorder, sheriff and treasurer.

County commissioners have the power to divide all or any part of the unincorporated territory of a county into zones for the purpose of regulating, among other things, the location and uses of buildings and other structures, and the uses of land for trade, industry, residence, recreation or other purposes (ORC Chapter 303.02). By statute, the county commissioners must appoint a five-member county rural zoning commission to administer the zoning laws. The county commissioners also may establish and maintain garbage and refuge disposal districts.

Townships

A civil township is a political subdivision of the state established to administer local government, and is recognized by the Ohio Constitution as both a unit of government and as an agency of the state. The powers and duties of townships are outlined in Article X of the Constitution of the State of Ohio and Title 5 of the Ohio Revised Code. A township's rights and privileges are limited to those functions specified by law and do not include all of the general powers of a corporation. Townships are governed by an elected three-member Board of Township Trustees.

Township trustees may regulate building and land use in unincorporated territory to promote public health and safety provided the regulations are in accordance with a comprehensive plan (ORC Chapter 519.02). If a township adopts zoning regulations prior to adoption of county zoning regulations, the township regulations take precedence unless a majority of affected voters elect to have the township plan replaced by the county plan. Township zoning regulations do not apply within municipal corporations, and cannot prohibit the use of land or buildings for agricultural purposes.

<u>Special Districts</u>

Special districts such as conservancy districts, health districts, park districts, sanitary districts, solid waste management districts and regional water and/or sewer districts also have special functional authorities that can be utilized within WHP areas.

Soil and Water Conservation Districts

Soil and Water Conservation Districts primarily study, plan and implement projects that prevent soil erosion and flood damage. They also deal with "the conservation, development, utilization and disposal of water" within the areas they serve. To accomplish that, Soil and Water Conservation Districts have a broad range of administrative, legal, research, plan development and project implementation powers, either by themselves or through the boards of commissioners of their respective counties.

Unlike the other local units of government, however, Soil and Water Conservation Districts are not empowered to make and enforce rules and regulations in accomplishing their purposes. Rather they function in an advisory capacity and provide technical assistance to landowners and local officials. It is through their land management practices, therefore, that Soil and Water Conservation Districts contribute to ground water protection. There are several principal areas in which this occurs. District personnel exert influence by providing information, training, technical assistance, preparation of plans for best management practices, and in some cases, cost sharing of improvements through available funding programs.

Most basic to Soil and Water Conservation District programs are soil conservation and erosion/sediment control, where efforts are directed to reduce soil loss through conservation tillage and other means. This is linked closely to programs geared to encourage proper use of fertilizers, herbicides and insecticides which may reach ground waters, either through runoff to surface streams or via direct infiltration through permeable soils.

In addition to these two areas, Soil and Water Conservation Districts work with operators of feedlots and poultry farms to develop and encourage animal waste controls that protect surface and ground waters. District staff also are available to assist communities with storm water runoff control plans. Animal production facilities having more than 1,000 animal units are regulated by Ohio EPA.

General and City Health Districts

The authority to regulate on-site sewage disposal systems in the State of Ohio lies with Ohio EPA, the Ohio Department of Health and local boards of health. Local boards of health may formulate, adopt and enforce regulations that are more stringent than the State Sanitary Code (ORC 6115). Ohio EPA is responsible for regulating on-site disposal systems serving more than three dwelling units in a single residential structure; having common leach fields serving more than one residential structure; or serving a commercial or industrial land use. The health district, however, may be responsible for inspecting and reporting on the safe operations of those systems. The board of health of a general or city health district also is charged with "...the inspection, licensing, and enforcement of sanitary standards of solid waste facilities...." (ORC 3734.02[C]).

Conservancy Districts

A conservancy district is a political subdivision and a public corporation of the state as enacted in ORC Section 6101.03 (F). One of the purposes for which conservancy districts may be organized is to "provide a water supply for domestic, industrial and public use." In Ohio, the Miami Conservancy District has been monitoring and conducting ground water studies in the Great Miami Buried Valley Aquifer for a number of years. The District has a tremendous amount of hydrogeologic information and plays a lead role in WHP initiatives for a number of public water systems.

Multi-jurisdictions

Difficulties in managing protection areas arise when the designated WHP area extends into political jurisdictions other than that of the water supply owner/operator. Frequently, community wellfields are situated in areas near corporation limits surrounded by open lands that have afforded some degree of isolation from potential contaminant sources as well as provided well sites for expansion. In such instances, delineated protection zones often extend into incorporated and unincorporated lands under another jurisdiction such as a township, county or possibly another state.

Managing potential pollution sources within a public water supply owner's jurisdiction usually is accomplished through traditional municipal government mechanisms such as zoning ordinances; subdivision regulations; construction or extension of sewer and water service; adoption of operating performance standards; or other local government ordinances to protect the residents' health and welfare. To apply similar land use restrictions outside that political boundary, however, requires the full cooperation, and agreement and legislative actions by other jurisdictions that control land within the designated WHP area boundary.

Ohio's WHP Program addresses these multi-jurisdictional problems by calling for the creation of a local WHP advisory council or WHP planning committee. Such bodies include representatives from all political jurisdictions with land in the protection area. Councils also should have representatives from local health departments; planning commissions; conservancy districts; citizen action groups; trade associations; and other interested parties.

A responsibility of the council or committee in a multi-jurisdictional area is to facilitate the orderly development of a comprehensive WHP plan that encompasses all land within and outside corporation limits or property boundaries. The council or committee participates actively in plan development and implementation to ensure that the plan provides for adequate levels of water supply protection throughout the delineated protection area.

The Ohio Revised Code provides for several forms of multi-jurisdictional mechanisms which make possible intergovernmental planning, management and coordination. These existing mechanisms may be used to enhance coordination between jurisdiction and to promote WHP planning.

Regional Councils of Governments

The Ohio Revised Code authorizes the establishment of regional councils of government by its political subdivisions. Agreements may be entered into by counties, municipalities, townships, special districts, school districts or others within Ohio to form a council of government. Through agreement with similar political subdivisions in adjoining states, such an organization may cross state lines.

A council of government has the power to study area governmental problems, encourage cooperative arrangements, and coordinated actions among members. A council of government may, as authorized to do so by its members, carry out the same functions and duties as the members themselves. This provision gives councils of government in Ohio capabilities which extend beyond planning and management into the implementation of plans and programs. Further, political subdivisions may contract with a council to perform any function or service which they themselves can perform. They also can contract with the council to provide services to it.

In Ohio, there are presently five designated planning agencies for water quality management. Programs for regional aquifer analysis and ground water education are conducted by the Miami Valley Regional Planning Commission; the Northeast Ohio Four County Regional Planning and Development Organization; the Toledo Metropolitan Area Council of Governments; and the Ohio-Kentucky-Indiana Regional Council of Governments; and other regional and local planning organizations.

Regional and County Planning Commissions

Regional planning commissions may be created in Ohio by cooperating municipal planning commissions, boards of township trustees and boards of county commissioners. Regional planning commissions have the power to carry out planning functions related to the physical, environmental, social, economic and governmental characteristics of their areas, and of outside areas to the extent that aspects of these characteristics affect their regions. Regional planning commissions are more restricted in their activities than are councils of government. Their role generally is limited to advising, planning and coordinating rather than providing direct services or plan implementation.

Interstate Regional Planning Commissions

Boards of county commissioners and municipalities may cooperate with their counterparts in Ohio and in adjoining states to create, by agreement or by compact, interstate regional planning commissions when the political subdivisions make up an area where intergovernmental cooperative planning would be of benefit. The membership of such a regional planning commission is determined by the counties and municipalities creating it. Its powers and duties are similar to those of regional planning commissions as described above.

State Agencies

Of the three levels of government, the State of Ohio holds the most legal authority to protect ground water and therefore plays a significant role in WHP. The Ohio Environmental Protection Agency and the Ohio Department of Natural Resources have the largest role through their respective missions to protect environmental quality and to manage natural resources. Other state departments with significant authority to protect ground water resources include the Ohio Departments of Health, Agriculture and Transportation, the State Fire Marshal within the Department of Commerce and the Public Utilities Commission.

Ohio Environmental Protection Agency

The Ohio Environmental Protection Agency was created under Ohio Revised Code Sections 121.02 and 3745.01, and is the primary state agency charged with protecting the environment. It also is the designated lead agency for developing Ohio's WHP Program (Appendix 2).

The **Division of Drinking and Ground Waters** was created in November 1991 by merging the former Division of Public Drinking and Division of Ground Water. Primary responsibilities of the Division include: administering Ohio's public water supply program (ORC 6109); overseeing implementation of Ohio's Ground Water Protection and Management Strategy; and developing and implementing Ohio's WHP Program. Other responsibilities include: administering the Underground Injection Control program in Ohio for Class I, IV and V injection wells (ORC 3734); providing technical support to other divisions within the Agency; and maintaining a network of water quality monitoring wells.

Principal wellhead protection duties of the Division include developing policies and guidance documents to help local officials and private purveyors implement local WHP plans; conducting wellhead protection demonstration projects; and promoting WHP planning through presentations and workshops. The Division provides one-on-one technical assistance to community officials and purveyors developing local WHP plans. Division staff are responsible for overseeing and tracking wellhead protection data and plan submittals, and take the lead in the WHP plan review process outlined in Chapter 1.

Other divisions which have lead roles in regulating or managing various existing pollution threats in and around designated WHP areas include the Divisions of **Emergency and Remedial Response, Solid and Infectious Waste Management, Hazardous Waste Management, Water Pollution Control and Water Quality Planning and Assessment.** These divisions also are principal repositories of inventory information for certain types of potential pollution sources.

The Division of Solid and Infectious Waste Management implements and oversees Ohio's solid waste, infectious waste and methane gas programs (ORC 3734). The Division reviews plans for new disposal facilities and issues permits to install; works with communities on long-range solid waste planning; and oversees and registers certain generators and transporters of infectious waste. Ohio's solid waste rules prohibit the siting of new landfills within a five-year time-of-travel boundary of a public water supply well.

The Division of Hazardous Waste Management provides cradle to grave management of hazardous waste in Ohio (ORC 3734). The Division reviews plans for facilities regulated under the Resource Conservation and Recovery Act, and is responsible for issuing permits for treatment, storage and disposal facilities. The Division also works with industry on pollution prevention activities (a critical component of WHP planning).

The Division of Emergency and Remedial Response investigates, cleans up and remediates sites contaminated with hazardous waste (ORC 3734). This includes: responding to chemical and petroleum releases, spills and waste dumping incidents; investigating alleged or suspected environmental violations that involve hazardous waste, solid waste, infectious waste, air pollution or water pollution; and, discovering, prioritizing, investigating and remediating unregulated hazardous waste sites. The Division is responsible for Ohio's involvement in the federal Superfund program and maintains a Master Sites List data base which tracks sites in Ohio where hazardous waste releases are known or suspected of causing contamination. Those sites located near a public water well receive priority status for investigative work.

The **Division of Water Pollution Control** regulates the discharge of wastewaters to surface waters in Ohio through the issuance of permits and through the review of engineering plans for installation of wastewater treatment facilities (ORC 6111 and ORC 6112). The Division also is responsible for enforcing many requirements of the Clean Water Act, and is involved in developing and implementing a water quality management plan. Significant ground water protection occurs through the review and modification of facility site plans.

The **Division of Water Quality Planning and Assessment** develops and implements Agency guidelines, policies and strategies to evaluate surface water quality pollution and abatement needs (ORC 3745). This includes monitoring surface waters to identify water quality problems due to point and nonpoint sources of pollution; developing Ohio's water quality standards; recommending pollution control measures and quantifying expected improvements; preparing watershed planning profiles designed to reduce nonpoint source pollution and executing nonpoint source demonstration projects. The Division plays an important role in wellhead protection where a public wellfield induces significant recharge from surface water. The Division also maintains Ohio EPA's Geographic Information System and provides geographic information support to other Ohio EPA divisions.

Ohio Department of Natural Resources

Several divisions within the Ohio Department of Natural Resources also have lead roles in regulating or managing various existing pollution threats and are the principal repositories of inventory information for those facilities as well as regional geologic and hydrogeologic data.

The **Division of Water** is responsible for the quantitative evaluation of Ohio's ground water resources. The Ground Water Resources Section within this Division is instrumental in providing valuable hydrogeologic information for use in delineating WHP areas. Specific functions include ground water mapping; administering Ohio's well log and drilling-report law; special hydrogeologic assistance to municipalities, industries and the general public regarding local geology, well drilling and development; and quantitative problem assessment. Statutory authority for these activities is contained in ORC Section 1521.

The **Division of Geological Survey** is responsible for collecting and disseminating information relating to the bedrock and surficial geology of the state and also is instrumental in providing valuable hydrogeologic information for use in delineating WHP areas. Through its mapping programs, core drilling program and seismic interpretation programs, the Geological Survey compiles maps, inventories of bedrock and surficial materials, and advises on mining-related issues (ORC 1505).

The **Division of Oil and Gas,** acting under authority of Section 1509 of the ORC, administers rules and regulations to ensure optimum management of oil and gas reserves and the control of pollution from activities associated with production. Major functions which directly relate to ground water protection include controls over oil well drilling, well casing and well abandonment techniques; and regulating storage and disposal practices for associated waste fluids. The Division also administers the state's underground injection control program for Class II and III injection wells.

The **Division of Reclamation** administers ORC Sections 1513 and 1514 to oversee mining in the state. The Division of Reclamation is required to fulfill certain surface and ground water monitoring and enforcement responsibilities for all areas affected by coal mining. In addition to regulating active mines, the Division also administers the state and federal Abandoned Mined Lands programs.

The **Division of Soil and Water Conservation,** under ORC Section 1511, is responsible for abating soil erosion and degradation of the waters of the state by sediments, substances attached to it and by animal wastes. The Division also has a variety of responsibilities for investigations to determine soil characteristics; for inventorying critical natural resource areas; and for administrating the Ohio Capabilities Analysis Program (OCAP), which provides mapping and analysis concerning geology, soils and ground water.

The Ohio Department of Health

The Ohio Department of Health is responsible for the general supervision and control of matters relating to the preservation and protection of public health (ORC Sections 3701.03 and 3701.13). Department functions include programs to regulate the siting, design, operation and maintenance of private residential water supply systems and sewage disposal systems, both of which may directly impact local ground water quality and drinking water safety.

The Department has developed rules governing residential well construction practices and a well permit system, which are administered in cooperation with local health departments. Other ground water-related activities include a registration program for private water system contractors and a local inspection and sampling program for private water supplies.

Ohio Department of Agriculture

The Ohio Department of Agriculture regulates the production, handling and distribution of agricultural products, including pesticides and fertilizers, and promotes agricultural development (ORC Section 121.092 and ORC Chapter 901). The Department's ground water-related authority is its power to regulate the distribution, transportation, storage and application of soil additives, fertilizers and pesticides (ORC Chapter 921). Within the Department, the Division of Plant Industry administers these requirements.

Ohio Department of Transportation

The Ohio Department of Transportation manages, constructs and maintains public transportation facilities, including developing plans and state policies concerning such facilities (ORC Section 121.02 and ORC Chapter 5501). Departmental efforts can affect ground water through construction of surface water drainage projects (road construction); operation of sewage disposal and water supply systems at roadside rests; and removal of snow and ice from state highways. In removing snow and de-icing roads, Ohio Department Of Transportation stores, transports, and applies nearly one million tons of salt per year. A portion of this salt, together with that used by the public and other governmental units, may reach and contaminate ground water. The Division of Highways administers a program to minimize the effect of road salt on ground water.

Ohio Department of Commerce, State Fire Marshal

The Ohio Department of Commerce was created under ORC Section 121.02. Within the Department of Commerce, the Division of the State Fire Marshal investigates the causes of fires; adopts and enforces the State Fire Code; conducts research on the cause and prevention of fires; operates the State Fire Training and Arson Training Academy; issues permits; and conducts numerous other functions related to fire safety, prevention and training (ORC Section 3737.22).

The State Fire Marshal's major ground water responsibilities concern the storage of materials which present a fire or explosive hazard and on-site guidance to other officials when emergency conditions involve a fire or explosion. Through assuring that flammable or explosive materials are stored in a manner to prevent fires and explosions, and by directly providing on-site guidance during emergencies, the actions of the Fire Marshal may influence whether or not hazardous substances are discharged to the ground water. In addition, the State Fire Marshal's office has state statutory responsibility to administer U.S. EPA's underground storage tank (UST) requirements adopted pursuant to the 1984 amendments to the Resource Conservation and Recovery Act (42 U.S.C. 6921).

Public Utilities Commission

The Public Utilities Commission of Ohio regulates the operation of certain public utilities and railroads. A public utility can include any entity that supplies electric, natural gas, sewer, water, telephone or telegraph service within the state, or is a motor carrier within the state (ORC Section 4905.02). The Commission's principal authority related to ground water protection is the regulation of sewer and water utility companies. It has minor authority to affect ground water protection through its ability to regulate motor carriers and railroads, which transport substances that can be spilled or leaked to the environment.

Ohio Water Development Authority

The Ohio Water Development Authority, established under ORC Section 6121.02, promotes and protects the state's water resources for the benefit of the state, its people and its economy (ORC Section 6121.03). Under ORC 6123, it also has similar responsibilities and goals concerning solid waste disposal and energy resources.

<u>Federal Agencies</u>

United States Environmental Protection Agency

The United States Environmental Protection Agency is the principal federal agency with responsibility for protecting the nation's air, water and land resources from pollution, including toxic and hazardous wastes. Its authority to address ground water management stems from six major national pollution control laws: Safe Drinking Water Act; Resource Conservation and Recovery Act of 1976; Comprehensive Environmental Response Compensation and Liability Act of 1980 ("Superfund"); Clean Water Act; Federal Insecticide, Fungicide and Rodenticide Act; and the Toxic Substances Control Act of 1976. The State of Ohio has been authorized by U.S. EPA to enforce those laws, and has adopted its own rules and regulations.

U.S. Department of Agriculture

The Soil Conservation Service gives technical and financial assistance to farmers, ranchers, and state and local governments to reduce soil erosion and sedimentation; prevent flood damages; reduce damages; conserve water and improve water quality; reduce energy requirements; and assure continued agricultural productivity. The Service helps individuals and groups plan and carry out conservation, mainly through local Soil and Water Conservation Districts organized under state laws. The Service also provides technical and financial assistance to sponsoring groups in planning and installing small watershed protection projects. The Soil Conservation Service also administers the Conservation Reserve Program, which pays farmers to seed certain crop lands to grass or trees. Those croplands within 2000 feet of a public water well receive high priority for consideration under this program.

The **Farmers Home Administration** provides credit and management assistance to persons in rural America. The Farmers Home Administration loans may be made to farmers, ranchers, rural homeowners or local agencies. Most such loans may be used to provide for or improve sewage treatment and water systems, and for resource conservation.

U.S. Department of Interior

The U.S. Geological Survey prepares maps; collects and interprets data on mineral and water resources; conducts fundamental and applied research in science and technology; and publishes and disseminates the results of its investigations in maps and reports.

Nuclear Regulatory Commission

The general mission of the Nuclear Regulatory Commission is to assure that civilian uses of nuclear materials and facilities comply with public health and safety, environmental quality, national security, and antitrust laws. In carrying out its general authority, the Nuclear Regulatory Commission plays the key role with respect to protecting ground water from radiological contamination.

Non-Governmental Associations

A number of non-governmental organizations and associations have an active role in ground water management and protection. These groups include environmental organizations such as the **Ohio Environmental Council, the Sierra Club, the Ohio Public Interest Campaign, and the League of Women Voters.** Professional associations such as the **Ohio Farm Bureau, the American Water Works Association, the Ohio Oil and Gas Association, the Ohio Aggregates Association, the Ohio Electric Utilities Institute, and the Water Management Association of Ohio** have an active interest in the regulation of ground water and have played a role in the development of Ohio's WHP Program. These advocate groups provide educational forums and a useful oversight to state agencies.

Many of these groups are represented on the **Inter-Agency Ground Water Advisory Council,** which meets regularly to provide advice to Ohio EPA, ODNR, ODH and other agencies or programs on matters related to ground water policy. This forum has played a very important role in the development of wellhead protection in Ohio.

Coordination

Implementing a comprehensive WHP program involves complex issues and efforts from a wide range of state, local and federal government officials and agencies. While the local purveyor and government(s) have primary responsibility for managing contamination threats within a designated WHP area, many activities may fall under the regulatory authority of state or federal agencies. Coordinating pollution control activities among these three levels of government is essential to ensure enforcement of the appropriate regulations, avoid duplication of effort, prevent conflicts with existing regulations and develop a successful local WHP plan.

Several mechanisms are in place in Ohio and within Ohio EPA to coordinate regulatory programs. One of the Governor's Cabinet Clusters, which includes the directors of Ohio EPA, Ohio Department of Natrual Resources and Ohio Department of Health, is active in improving inter-agency coordination of programs and policies. Ohio's Ground Water Protection and Management Strategy identifies several ground water coordination activities. In addition, existing advisory groups, like the Inter-Agency Ground Water Advisory Council, also provide mechanisms for communication of efforts being undertaken or considered by Ohio EPA, Ohio Department of Natural Resources, Ohio Department of Health, Ohio Department of Agriculture, the State Fire Marshal's Office, and other involved agencies.

The State Coordinating Committee on Ground Water was formed in 1992 to enhance coordination among state level departments. The purpose of this Committee is *to promote and guide the implementation of a coordinated, comprehensive and effective ground water protection and management program for the State of Ohio.* Committee membership consists of representatives from all state programs with statutory responsibilities for the management of ground water. Representatives include several divisions within Ohio EPA; Ohio Departments of Natural Resources, Health, Agriculture, Transportation and Development; the State Fire Marshal in the Department of Commerce; and the Public Utilities Commission of Ohio. Specific goals of the Committee include:

- To promote public and private actions which lead to effective protection and management of ground water.
- To enhance communication and awareness among state departments implementing programs affecting ground water.
- To identify common issues and linkages between various departments and their programs.

- To identify unaddressed water quality and quantity issues.

- To identify and to initiate resolution of conflicts.

- To enhance communication among state and local agencies and the public.

- To review and recommend revisions, as necessary, to state plans affecting ground water protection and management.

The State Coordinating Committee on Ground Water will serve as the formal mechanism for addressing cross-program issues related to the Ohio WHP Program, including options for differential management of potential pollution sources within WHP areas.

CHAPTER 3

DELINEATION OF WELLHEAD PROTECTION AREAS

Ohio's diverse geologic settings and wide ranging community needs and resources require a flexible approach to the delineation of WHP areas. To be most effective, a WHP area must be delineated based on the hydrogeologic conditions that are unique to the given aquifer and wellfield. The different needs as well as different technical, financial and personnel resources of Ohio's public water supply systems also dictate a flexible approach to the delineation of WHP areas. A rigidly defined and complex methodology would prove unworkable for many small, public water supplies.

Several processes have been used in Ohio to aid in selecting the most applicable delineation criteria for WHP areas and to evaluate the technical aspects of delineation methods. Ohio's Inter-Agency Ground Water Advisory Council has considered draft wellhead protection policies for several years. Delineation criteria, thresholds and methods were reviewed and discussed by a subcommittee for two years. Documentation from other states and from U.S. EPA were reviewed by a subcommittee and recommendations were made to the Agency on Ohio's draft WHP Program. Additionally, a work group consisting of representatives of the Division of Drinking and Ground Waters (Ohio EPA) and the Divisions of Water and Geological Survey (ODNR) reviewed delineation criteria and methods for mapping WHP areas in Ohio.

Research into the applicability of delineation methods to different geologic settings has been conducted for several Ohio community water systems. Partial funding was provided by a U.S. EPA grant to The Ohio State University to support studies on the applicability of various WHP area delineation techniques for cities in two of the most common hydrogeologic settings in Ohio: a till covered fractured carbonate aquifer system at Richwood (Central Ohio), and a buried valley aquifer system at Wooster (Northeast Ohio). Comparative studies were conducted for seven different delineation methods including an analytical model developed by the University. The comparison of delineation methods and selected conclusions for each study are contained in Appendix 3.

Ohio EPA has gained additional delineation experience while providing technical assistance to communities in Ohio developing WHP plans. The Division of Drinking and Ground Waters has conducted research into the technical aspects of WHP planning, including delineation of WHP areas at the Springfield, Ohio wellfield. This study also was funded partially by U.S. EPA.

Wellhead Protection Area Delineation Criteria

A WHP area is defined as the surface and subsurface area surrounding a well or wellfield that contributes water to a wellfield and through which contaminants are reasonably likely to move toward and reach such a well or wellfield. According to U.S. EPA guidance (1987), a WHP area should protect a public water well from three general categories of threats.

- Direct introduction of contaminants in the immediate well area including contaminants from accidental spills, road runoff, leakage of chemicals and other incidents that are carried across the land surface to the well;

- Microbial contaminants, especially bacteria and viruses, that could remain in water delivered to consumers even after treatment; and,

- Chemical contaminants from a variety of sources, many of which are very persistent and may travel long distances before being adsorbed to subsurface media, transformed to less harmful chemicals, diluted to non-harmful concentrations, or otherwise rendered less threatening.

The delineation of a WHP area is based on the selection of *criteria* that describe the physical processes of ground water flow and contaminant transport. Two basic delineation criteria are recommended for use in Ohio.

- Time-of-travel (TOT)--the advective travel time for contaminants to flow through an aquifer and reach the well or wellfield;

- Flow boundaries--ground water divides and/or other physical and hydrogeologic features that control ground water flow to the well or wellfield.

Wellhead protection delineation *criteria thresholds* are the numeric values selected for each WHP area criterion used in a delineation (e.g., a TOT of 5 years). Multiple protection zones may be defined around a water supply well or wellfield by using different thresholds for the same criterion (e.g., one-year and five-year TOT). The purpose of multiple protection zones is to establish areas for different management strategies based on proximity to the wellfield.

Time-of-travel in combination with a flow boundary criterion is the preferred criterion for delineation. A TOT WHP area is defined as the area surrounding a well or wellfield that contributes flow to the well(s) within a specified period of time. Ohio EPA recommends public water purveyors use a threshold of five years. A five-year TOT WHP area represents the area surrounding the well or wellfield that will contribute ground water flow to the well(s) within five years.

The five-year TOT fulfills Ohio's WHP Program objective by allowing a purveyor time to respond to ground water contamination reaching the WHP area. Past experience has shown that five years should provide adequate time to design an interceptor well system, add treatment to the water system, or even develop an alternate water source. The five-year TOT also provides a manageable area on which purveyors can focus their attention. This enables them to identify activities which may pose a threat to ground water contamination and to develop a management strategy to prevent contamination from occurring.

Ohio EPA also recommends delineating an inner management zone with a one-year TOT. Due to the proximity to the well or wellfield (i.e. shorter travel time and therefore shorter response time), this zone may require more stringent management controls than the five-year WHP area. In some instances, a purveyor also may choose to have an additional management zone beyond the five-year WHP area (e.g. 10 or more years). This is especially useful where the aquifer is extremely susceptible to contamination from surface or near surface activities.

Wellhead Protection Area Delineation Methods

Time-of-travel WHP areas can be defined through a number of different techniques that range from the simple calculated fixed-radius method to resource and data-intensive numerical computer modeling methods. While the latter method is the most accurate, the amount of hydrogeologic information needed to develop such a model may delay or even prohibit the timely development of a WHP plan. Ohio EPA evaluated four methods to delineate TOT WHP areas. These methods listed are in order of increasing cost and sophistication.

- Calculated fixed-radius methods--employ the use of analytical equations (such as the volumetric flow or Thesis equation), and site specific hydrogeologic conditions (such as well discharge, transmissivity and aquifer thickness), to determine a circle for a specified distance, drawdown or time-of-travel;

- Analytical methods--use well hydraulics and ground water flow equations to define the areas of contribution to the well or wellfield. Analytical methods generally assume the aquifer is uniform and homogeneous with a relatively constant saturated thickness and uniform regional hydraulic gradient;

- Semi-analytical methods--use analytical well hydraulics equations combined with more complex ground water flow equations to delineate a two-dimensional area of contribution to the well. Requires more site-specific values for aquifer parameters and fewer simplifying assumptions; and

- Numerical flow/solute transport models--use a combination of complex numerical ground water flow equations to delineate three-dimensional areas of contribution to the well or wellfield. Requires use of a powerful computer and detailed hydrogeologic information. Requires fewer simplifying assumptions.

Selection of the most appropriate method to use when delineating a WHP area is made after consideration of the availability of geologic and hydrogeologic information; the nature of existing and potential pollution threats; and the availability of technical expertise and financial resources to acquire additional hydrogeologic data. As such, the delineation method varies for different situations.

Ohio EPA recommends that the majority of larger water supplies utilize semi-analytical methods, usually combined with geologic mapping, to delineate a TOT WHP area. Although semi-analytical models require simplifying assumptions about aquifer properties and dimensions (e.g., homogeneous, infinite aquifer), research in Ohio has shown they can provide a high level of precision in delineating TOT boundaries. When used in conjunction with image well theory, the effects of hydraulic boundary conditions such as valley walls and induced river recharge can be accounted for. Semi-analytical models also can be adjusted to accommodate changing hydraulic conditions such as increased water usage or variations in recharge conditions. By carrying out a geologic assessment of aquifer boundaries and characteristics, a WHP area defined by semi-analytical flow model can be modified to delineate the WHP area more accurately.

Cities with considerable hydrogeologic information, complex hydrogeologic settings or with numerous pollution threats can obtain a more accurate delineation of their WHP area using a numerical flow model. These models accommodate a significant degree of variation in aquifer material properties and aquifer dynamics. While such a properly executed and evaluated model can provide the best delineation of the zone of contribution to a well or wellfield, it also is the most complex and expensive approach.

For many of the smaller public water supplies in Ohio, certain types of hydrogeologic information (i.e. hydraulic conductivity and ground water flow direction and velocity) is not readily available and the cost of acquiring it may be prohibitive. In such situations, a simple analytical model or a calculated fixed-radius method, combined with basic hydrogeologic mapping, may be used. By making reasoned estimates of aquifer properties and maximizing pumping rates, these methods provide a conservatively sized WHP area to allow for adequate protection of the wellhead or wellfield.

For most public water supplies located in a confined aquifer setting, Ohio EPA recommends using a calculated fixed-radius method combined with hydrogeologic mapping to delineate the WHP area. These purveyors, however, may elect or, due to a complex geologic setting (e.g., multiple aquifers) or multiple sources of pollution, be required to use a more scientific method. Systems utilizing a confined aquifer also will need to identify primary recharge areas. If a recharge area is not next to the well or wellfield, a separate "satellite" WHP area should be designated. In these cases, hydrogeologic mapping methods should be used to identify WHP areas. A flow boundary criterion combined with a five-year TOT criterion is recommended when delineating recharge areas.

Ohio EPA will be developing a library of calculated fixed-radius and variably shaped WHP areas as part of the technical guidance document to be completed in 1992. This collection of standardized WHP areas will approximate one-year and five-year TOTs for several generic hydrogeologic settings common to Ohio. These WHP areas will be generated using the calculated fixed-radius method and analytical modeling techniques applied to different sets of hydrogeologic parameters (e.g., transmissivity, aquifer thickness and gradient) under varying rates of pumping. Many of the smallest community and non-community systems will be able to apply one of these pre-determined WHP area shapes to their wellfield by selecting one that has similar hydrogeologic conditions and pumping rates as those found at their wellfield. The cost of applying this delineation method is extremely low and would require limited field information or technical expertise.

Ohio EPA recommends that communities use the maximum pumping rates when delineating WHP areas. This helps to account for future wellfield expansion and produces a more conservatively sized [larger] WHP area.

To aid in the evaluation of delineated areas, Ohio EPA requests that all WHP areas be submitted on standard 1:24,000 scale topographic maps. These maps can depict the location of the WHP area boundary accurately as well as the locations of all wells and any other features affecting boundary locations.

The Division of Drinking and Ground Waters is developing automated mapping capabilities under a grant from U.S.EPA, and will be providing more specific standards and formats for mapping and reporting such WHP area attributes.

Protection of public water supplies for the future requires ongoing vigilance and continued evaluation of both the ground water resource and potential pollution sources. Wellhead protection areas are delineated at a set time under a unique set of hydraulic conditions. Because the needs of a water system change, and pumping rates change, WHP areas must be reviewed periodically. While Ohio EPA recommends that public water systems utilize maximum pumping rates when delineating WHP areas, refinement of the delineation of the WHP area may still be necessary, including a reassessment of the method used. It is conceivable that a purveyor may choose to refine the protection area delineation through utilization of more sophisticated methods and/or the incorporation of more accurate and complete data after the initial WHP plan submittal. As discussed in Chapter 1, Ohio EPA recommends that community water systems re-evaluate their WHP area at least every 10 years to ensure adequate protection of their wellfield. Some systems may, under certain conditions, be required by Ohio EPA to re-assess their WHP area more frequently.

CHAPTER 4

POLLUTION SOURCE IDENTIFICATION AND INVENTORY

An essential element of WHP planning is an inventory of all potential sources of ground water contamination in and around delineated WHP areas. The purpose of the inventory is to identify any past, present and proposed activities that may pose a threat to the well or wellfield. Provisions in the 1986 Safe Drinking Water Act Amendments specify that state programs "...shall, at a minimum,...identify within each WHP area all potential anthropogenic sources of contaminants which may have any adverse effect on the health of persons." The comprehensive, detailed land use inventory is essential for development of an effective WHP management plan.

Although Ohio EPA and other state agencies provide technical information and assistance to communities on pollution sources, the overall responsibility for completing an inventory rests with the private water purveyor or local government-owned community water system. Several processes may be needed for conducting a pollution source inventory. These include conducting windshield surveys of the area; meeting with local and state officials; searching files and records; interviewing individual residents;and/or inspecting sites.

The Division of Drinking and Ground Waters completed a guidance document for conducting a pollution source inventory in the fall of 1991. This document, available from the Division, will assist community officials and water purveyors in conducting the pollution source inventory. It includes lists of potential pollution sources; methods for describing various sources; how to acquire essential information; how to prioritize sources; and identifies local, state and in some instances federal agencies who maintain records of land use activities. It is anticipated that, through the use of the guidance, local water purveyors can carry out an efficient and comprehensive inventory of their WHP area within a reasonable period of time and with minimal financial and staff resources.

Ohio EPA encourages start-up of the pollution source inventory as early as possible in the development of a WHP plan. Inventory activities should be carried out concurrently with other field activities associated with the WHP area delineation process. Information gathered during the inventory is essential to developing an appropriate management strategy. In fact, the inventory is actually the beginning of efforts to develop the management strategy. This is because as purveyors identify potential sources of contamination, they can begin identifying options to eliminate or manage that threat. A purveyor may even be able to initiate actions to eliminate a threat of contamination before the WHP plan is completed.

Ohio EPA also encourages the use of personal site inspections and interviews with the owners and operators of facilities located in the WHP area. While they can be time consuming, site visits not only can provide detailed information on current and past industry processes, management practices and pollution threats, but also can serve as excellent educational and public involvement tools. Site visits provide an opportunity to explain to people living and working in the WHP area where they are located in relation to the public water wells; that their activities potentially could impact the quality of ground water and therefore potentially impact the public water supply; and, to introduce the concepts of WHP planning.

While the WHP plan submitted to Ohio EPA must identify all potential sources of ground water contamination in the WHP area, in highly developed areas, conducting individual site inspections of every facility may not be practicable initially. In some instances, potential pollution sources can be ranked according to their relative potential to cause ground water contamination. Detailed site inspections then can be prioritized and conducted for those facilities that appear to present the greatest pollution threat based on type of activity, hydrogeologic conditions and proximity to the wellfield.

Ohio EPA has developed standard forms for reporting pollution source inventory information tailored to specific types of facilities as part of the technical guidance document completed in 1991. Information to be compiled includes: owner's name and address; latitude and longitude; distance from nearest production well; pollution source or type (including chemical inventories); start-up of facility or current processes; operating status; permit numbers; and identification of public agencies that maintain facility records on operations and design. Those responsible for conducting inventories also should report any suspected incidents, malfunctions or other operational and design deficiencies that could be of significance in assessing ground water pollution impacts.

The key to a successful and cost-effective inventory is locating all existing sources of information. Generally, a large amount of inventory information is available from a number of state and local government agencies. Several local or regional planning agencies have completed inventories of potential pollution sources. Using this available information can save a tremendous amount of time and resources.

It is important for each purveyor to assess historic as well as potential land uses to produce a complete comprehensive inventory. In the Springfield demonstration project, this was accomplished by reviewing aerial photographs and local government-prepared land use and zoning maps covering the last 40 to 50 years. Zoning maps identify those areas where future development could present a threat to ground water. Memories of long-time residents are useful to augment more official records of past land uses.

Potential pollution sources and inventories of land use should be plotted on topographic maps on a scale of 1:24,000. When superimposed with a map of the WHP area boundaries (the same scale), they are useful in assessing potential threats to the wellfield and development of the management component of the local plan. Maps of pollution sources, when used in combination with ground water flow maps, are also useful in designing an effective ground water monitoring program plan and contingency plans.

Maintaining an accurate and comprehensive inventory and assessment of potential pollution sources is an on-going effort that requires periodic updating and oversight. Local officials should establish routine mechanisms for updating inventory information. This includes any new activities and changes in the operational status of previously inventoried facilities. Each purveyor should evaluate updated inventory information to assure that the management element of their WHP plan still adequately protects the wellfield and public health from contamination.

As discussed in Chapter 1, a comprehensive update and verification of the pollution source inventory should be conducted and submitted to Ohio EPA every 10 years. If a purveyor has previously established routine mechanisms for updating and recording changes in the WHP area, this update should require little effort. In some instances, the update will be accomplished with the same process as the original inventory (e.g. reviewing available public records, annual inventory updates and field visits). The comprehensive inventory update will help assure that information needed to support local decisions accurately represents current conditions.

<u>Pollution Source Categories</u>

Table 1 lists three general categories of potential ground water pollution sources. These sources are categorized on the basis of their relative potential to cause ground water contamination. The purpose of this type of categorization is to provide an opportunity for those conducting pollution source inventories to direct more attention toward identification and assessment of those particular sources with the greatest relative pollution risk. For example, a purveyor may use this type of prioritization to identify facilities where on-site inspections should be conducted first. This system also can be used to prioritize the establishment of WHP management system options including ground water monitoring.

It is important to recognize that neither the categories nor the potential pollution sources in Table 1 are fixed or absolute. The potential to pollute ground water depends on numerous factors such as the hydrogeologic setting; regulatory controls in place; specific management and operation practices; and the physical and chemical characteristics of the potential contaminants. Therefore, based on site-specific conditions, individual sites may present a much higher or much lower risk than indicated. For this reason, the risk per category is reflected as a range. Ohio EPA prepared this table as a general reference tool. Those responsible for conducting wellhead protection activities should base their prioritization on actual site conditions.

Several different sources of information have been used to compile and categorize the various potential sources of ground water contamination. A 1984 report by the Office of Technology Assessment entitled "Protecting the Nation's Ground Water from Contamination" references a wide range of potential pollution sources. Several of the larger regional planning agencies in Ohio have conducted various types of pollution source or land use inventories. The Ohio EPA Division of Drinking and Ground Waters has used these lists and inventories, as well as other sources of information, to compile an initial listing of potential pollution sources. These sources were categorized using such factors as the degree of regulatory control, known occurrences of ground water contamination in Ohio, and the types of contaminants normally associated with specific activities.

TABLE 1. SAMPLE RELATIVE POLLUTION RISK RANKING

CATEGORY I - MEDIUM TO HIGH POLLUTION RISK	
SOURCE	**DATA ACQUISITION SOURCES/METHODS**
Regulated hazardous materials (permitted treatment, storage or disposal facilities)	- Ohio EPA - Division of Hazardous Waste Management - Ohio EPA - Division of Emergency and Remedial Response - Local emergency planning districts - Associations of industrial and commercial entities - Chambers of Commerce, etc.
Unregulated hazardous materials (non-permitted or pre-regulation disposal sites, spills and orhan plumes)	- Ohio EPA - Division of Hazardous Waste Management - Division of Emergency and Remedial Response - Industrial and commercial entities and local residents - Regional Planning Organizations - Field reconnaissance and local residents
Municipal and non-exempt solid waste disposal facilities (Operating and Abandoned) permitted prior to 1/81	- Ohio EPA - Division of Solid and Infectious Waste Management - Local health departments - Local residents - Regional Planning Office
Storage tanks (above and below ground - flammable, toxics, petroleum products and other chemicals)	- Ohio EPA - Division of Emergency and Remedial Response - Ohio EPA Division of Hazardous Waste Management - Local residents - State Fire Marshal - Under Ground Storage Tanks Program - Local emergency planning districts - Local fire departments
Certain subclasses of Class V injection wells (industrial waste disposal)	- Ohio EPA - Division of Drinking and Ground Waters, Class V Inventory
CATEGORY II - MEDIUM POLLUTION RISK	
SOURCE	**DATA ACQUISITION SOURCES/METHODS**
On-lot sewage systems (septic systems, dry wells, package plants)	- Ohio EPA - Division of Water Pollution Control - Local health departments - Field reconnaissance - Local planning agencies

TABLE 1. SAMPLE RELATIVE POLLUTION RISK RANKING (continued)

CATEGORY II - MEDIUM POLLUTION RISK (continued)	
SOURCE	**DATA ACQUISITION SOURCES/METHODS**
Non-hazardous wastewater (storage lagoons, land applications sites - sludge and spray irrigation, NPDES discharges to recharge waters)	- Ohio EPA - Division of Water Pollution Control - Ohio EPA - Division of Drinking and Ground Waters - Local sewage departments - Local residents
Oil and gas drilling and production (storage pits, separators, brine spreading, transmission lines, injection wells)	- ODNR Division of Oil and Gas - Local oil and gas inspectors - Local highway departments - Field reconnaissance and local residents
Bulk chemical and products stockpiles and transfer stations (salt, coal, and other dry chemicals and products	- ODNR Division of Reclamation - Local highway departments - Utility company facilities - Ohio Department of Transportation - Industrial and commercial facilities
Miscellaneous chemical and product use; storage and disposal (manufactured products, warehouse goods, raw material storage, production and feed stocks, waste storage)	- Industrial and commercial facilities - Ohio EPA Divisions of Water Pollution Control and Hazardous Waste Management - Local emergency planning districts and fire departments
Pesticide and fertilizer application - high volume per unit area (orchards, nurseries, truck farms, golf courses, bulk storage and mixing plants)	- USGS Topographic maps - Aerial photos (USDA or Ohio DNR) - Parks and recreation departments - Ohio Department of Agriculture - County Agricultural Extension Offices - Soil and Water Conservation Districts
Previously permitted exempted solid waste disposal (fly ash, bottom ash, foundry sand, demolition sites) (active and abandoned)	- Ohio EPA - Division of Solid and Infectious Waste Management - Ohio EPA - Division of Water Pollution Control - ODNR - Division of Reclamation - Local health departments - Electric utility companies - Local planning agencies
Coal mining other mineral extraction areas (active and abandoned)	- ODNR Divisions of Reclamation and Geological Survey - Ohio Coal Association - Ohio EPA - Divisions of Water Pollution Control and Water Quality Planning and Assessment - Field reconnaissance and Local residents

TABLE 1. SAMPLE RELATIVE POLLUTION RISK RANKING (continued)

CATEGORY II - MEDIUM POLLUTION RISK (continued)	
SOURCE	**DATA ACQUISITION SOURCES/METHODS**
Solid waste disposal facilities (operating and abandoned) permitted between 1/81 and 1/89	- Ohio EPA - Division of Solid and Infectious Waste Management - Ohio EPA - Division of Emergency and Remedial Response - Local health departments - Regional Planning Office - Local residents - Local and regional planning agencies
CATEGORY III - MEDIUM TO LOW POLLUTION RISK	
SOURCE	**DATA ACQUISITION SOURCES/METHODS**
Highway maintenance (road salt and road oil application, etc.)	- Local highway departments - Ohio Department of Transportation - Mining companies
Transmission lines (fuels, chemicals, sewage, etc.)	- Public Utilities Commission of Ohio - Local sewage departments - Ohio EPA - Division of Water Pollution Control - Utility companies - Ohio Petroleum Marketers Association - Local planning agencies
General farming and residential lawn and garden maintenance	- ODNR - Division of Soil and Water Conservation and local SWC districts - Field reconnaissance
Exempted solid waste disposal facilities (permitted under HB592) for flyash, bottom ash, foundry sand, demolition sites (active or properly closed). Miscellaneous sources (cemeteries, abandoned wells, quarries, junk yards)	- Divisions of Reclamation and Geological Survey - ODNR - Division of Soil and Water Conservation and local SWC district - Local and regional planning agencies - ODNR - Division of Water - Field reconnaissance and local residents
Animal waste areas (feed lots, animal waste lagoons, animal burial sites, land application sites)	- Ohio EPA - Division of Water Pollution Control and Water Quality Planning and Assessment - County Agricultural Extension Offices - ODNR - Division of Soil and Water Conservation and local SWC Districts - Field reconnaissance

CHAPTER 5

MANAGEMENT OF WELLHEAD PROTECTION AREAS

The most important element in establishing an effective local WHP planning process is developing and implementing a comprehensive and coordinated management strategy to control existing as well as potential new sources of ground water contamination. Public water systems' WHP plans should include local management initiatives to prevent contamination from existing as well as future potential pollution sources; modified contingency plans which identify short-term as well as long-term alternate water sources in the event of contamination; and policies and procedures for protecting all existing and new water supply wells. The management element of the WHP plan also should include a ground water monitoring program plan which would provide an early warning system of impending contamination; identify financial resources to support WHP plan implementation; and discuss procedures which will be adopted to ensure public participation throughout plan development and implementation.

The preparation of the management element builds on the information gathered during the WHP area delineation and pollution source inventory process. This allows the plan's management strategy to focus on a clearly defined protection area and specific potential pollution sources or land uses. Communities within an active regional planning and development district having an effective ground water planning and management framework, can begin developing the management element before a delineation and inventory is complete. As discussed in Chapter 4, as potential sources of ground water contamination are identified, purveyors can begin to develop, and even implement, options for eliminating or managing that threat.

Developing the management element of a plan must build on existing regulatory control programs at all levels of government. While managing contamination threats within a designated WHP area is primarily the responsibility of the purveyor and local government(s), many activities may fall under the regulatory authority of state or federal agencies. Coordinating pollution control activities among these three levels of government is essential to ensure enforcement of the appropriate regulations, avoid duplication of effort and prevent conflicts with existing regulations.

Public water supply owners and operators need to understand the sometimes complex legal and institutional framework within which ground water is protected in Ohio. By knowing what regulations apply to potential pollution sources within their WHP areas and what agencies are responsible for implementing them, the responsible parties can better determine what activities within the WHP area are unregulated and develop and institute locally acceptable control systems. They also can determine what potential pollution sources already are regulated; work cooperatively with the responsible agency or agencies to ensure compliance; and, if a violation is noted, ensure that enforcement actions are taken. In some instances, local governments may decide to implement regulatory controls more stringent than those enforced at the state or federal level. By augmenting existing regulatory and institutional systems, communities can make the most efficient use of their limited resources.

Many of the WHP areas to be delineated in Ohio will be, at least in part, in areas outside the jurisdiction of the water supply owner. Land use may be controlled by other communities, counties, townships, states and/or federal agencies. Cooperation from authorities in other jurisdictions is essential for a public water supply owner to implement a WHP plan. Officials from other jurisdictions should be involved in plan development at the earliest stage possible. To help resolve multi-jurisdictional issues, Ohio's WHP Program promotes and encourages the establishment of a council or committee consisting of representatives from each jurisdiction plus representatives of other constituencies (e.g. industry and citizens) within the WHP area.

The purpose of the councils or committees is to foster effective and consistent management of potential pollution sources and land use activities throughout the entire WHP area. Coordinated and consistent policies and regulatory decisions can be enhanced by including representatives from local boards of health; planning agencies; prominent industrial and commercial interests; agricultural organizations; and citizen action groups.

Local Management Options

The management strategy of a local WHP plan should establish policies and procedures to prevent ground water contamination from all potential sources of ground water contamination identified in the pollution source inventory for all existing and new water supply wells. The options available for controlling potential sources of pollution within WHP areas will vary depending on the type of the system and the population served. They also vary depending on the nature of current land uses and the types of potential pollution sources identified during the inventory process. Because each public water system faces different ground water threats and problems, no single wellhead protection tool or combination of tools can be prescribed as best for all systems. However, some of the more useful management options are highlighted below.

- Zoning ordinances: direct land development and regulate land uses by specifying activities which are allowed, restricted or prohibited;

- Subdivision ordinances: characterize allowable land use mixes in large, subdivided development;

- Site plan review: helps ensure compliance with development plans;

- Design standards: help prevent ground water contamination by setting building and site design and construction standards;

- Operating standards: help regulate potentially hazardous practices by prescribing methods for carrying out or maintaining safe operation processes;

- Purchase of property or development rights: ensures control of land uses in wellhead areas consistent with an Ohio EPA approved plan;

- Source prohibitions: prohibit development or materials that absolutely threaten ground water or are in direct pathways to ground water;

- Wellfield management and/or excess capacity: configure well placement and pumping rates to control ground water flow directions and gradients to prevent intrusion of poor quality ground water.

- Public education: builds support for ground water protection activities, and instills pollution prevention ethic in residents;

- Spill reporting and emergency response: provides early notification to water plant officials and triggers emergency response procedures;

- Ground water monitoring: helps assess natural ground water quality and provides early warning in the event of contamination;

- Household hazardous waste collection: reduces threats to ground water from residential hazardous waste disposal which presently is regulated only differentially; and,

- Water conservation measures: reduce the need to expand WHP area and help prevent intrusion of poorer quality water.

Management options for controlling specific contaminant sources should consider the degree of risk posed by the source including proximity to the wellfield, hydrogeologic sensitivity and type of activity. Facilities located immediately adjacent to the well or wellfield that pose a high risk to ground water because of certain chemical use, storage or disposal practices may require more stringent controls than those posing less risk and located on the perimeter of the WHP area. To address this issue, Ohio's WHP Program calls for delineating a management zone with a one-year TOT within the five-year TOT WHP area. A purveyor may wish to implement even stronger management controls within this area. For example, a community may choose to prohibit the siting of a certain type of facility within the one-year TOT zone, but allow that same type of facility to be located in some other part of the WHP area provided protective design, installation and operating practices are utilized.

Ohio EPA's Division of Drinking and Ground Waters prepared a list of management options for controlling existing and potential threats to ground water as part of the Springfield Demonstration Project (See Appendix 4). These options are provided only as examples of potential management tools which may be developed and do not address all of the activities that can lead to ground water contamination in this or other WHP areas.

The management component of a local WHP plan will vary depending on the type of the system and the population served. Because privately-owned non-community water systems have either limited or no authority to control land use or other activities beyond their property boundary, the management component of their WHP plan will be different than that of a government-owned community system. It may include a memorandum of agreement with the local political jurisdiction(s) to implement WHP planning initiatives. At times, it may be as simple as instituting best management practices on the land under the property owner's control.

Ohio EPA intends to sponsor a series of invitational wellhead protection workshops during 1992 and 1993 to assist the Agency in defining specific management options for different types of public water systems (i.e. different sized government owned systems and privately owned community and non-community systems). Representatives from the various associations in Ohio, regional planning agencies, consulting firms, local officials and purveyors will be invited to participate. By soliciting recommendations from individuals who can represent various interests and concerns, Ohio hopes to define a set of reasonable and workable management options. These options then will be incorporated as part of a technical guidance document to be developed by the Division of Drinking and Ground Waters.

To facilitate technical assistance to the small community and non-community systems, Ohio EPA also is considering developing a generic "checklist' or "fill-in-the blank" model WHP plan. This "checklist" or "fill-in-the-blank" model plan would be part of the technical guidance document to be developed. It would aid the small purveyor in selecting and applying appropriate WHP management techniques. By using this model plan in combination with other guidance documents (i.e. those on delineation and conducting a pollution source inventory), even the smallest purveyors should be able to develop and implement a WHP plan that complies with the state's WHP Program.

Education, training and public involvement programs are other essential components of a successful and approvable local WHP plan. People living or working in a designated WHP area must be made aware very early in the planning stage that their activities can affect the quality of the local water supply. They also need to know how they can avoid such impacts. Ohio EPA made several recommendations for educational or training programs for Springfield's WHP plan. Relatively simple and inexpensive methods include posting signs designating the boundaries of WHP zones on roads and highways and placing posters in work places informing people they are located in a WHP area. More complex and expensive training programs on proper materials use, handling and storage also could be used.

Public education efforts and public involvement in decision-making can be accomplished through technical advisory groups; public hearings; meetings; seminars; newsletters; brochures;and public service announcements. Open communication promotes public trust and confidence and ultimately the development of a WHP plan which not only protects the water source and public health but also reflects the needs and desires of involved parties.

State Management Options

Many management techniques are applicable to all areas of the state. State rules, regulations and policies can provide an increased level of protection to all WHP areas. Several programs are now in place which allow for differential management and adoption of more stringent pollution controls in WHP areas. For example, Ohio's solid waste rules (OAC 3745-27) prohibit the siting of new landfills within a five-year TOT boundary of a public water supply well. They also require owners of existing landfills within WHP areas to prepare closure plans and implement post-closure ground water monitoring.

Ohio EPA makes every effort to prioritize remedial actions for pollution threats in delineated WHP areas. The Division of Emergency and Remedial Response gives priority status to sites with contaminated ground water located within a WHP area. Recently, the Division has been conducting follow-up studies and special investigations around public drinking water wells where volatile organic compounds (VOC) have been detected.

Proposed rules of the State Fire Marshal (OAC 1301: 7-9) include provisions for defining "Sensitive Areas" which include lands within a specified distance of a public wellfield. Underground storage tanks and piping within such areas are required to have double-lined containment systems, spill and overfill prevention measures and must be checked for releases of regulated substances at regular intervals.

Regulatory authorities of Ohio EPA and other state agencies can be strengthened to provide even more protection to WHP areas through rule amendments. As discussed, several programs are already in place which allow for differential management and adoption of more stringent pollution controls within a WHP area. Other options for differential management of potential pollution sources within WHP areas (e.g. oil and gas production, agricultural activities, road salt storage and use, and mining operation), will be considered by the state Coordinating Committee on Ground Water (see Chapter 2) during 1992 and 1993.

Over the long term, education can be a very effective tool to ensure continued safety of Ohio's public water supplies. A primary task of Ohio EPA and other state agencies in implementing the WHP Program is to provide effective guidance and education to the regulated community and the public through seminars conducted or sponsored by Ohio EPA; technical and management training; newsletters; demonstration projects; and other reports. Since 1988, numerous educational seminars have been conducted or sponsored by Ohio EPA throughout the state. Nearly 20 wellhead protection presentations were given to regional planning groups, water purveyors and professional associations during 1991. To assists purveyors in developing WHP plans, the Division of Drinking and Ground Waters has prepared or funded several reports and technical guidance documents. As discussed in Chapter 1, more demonstration projects, technical guidance documents and policies will be developed over the next several years. Education of the general public will continue to be a high priority throughout the implementation phase of the WHP Program in Ohio.

Ground Water Monitoring

A ground water monitoring plan is a key element of an effective WHP plan. Although not all systems may need to install new monitoring wells, almost systems will need to prepare an approvable monitoring plan that assesses the need for monitoring and which, if required to be put into effect, would provide an early warning of impending contamination. In some instances, an effective ground water monitoring network can be accomplished by testing existing wells on surrounding properties. A purveyor also may request a waiver from ground water monitoring if it can be shown that no major pollution sources have the potential to affect ground water reaching the well or wellfield. Whether new or existing wells are utilized for monitoring purposes, they should be located and/or constructed in a fashion dictated by local ground water flow patterns, hydrogeologic conditions and potential pollution threats. Also, they should be sampled at a frequency that will allow a purveyor adequate response time to implement remedial actions in the event contamination is detected. Sampling schedules and parameter lists should be included as part of the ground water monitoring plan. The plan should include a map (1:24,000 scale), description of wells, sampling schedules, parameter lists and a Quality Assurance/Quality Control plan.

CHAPTER 6
CONTINGENCY PLANS

Emergency and contingency planning is an essential element of local WHP plans. All public water systems face potential disruptions in service due to operational problems such as water main breaks and equipment breakdown, as well as water quantity or quality problems. Even if a water system develops an excellent WHP area management strategy, contamination can still occur due to leaks, spills, illegal discharges and other activities in and around the WHP area. A properly prepared and updated contingency plan helps ensure that local officials are prepared to respond to emergency situations and ready to provide alternative sources of water.

Chapter 3745-85 of the Ohio Administrative Code requires each community water system in Ohio to prepare and maintain a contingency plan for providing safe drinking water during emergency conditions. This section of the code also outlines the required contents of each public water system's contingency plan.

Ohio EPA has prepared a state Drinking Water Supply Emergency Plan (1991). This plan outlines an organizational structure and procedural guidelines utilized by Ohio EPA in confronting a typical water supply crisis. It also was developed to assist local officials by outlining what factors should be addressed by each water purveyor's own emergency plan. These factors include a description of the methods and procedures to use when responding to emergency situations and the duties, responsibilities and functions of involved parties. In addition, each emergency plan should identify alternative sources of water; resources authorized for expenditure under emergency conditions; and methods of notifying users of emergency situations. To further assist the small purveyor, Ohio EPA has developed a generic Drinking Water Supply Contingency Plan. This "fill-in-the-blank" plan addresses each element required by OAC 3745-85. Appendix 5 contains a copy of OAC 3745-85 and the generic Drinking Water Supply Contingency Plan.

When a chemical release occurs in the WHP area, different levels of response are necessary depending on the magnitude of the release. To prevent disruption of service, a purveyor needs to have previously identified both short- and long-term alternative sources of water. For instance, to prevent contaminants from reaching a well, it may be necessary to cease pumping until remedial actions can be taken. In the worst-case scenario, a purveyor may need to abandon a well due to contamination.

While many existing community water systems' contingency plans already contain provisions for alternative sources of water, Ohio's WHP Program expands on the current emergency planning requirements (ORC 3745-85) and calls for public water systems to amend their contingency plans to specifically identify temporary and long-term alternate drinking water supplies and the financial mechanisms for implementing those alternatives in the event of contamination.

Local officials also need to coordinate their public water system contingency plan with emergency planning requirements of the federal "Superfund Amendments and Re-authorization Act of 1986" (SARA) Title III and ORC Chapter 3750. Title III has four major sections important to WHP planning: emergency planning; emergency notification; community right to know reporting requirements; and toxic chemical release inventory reporting. Ohio EPA's Divisions of Emergency and Remedial Response and Air Pollution Control are responsible for administering these programs.

In general, the emergency planning provisions of Title III require specific hazardous material response plans be developed that establish state, local and federal responsibilities, clarify response procedures and identify the resources necessary in the event hazardous substances are released to the environment. The State Emergency Response Commission for Ohio was created in accordance with Title III and ORC Chapter 3750. State Emergency Response Commission is responsible for designating local emergency planning districts and appointing Local Emergency Planning Committees. The primary responsibility of Local Emergency Planning Committees is to develop and maintain emergency response and preparedness plans for chemical releases to the environment. If properly developed and updated, emergency response plans can reduce the risk of contamination to the public well or wellfield.

U.S. EPA has suggested that states prioritize the development of contingency plans for "major" public water supplies. In Ohio, drinking water contingency plans currently are required for all community water systems. Ohio's WHP Program also calls for all non-community public water systems to prepare contingency plans using Ohio EPA's contingency plan as a guide, with modifications based on the provisions listed above.

CHAPTER 7

NEW WELLS

Ohio rules and regulations require public water purveyors to submit detailed plans to Ohio EPA for approval prior to installing new public water wells. Chapter 6109.07 of the Ohio Revised Code states that "no person shall begin construction or installation of a public water system, or make a substantial change in a public water system, until plans therefore have been approved by the Director of Ohio EPA." An application for approval of such plans is to be submitted to Ohio EPA for review and approval. Upon receipt of an application, "the director shall consider the need for compliance with requirements of the Safe Drinking Water Act, and generally accepted standards for constructing and equipping the water systems, and shall issue an order approving or disapproving such plans." Ohio EPA utilizes this authority to require WHP planning for certain new public well installations.

Currently, Ohio EPA asks community water systems to submit a work plan to develop a WHP plan as a condition of plan approval. The work plan must include a schedule for submitting a complete WHP plan to Ohio EPA for its review. The WHP plan should be completed in accordance with Ohio's WHP Program and guidance documents to be prepared by Ohio EPA.

As wellhead protection becomes more fully implemented in Ohio, Ohio EPA may request certain public water purveyors to submit an estimated WHP area and preliminary pollution source inventory as part of an application for approval for a new public well. The application for approval also will contain a schedule for completing a WHP plan. Following site approval and construction of the new well or wellfield, the purveyor will finalize the WHP plan and submit it to Ohio EPA for its review within the time specified in the application.

In addition to protecting existing and new wells, Ohio's WHP Program recommends local purveyors conduct water supply planning to help assure an adequate supply of water for future population needs. Local officials should project future population growth (10 to 25 years ahead) and expected water demand compared to current production capabilities. If a need for future expansion is identified, local officials should investigate potential sites for new wells. This is especially critical in areas where the land most suitable for a new well or wellfield may be lost to development or is threatened by existing sources of contamination.

Investigating potential sites for future well development involves identifying areas capable of producing adequate supplies, estimating a WHP area and conducting a preliminary pollution source inventory. Potential sites then can be selected to maximize yield and minimize potential sources of ground water contamination.

Once a potential new well site has been selected, the purveyor can take steps to secure and protect that area from potential contamination, including development of a modified WHP plan. Of course, a WHP plan designed to protect a site not expected to be developed for another 15 years will differ from one for an existing well. It also will vary depending on the types of pollution threats identified. For example, a management plan for a potential well site in an isolated rural setting may simply mean acquisition of available land.

While this type of water supply planning is not required under Ohio's WHP Program, communities choosing to use this process will be more assured of having a safe supply of water for future needs. In addition, they already will have addressed many components of WHP planning prior to new well installation.

CHAPTER 8

PUBLIC PARTICIPATION IN WELLHEAD PROTECTION

The public has actively contributed to development of the Ohio WHP Program. Opportunity for public input has been provided through a public advisory council, public meetings and workshops, and public comment periods.

The Inter-Agency Ground Water Advisory Council is a technical advisory body composed of representatives with varied interests in the management of ground water resources. Originally an advisory body to Ohio EPA, Inter-Agency Ground Water Advisory Council's charge was expanded in 1986 under the Ohio Ground Water Protection and Management Strategy to advise all state departments concerned with the protection and management of the state's ground water. This council has a membership of more than 200, with additional involvement of 100 state department representatives. Through both extensive subcommittee review and full Council discussion over the past four years, sections and drafts of the Ohio WHP Program have been modified to reflect the interests of Inter-Agency Ground Water Advisory Council participants.

Ohio EPA completed the first draft of the Ohio WHP Program in June 1989 and submitted that draft to U.S. EPA for review and comment. The Program also was presented to Inter-Agency Ground Water Advisory Council and to various other groups around the state for their review and comment. A second draft was completed in January 1991 incorporating many of the comments received during the previous 18 months. Three public information meetings and hearings were conducted across the state in February 1991, and a formal comment period for submitting written comments ran through March 15, 1991. The public meetings were held in Akron, Columbus and Dayton to encourage attendance of interested parties throughout the state. Announcement of the meetings and solicitation of public comments were made through public notices, news releases, mailing announcements and networking through consultants and purveyors. Changes to the Program were made based on the comments received at the meetings and during the comment period. A complete summary of the Agency's responses to the comments was completed in May 1991. Availability of the final Ohio WHP Program was announced through news articles and mailings.

During 1989 and 1990, much of Ohio EPA's efforts were focused on proposed legislation to support WHP planning in Ohio. Two informational meetings were held, and comments recorded, in 1989 and 1990, and a mailing was sent to more than 2,000 purveyors in 1990 to solicit comments on a proposed safe drinking water bill with wellhead protection components. As discussed in Chapter 1, this bill was introduced in the 118th General Assembly but was not acted on. After minor revisions, this proposed legislation was again made available for public review in 1992 to both the Inter-Agency Ground Water Advisory Council and an ad hoc advisory committee. The ad hoc committee also was charged with reviewing proposed legislative language for a surface water protection bill. In accordance with recommendations from this committee, the two bills were combined and currently are being reviewed by the Legislative Review Committee.

Presentations and articles are an excellent way of promoting Ohio's WHP Program and soliciting comments from individuals directly responsible for developing and implementing local WHP plans. Ohio EPA has utilized public workshops, educational seminars news releases and articles in various publications as effective public involvement and education tools. Since 1988, numerous educational seminars and workshops have been conducted or sponsored by Ohio EPA throughout the state. Nearly 20 wellhead protection presentations were given to regional planning groups, water purveyors and professional associations during 1991. An article on the need for wellhead protection and what Ohio is doing in developing a program was published in Environment Ohio, the Agency's public newsletter, in 1991.

Ohio EPA will continue to educate and actively seek the participation of both the technical and general public in the implementation stages of the program. Additional articles, fact sheets, news releases, educational seminars and workshops will be prepared or conducted throughout the planning and implementation stages. For example, the Division of Drinking and Ground Waters will conduct a series of invitational wellhead protection workshops during 1992. The workshops will be used to solicit comments and recommendations from selected individuals on what criteria Ohio EPA should use to evaluate local WHP plans for the various types of public water systems. Additional workshops will be sponsored to identify reasonable and workable WHP area management options for Ohio's various types of public water systems. Information generated in these workshops will be used to establish Ohio EPA policies and technical guidance documents to be developed in 1992 and 1993.

Ohio EPA also encourages local governments to involve their communities in the early stages of WHP planning activities. Agency staff have assisted local representatives in numerous planning meetings on technical and public involvement aspects. Staff also have attended and participated in local public meetings.

In the end, the success of a local WHP plan depends on the cooperation of people living and working in the WHP area. These people need to be given a sense of "ownership" in the plan. They should understand that their activities can affect the quality of the local water supply as well as how they can avoid such impacts. Through open communication and public involvement, local officials can promote public trust and confidence, and ultimately develop a WHP plan which not only protects the water source and public health, but also reflects the needs and desires of everyone involved.

APPENDIX 1

BRINE PROGRAM CERTIFICATION

CERTIFICATION
OF
OHIO BRINE DISPOSAL PROGRAM

Consistent with Section 1428 of the Safe Drinking Water Act Amendments of 1986, the Director of the Ohio Environmental Protection Agency must submit a Wellhead Protection Plan to protect wellhead areas within its borders from contaminants which may have adverse effect on the health of persons. Subsection (i) therein requires that:

> States in which there are more than 2,500 active wells at which annular injection is used as of January 1,1986, shall include in their State program a certification that a State program exists and is being adequately enforced that provides protection from contaminants which may have any adverse effect on the health of persons and which are associated with the annular injection or surface disposal of brines associated with oil and gas production.

As of January 1, 1986, there were approximately 5,000 authorized annular disposal wells in Ohio.

Therefore, in order to comply with the mandate of Subsection (i) of Section 1428 of the Safe Drinking Water Act Amendments of 1986, and as demonstrated by the attached Ohio Brine Disposal Program document, the undersigned, affirm and certify the following:

1) Pursuant to Chapter 1509 of the Ohio Revised Code, the Ohio Department of Natural Resources, Division of Oil and Gas (Division) has implemented a State program that protects the health of persons from any adverse effect by contaminations associated with the injection, annular disposal or surface disposal of brines associated with oil and gas production.

2) The State program is being adequately enforced to protect the health of persons from any adverse effect by contaminants associated with the injection, annular disposal or surface disposal of brines associated with oil and gas production.

F. S. Buchholzer, — May 6, 1992

FRANCES S. BUCHHOLZER — Date
Director
Ohio Department of Natural Resources

Donald R. Schregardus — May 6, 1992

DONALD R. SCHREGARDUS — Date
Director
Ohio Environmental Protection Agency

(F) The methods of notification of users that an emergency exists;

(G) If depressurization of the water system has occurred, the procedure that will be used to return the system to normal service;

(H) Twenty-four-hour telephone numbers for:

(1) The Ohio environmental protection agency, office of public water supply;

(2) Police;

(3) Fire;

(4) The local disaster services agency;

(5) All water supply personnel;

(6) Municipal administrative personnel;

(7) Contractors for line breaks, "first call" and "second call;"

(8) Electric power supplier;

(9) Electricians, "first call" and "second call;"

(10) Well drilling and pump service contractors, "first call" and "second call;"

(11) Plant mechanical contractors, "first call" and "second call;"

(12) All suppliers of equipment and chemicals normally used;

(13) Hospital, emergency squad, medical assistance.

(Adopted October 9, 1980; effective November 26, 1980)

3745-85-05 Revision required.

The contingency plan required by this chapter of the Administrative Code shall be revised and updated as necessary, but at least annually.

(Adopted October 9, 1980; effective November 26, 1980)

APPENDIX 2

WELLHEAD PROTECTION AUTHORIZATION

STATE OF OHIO
OFFICE OF THE GOVERNOR
COLUMBUS 43266-0601

.HARD F. CELESTE
GOVERNOR

June 16, 1989

Val Adamkus
Regional Administrator
U. S. Environmental Protection Agency
Region 5
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Adamkus:

The 1986 Amendments to the Safe Drinking Water Act require each state to develop a Wellhead Protection Program for public water supplies which utilize a ground water source.

I have designated The Ohio Environmental Protection Agency as the lead agency for implementing the Wellhead Protection Program in Ohio. The Ohio EPA's Division of Ground Water has assumed responsibility for program development and has been coordinating research and development activities toward this goal. Through a cooperative effort with the Ohio Department of Natural Resources, the Ohio Department of Health, and with the participation of the Citizens of Ohio, a State program is being prepared.

The Agency also is developing comprehensive legislation for introduction into Ohio General Assembly this summer to establish the State program. I have given this legislation a priority status due to the need for effective wellhead programs to protect the public health and welfare.

I look forward to working with you on ground water protection and the many important environmental issues that affect the Midwest.

Respectfully yours,

Richard F. Celeste

Richard F. Celeste
Governor, The State Of Ohio

APPENDIX 3

COMPARISON OF DELINEATION METHODS AND CONCLUSIONS

CHAPTER VIII

Comparison of Delineation Methods and Conclusions

Traveltime-related capture zones were delineated using the calculated-fixed radius, analytical, semianalytical and numerical methods. Differences in the theory, assumptions, and conceptualization of the flow system at Wooster for each method cause the size and shape of the capture zones to differ. The more accurately the method predicts the velocity distribution of the flow system, the more accurate is the determination of the traveltime-related capture zone. Thus, more accurate predictions are the result of the more accurate simulation of the flow system. The calculated-fixed radius, analytical and semianalytical methods assume that the aquifer at Wooster behaves in a Theis-like manner. The numerical method does not require that flow is horizontal, as does the Theis assumptions, allows three-dimensional flow, and incorporates recharge, heterogeneity and complex boundary conditions.

The analytical method using the analytical model RESSQ (Javandel and others, 1984) computes reverse flowpaths and traveltimes from wells using the stream function. The semianalytical method couples the semianalytical flow model CAPZONE (Bair and others, in press) with the particle-tracking program GWPATH (Shafer, 1990). The numerical method couples the numerical finite-difference flow model MODFLOW (McDonald and Harbaugh, 1988) with the particle-tracking program MODPATH (Pollock, 1989).

Comparison of the four WPA delineation methods at Wooster is based on comparison of the flow models and comparison of traveltime-related capture zones determined by each method. The abilities of each ground-water flow model to simulate the flow system under pumping stress is compared using the RMSE between measured and simulated heads. The ability of the methods to delineate realistic traveltime-related capture zones is evaluated by comparing the size and shape of the 1-year capture zones and the ending locations of flowpaths forming the 1-year capture zones.

Comparison of Flow Models

The RMSE between measured and simulated heads is used to compare the ability of each ground-water flow model to simulate the measured head distribution in the aquifer under pumping stress. Comparison of RMSEs is possible between the semianalytical and numerical ground-water flow models with little difficulty. The analytical method using RESSQ does not allow this type of analysis because RESSQ (in its present form) only solves for the stream function, not for the distribution of hydraulic head. For this reason the analytical method (RESSQ) was not calibrated to measured head conditions.

The heads simulated by the numerical and semianalytical flow models were compared to measured heads from November 1986, which represent average water levels and are assumed to represent steady-state conditions (Chapter 4). The numerical and semianalytical flow models each had a RMSE of 2.0 feet in the South

Wellfield area. In the North Wellfield area, the RMSE was 7.5 feet for the semianalytical method and 2.5 feet for the numerical method.

The numerical flow model simulated the measured head distribution at the North Wellfield more accurately than the semianalytical flow model because of the more realistic specification of hydrogeologic parameters and boundary conditions in the numerical model. The numerical model incorporated the effects of spatially varying recharge, infiltration from partially penetrating streams, and vertical leakage across confining layers. For instance, although Killbuck Creek and Apple Creek have low vertical-streambed conductivities near the wellfields, they each lose a small amount of water to the aquifer along certain stream reaches. The analytical and semianalytical models only incorporate the effects of fully penetrating tributaries and leakage across the bedrock valley walls and can not incorporate the effects of these partially penetrating, slightly leaky streambeds.

Comparison of Capture Zones

The size and shape of 1-year capture zones and the distribution of flowpath endpoints around each well/wellfield were compared for each delineation method. Capture zones and flowpaths are computed directly by RESSQ for the analytical method, by GWPATH for the head distributions computed by CAPZONE for the semianalytical method, and by MODPATH based on cell-by-cell fluxes determined by MODFLOW for the numerical method.

Size

Table 19 lists the areas of the 1-year capture zones of S1, S2, and the North Wellfield determined by each method based on 1986 pumping rates and on post-remediation pumping rates. The capture zones delineated with the analytical method have the smallest sizes. The largest capture zones are delineated by the semianalytical method at the South Wellfield and by the numerical method at the North Wellfield.

Table 19

Areas of 1-year capture zones at S1, S2, and the North Wellfield for each method.

Method	Area (acres)		
	S1	S2	North Wellfield
	1986 pumping rates		
Calculated-fixed radius	20	60	340
Analytical (RESSQ)	19	54	318
Semianalytical (CAPZONE/GWPATH)	34+	74+	356
Numerical (MODFLOW/MODPATH)	25	67	476
	Post-remediation pumping rates		
Analytical (RESSQ)	126	124	---
Semianalytical (CAPZONE/GWPATH)	163	94	---
Numerical (MODFLOW/MODPATH)	159	123	308

Shape

Figure 48 shows a plan view of the 1-year capture zones delineated by each method. The calculated-fixed radius method delineates circular capture zones (fig. 32). The analytical method (RESSQ) delineates elliptical capture zones at S1 and

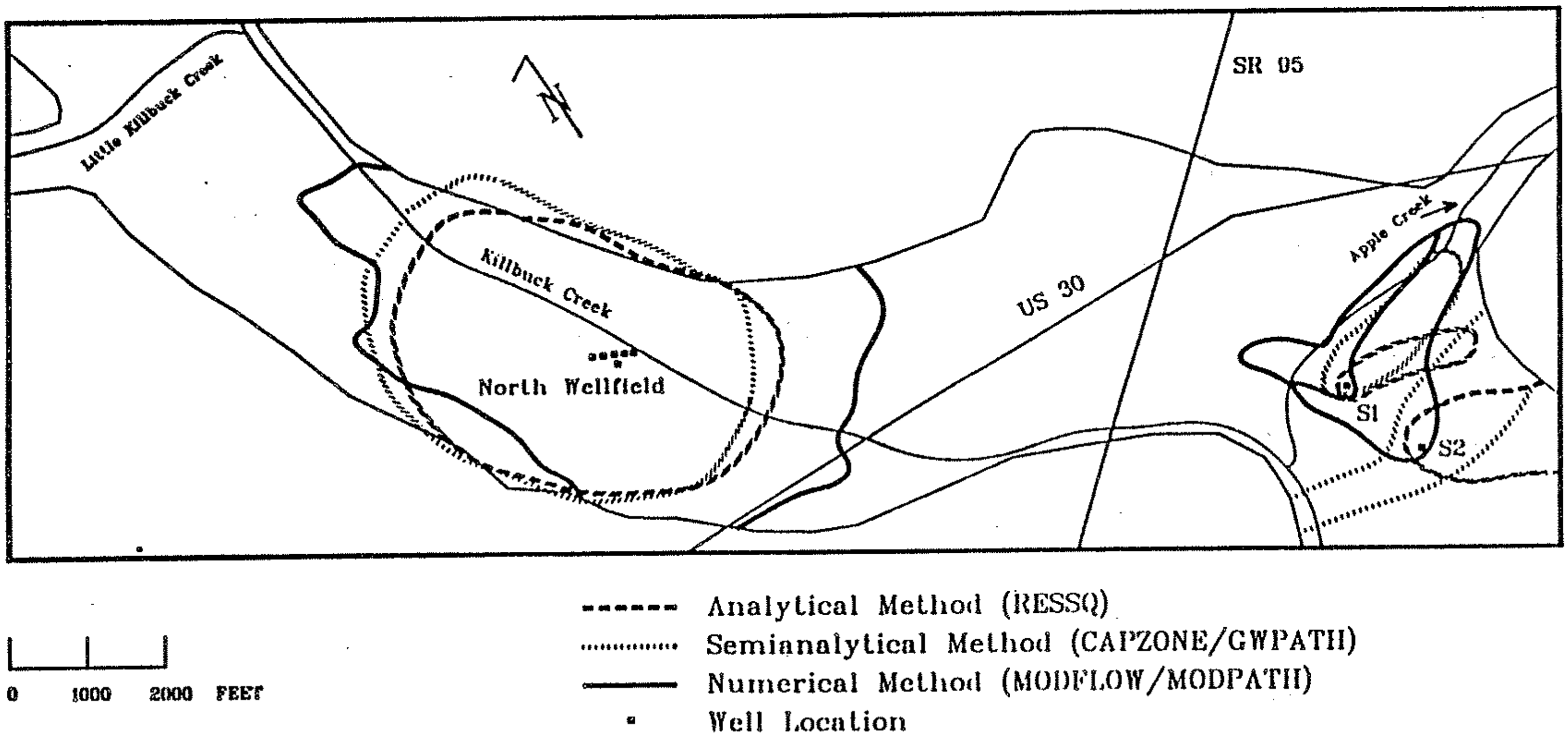


Figure 48. Map showing 1-year capture zones at S1, S2 and the North Wellfield for each WPA delineation method.

S2 and at the North Wellfield (fig. 48). The elliptical shapes are due to the assumption of a uniform regional flow field in RESSQ. The ellipses extend farther downvalley at the North Wellfield than at the South Wellfield due to the flatter regional hydraulic gradients at the North Wellfield. At the South Wellfield, the elliptical capture zones predominantly extend upgradient because of the steep hydraulic gradients in the valley east of the production wells (fig. 48).

Flattened elliptical 1-year capture zones are delineated by the semianalytical method (CAPZONE/GWPATH) at the North Wellfield (fig. 48). The flattening in the ellipses is due to the incorporation of a nonuniform regional flow field in the semianalytical flow model (CAPZONE). At the South Wellfield, bifurcated capture zones are delineated because of the incorporation of the nonuniform regional flow field (fig. 48).

The numerical method (MODFLOW/MODPATH) delineates 1-year capture zones with irregular shapes (fig. 48). The 1-year capture zone at the North Wellfield is roughly elliptical in shape with elongate appendages occurring because of particles traveling at different velocities in different model layers along the flowpaths. At the South Wellfield, the 1-year capture zones of S1 and S2 are bifurcated. One branch of the 1-year capture zone of each well extends upgradient to the northeast towards Apple Creek, whereas the other branch extends upgradient to the northwest side of the valley. The capture zones are bifurcated because of flow converging toward the middle of the valley from both valley sides and the steepening of gradients caused by the pumping of I1 intercepting flow that would otherwise lie within the capture zone for S1 (fig. 45 shows this occurrence for the predicted, post-remediation pumping conditions). The converging flow directions and pumping at S1 cause the same bifurcation in the capture zone of S2 at 1986 pumping rates and at post-remediation pumping rates (figs. 44 and 45).

Discussion

The shapes of the capture zones become more complex with increasing complexity in conceptualizing the flow system in each method. Only the numerical method accounts for the irregular shape of the valley walls, the nonlinear hydrogeologic features (streams), and spatial variations in the thickness and hydraulic properties of the various hydrogeologic units that comprise the buried, glacial-valley aquifer. Flow velocities in the stratified-drift aquifer are more accurately estimated if flow between the North and South Wellfields is included in one flow model. Including the entire flow field in one model accounts for changes in the position of the ground-water divide between the wellfields. When using the numerical methods, it was necessary to separate the North and South Wellfields to avoid the problem of inappropriately simulating complicated boundary conditions using analytical and semianalytical techniques. The North and South Wellfields can not be included in a single analytical model because of the different directions and magnitudes of regional flow at each wellfield. Although the semianalytical model allows for a nonuniform flow field, it, like the analytical model, requires simplification of the valley geometry to represent the lateral boundaries with an image-well solution.

The analytical and semianalytical methods both require a uniform aquifer thickness to satisfy the assumptions of the well-hydraulics equation used in the models. Vertical discretization of the flow field in the numerical model produces a more appropriate simulation of vertical leakage across model layers, head distributions, flowpaths, as well as more appropriate determinations of volumetric water budgets. Because the velocity field differs in each layer of the numerical model, flowpaths are able to refract across hydraulic-conductivity boundaries.

Because the numerical method most accurately simulates flow at the North Wellfield (the lowest RMSE), the 476-acre area and the nearly elliptical shape of the 1-year capture zone is the most appropriately delineated WPA. If the 1-year capture zone delineated by any of the other methods was used to implement a traveltime-related WPA, the size of the area would be underestimated and the shape would be inappropriate.

Although the numerical and semianalytical flow models each have the same accuracy at the South Wellfield (a RMSE of 2.0 feet for each) and the areas of the 1-year captures zones are nearly equal (table 19), the shapes of the 1-year capture zones and their relations to the land surface are not the same. The size and shape of the 1-year capture zone delineated by the numerical method is the more appropriate WPA delineation method at the South Wellfield because of incorporation of the complexities of the three-dimensional flow field in the numerical model. The size of the 1-year capture zones delineated by the calculated-fixed radius and analytical methods are too small and the shapes of the 1-year capture zones are inappropriate for the complex hydrogeologic boundaries and nonuniform flow field.

Distribution of Flowpath Endpoints

The distribution of flowpath endpoints within capture zones can be used to determine optimal locations for monitoring wells to be used to detect contaminants entering the capture zone. To determine if there are any preferential directions of ground-water flow in the capture zones, 100 particles were evenly distributed around the wells reverse tracked for 1 year using the particle-tracking programs associated with the analytical, semianalytical, and numerical models. The locations of the flowpath endpoints were recorded in polar coordinates from the center of each well/wellfield and the distributions of these points in 5° intervals of arc were used to construct rose diagrams. Figure 49 shows the distribution of 1-year endpoints at the North Wellfield for each method, figure 50 shows these distributions at S1, and figure 51 shows these distributions at S2. The calculated-fixed radius method predicts an even distribution of flowpath endpoints around the 1-year capture zone because the volumetric-flow equation assumes uniform radial flow to the well.

The analytical method predicts that the 1-year reverse-tracked flowpaths from the North Wellfield are distributed generally to the northwest and southeast, or up and down valley (fig. 49-a). The semianalytical method predicts that the greatest density of 1-year flowpaths end toward Clear Creek and upvalley (northwest) with a lower density of flowpaths ending in a downvalley (southeasterly) direction (fig. 49-b). The numerical method predicts that flowpaths predominantly converge toward recharge areas in the vicinity of the North Wellfield (fig. 49-c). The cluster of endpoints north of the North Wellfield indicates flowpaths which terminate at Clear Creek within one year (fig. 49-c). The other two major clusters of endpoints indicate flowpaths which extend upvalley towards (but not intercepting) Little Killbuck Creek. Lower densities of 1-year flowpath endpoints converge toward the two small tributaries to the southwest of the wellfield.

At the South Wellfield, the analytical method predicts that all 1-year flowpaths terminate in the upgradient direction (figs. 50-a and 51-a). The semianalytical method predicts two predominant flowpath directions -- upgradient to the eastern and western sides of the valley (figs. 50-b and 51-b).

The results of the numerical method differ from those of the analytical and semianalytical methods because of the three-dimensional resolution of velocity vectors. Consequently, particles along the flowpaths move horizontally and vertically within the flow system. For instance, (figs. 46 and 51-c, 75 percent of the 1-year reverse-tracked flowpaths from the screened interval of S2 in model layer 3 move upward into model layer 1 and terminate in the losing reaches of Apple Creek in a cluster between 5° and 20° east of north. Likewise, nearly 50 percent of the 1-year reverse-tracked flowpaths from the screened interval of S1 in model layer 3 end in the losing reaches of Apple Creek in model layer 1 (figs. 46 and 50-c). This indicates that infiltration through the streambed of Apple Creek may reach S1 and S2 within 1 year.

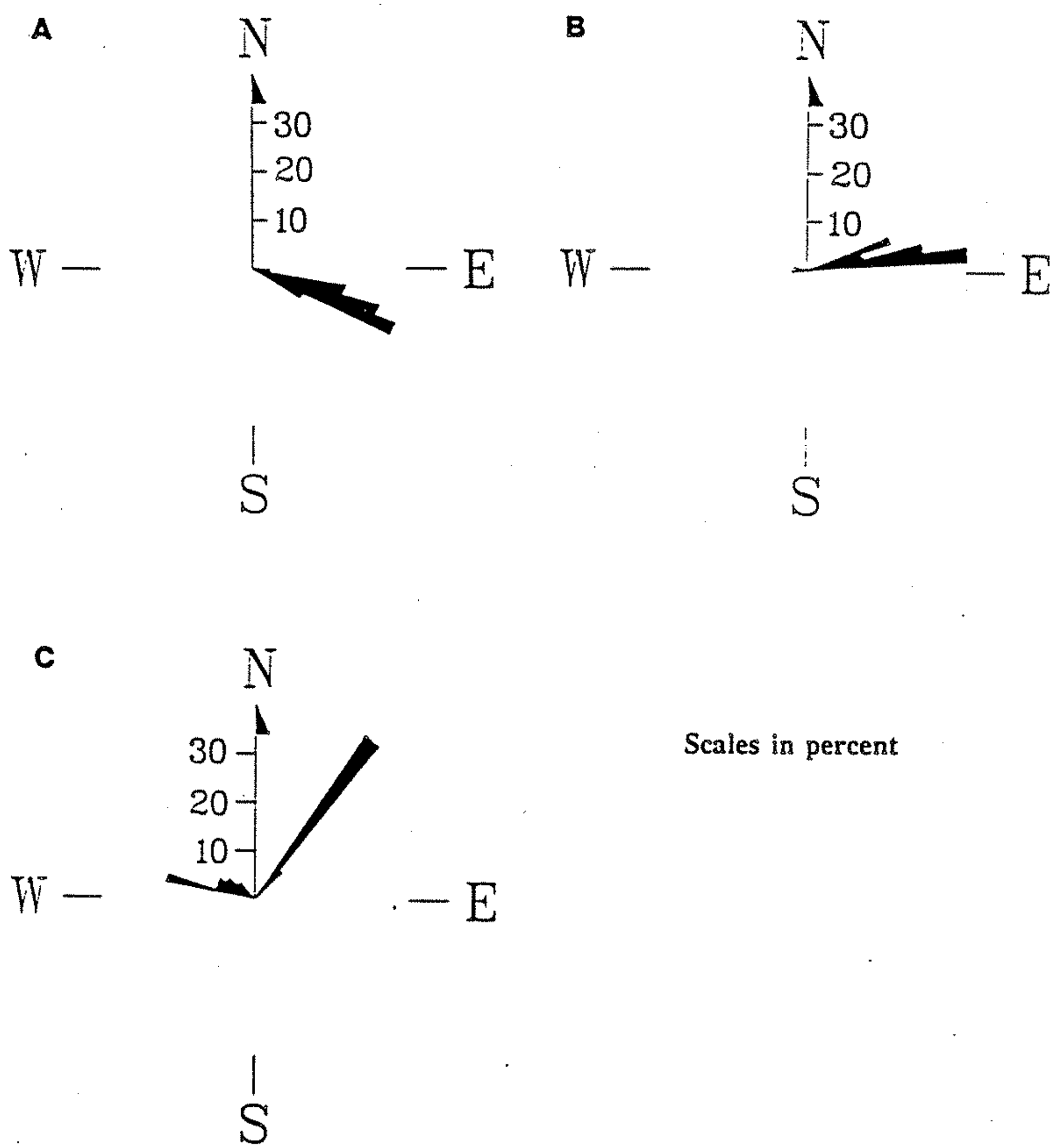


Figure 50. Rose diagrams of the 1-year flowpath endpoints at S1 Wellfield calculated by the analytical (A), semianalytical (B), and numerical (C) methods.

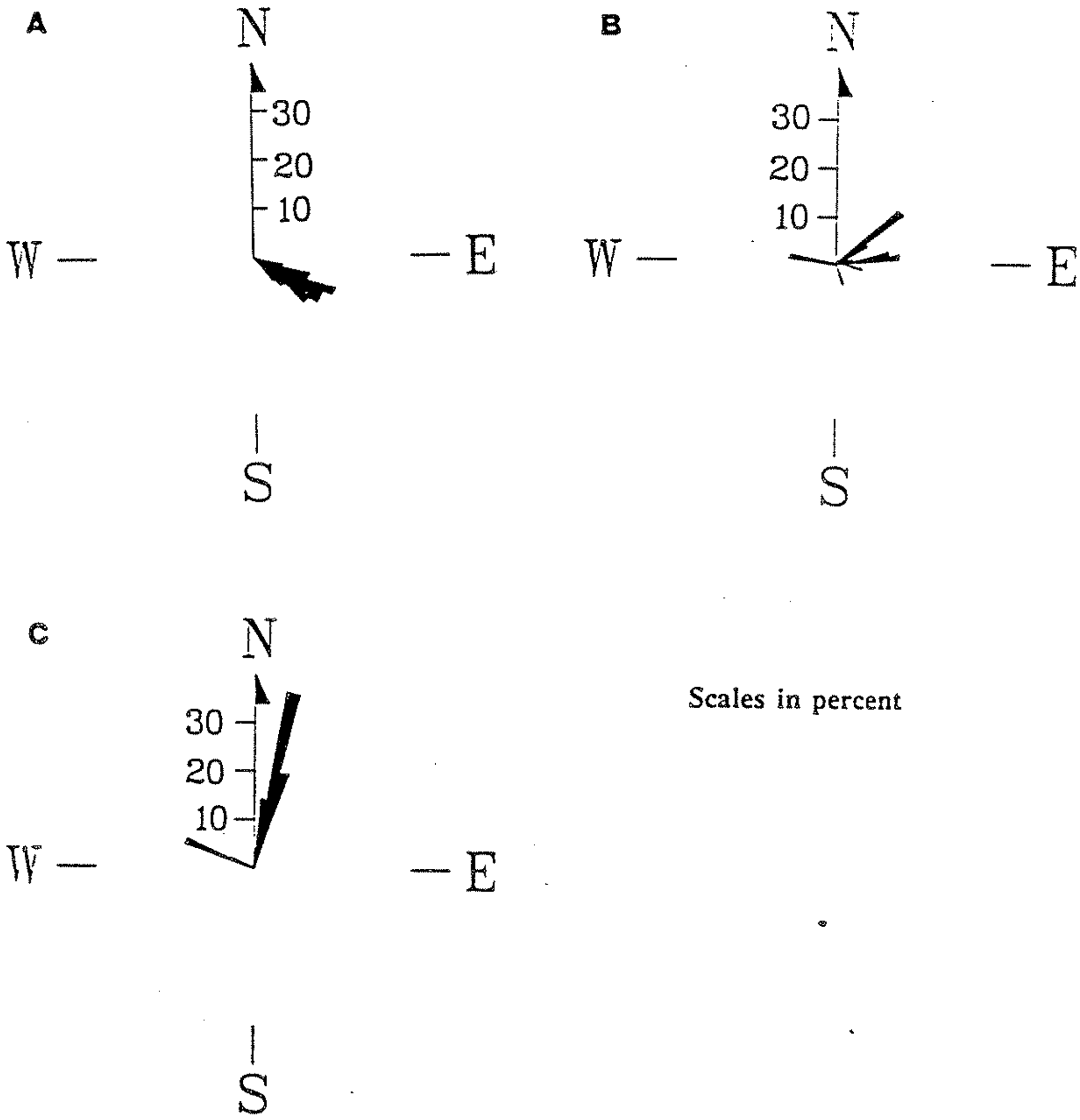


Figure 51. Rose diagrams of the 1-year flowpath endpoints at S2 Wellfield calculated by the analytical (A), semianalytical (B), and numerical (C) methods.

Conclusions

The numerical method is the most appropriate method for delineating traveltime-related capture zones in stratified-drift aquifers located in buried-glacial valleys that are characterized by complex boundaries, irregular boundary shapes, and spatially varying hydrostratigraphic units that are difficult to conceptualize, characterize and model. The numerical model is the most accurate model at computing heads and cell-by-cell flow terms if the vertical component of flow is significant.

The semianalytical method may be appropriate in stratified-drift aquifers if the boundary conditions are relatively simple, an accurate prepumping potentiometric surface is defined, the boundaries are suitable to an image-well solution, and the recharge areas are nearly contiguous about the well/wellfield. The semianalytical flow model is accurate if the nonuniform flow system obeys the assumptions necessary for application of the analytical solution.

The analytical method does not adequately simulate the complexity of stratified-drift aquifers for delineation of traveltime-related capture zones. Flow in most stratified-drift aquifers can not be adequately described with a uniform flow velocity in addition to applying the assumptions necessary for the analytical solution.

The calculated-fixed radius method is absolutely inadequate in delineating traveltime-related capture zones in this type of hydrogeologic setting. The flow in stratified-drift aquifers is not radially uniform as described with the volumetric flow equation.

CHAPTER VII

COMPARISON OF DELINEATION METHODS AND CONCLUSIONS

The objectives of this study were to compare various methods of delineating WPAs in a hydrogeologic setting consisting of fractured carbonate bedrock overlain by till, one of the two most common hydrogeologic settings in Ohio. To accomplish this a variety of field work was performed. Water levels were measured to obtain a good representation of the regional potentiometric surface and two aquifer tests were conducted to obtain site-specific values of aquifer and confining bed properties. The field data were used in the construction of the different types of ground-water flow models required by three of the USEPA suggested methods of delineating WPAs.

A total of seven WPA delineation methods were discussed or evaluated at the New Wellfield at Richwood, Ohio. Three of these methods are not directly comparable to the other six methods. The arbitrary-fixed radius method is the only method to use a distance criterion for delineation, whereas the simplified-variable shape method relies on the results from other more sophisticated methods and the suggested hydrogeologic mapping methods are not applicable to the hydrogeology at the Richwood site. The remaining four methods all delineate WPAs based on a time-of-travel criterion.

Characteristics of the Delineated Capture Zones

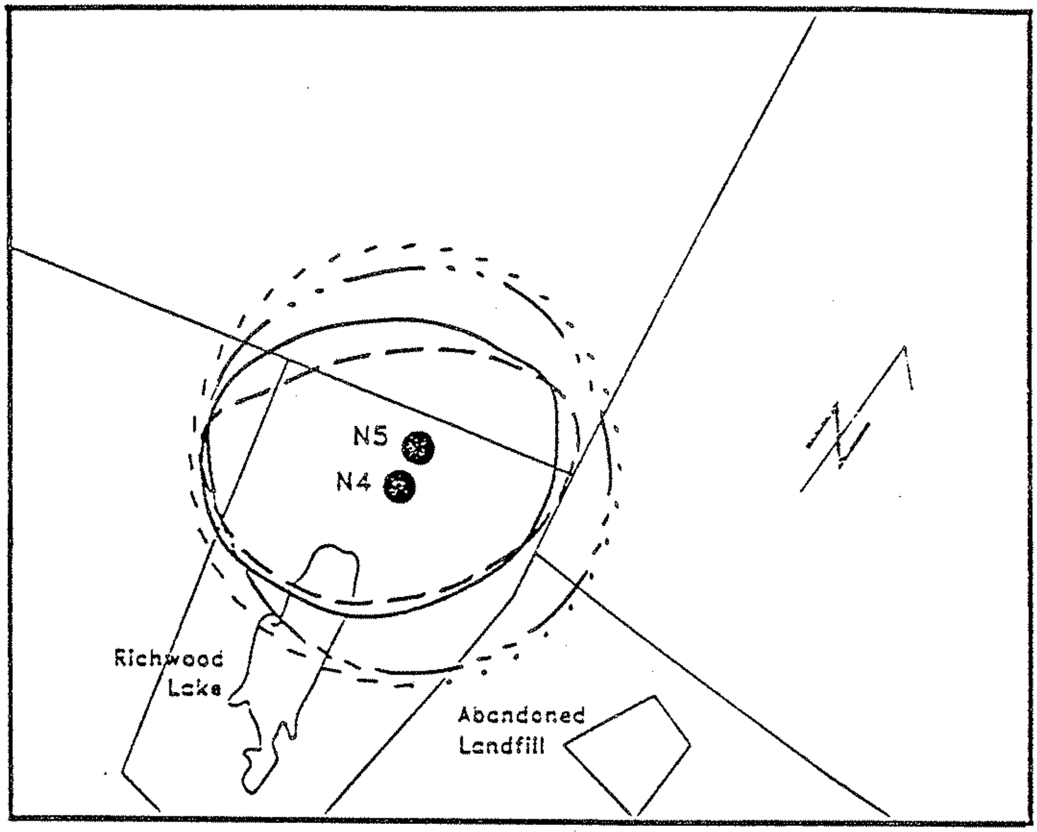
To visually compare the shape and size of the WPAs delineated by the calculated-fixed radius, analytical, semianalytical, and numerical methods, the 5-year capture zones determined by each method were plotted on the same base map (fig. 50). Table 6 lists the area of each 5-year capture zone as well as the areas of the 1- and 2-year capture zones which are not depicted on figure 50.

Table 6.

Areas of 1-, 2-, and 5-year capture zones.

Method	Area (acres) 1-year	2-year	5-year
Calculated-Fixed Radius	42	87	208
Analytical (RESSQ)	39	85	207
Semianalytical (CAPZONE/GWPATH)	32	51	89
Numerical (MODFLOW/MODPATH)	30	54	103

Another means of comparing capture zones is to examine the distribution of endpoints from the set of flowpaths used to define it. Using RESSQ, GWPATH, and MODPATH 100 5-year reverse-tracked flowpaths emanating from wells N4 and N5 were computed. The distribution of their endpoints then was plotted on a rose diagram (figs. 51, 52, and 53) whose center corresponds to the center of the wellfield.



EXPLANATION

· · · · Calculated-fixed radius
—— · · – Analytical model (RESSQ)
— — – Semianalytical model (CAPZONE/GWPATH)
——— Numerical model (MODFLOW/MODPATH)

0 1000 2000

Scale in feet

Figure 50. 5-year capture zones of the New Wellfield based on the calculated-fixed radius and the RESSQ, CAPZONE/GWPATH, and MODFLOW/MODPATH models.

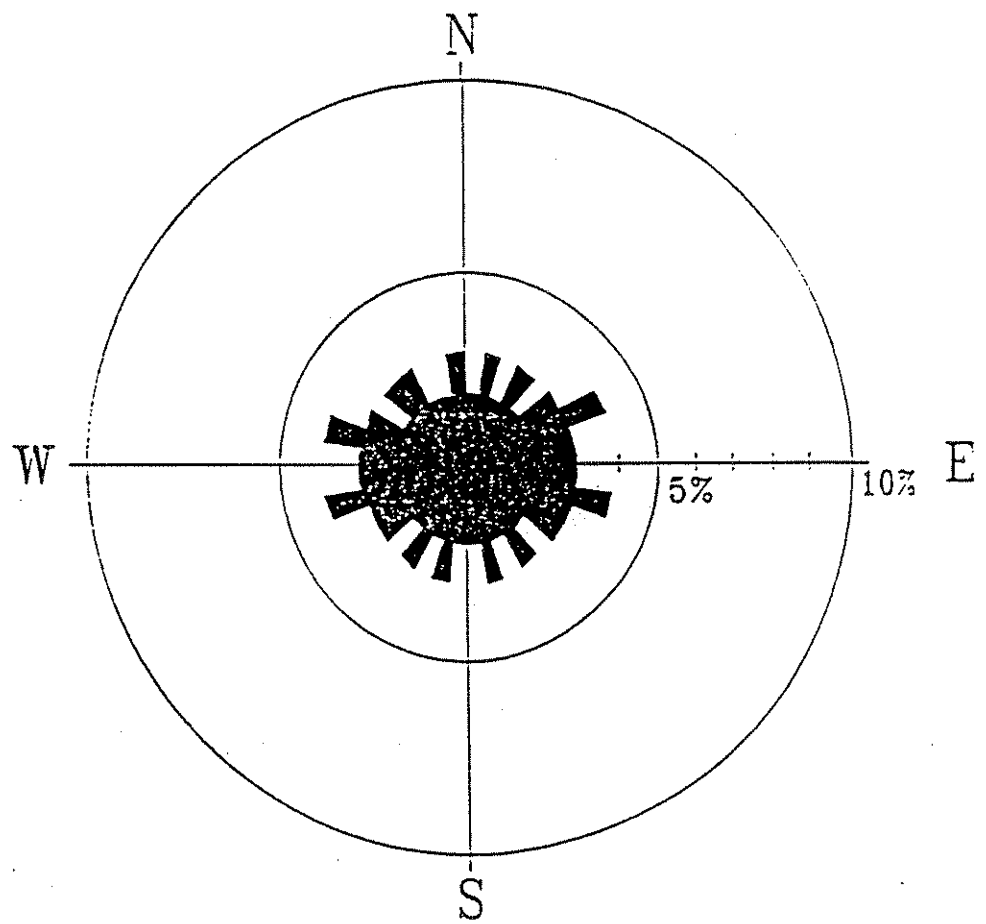


Figure 51. Rose diagram of endpoints from 5-year reverse-tracked flowpaths determined by RESSQ (plotted in percent).

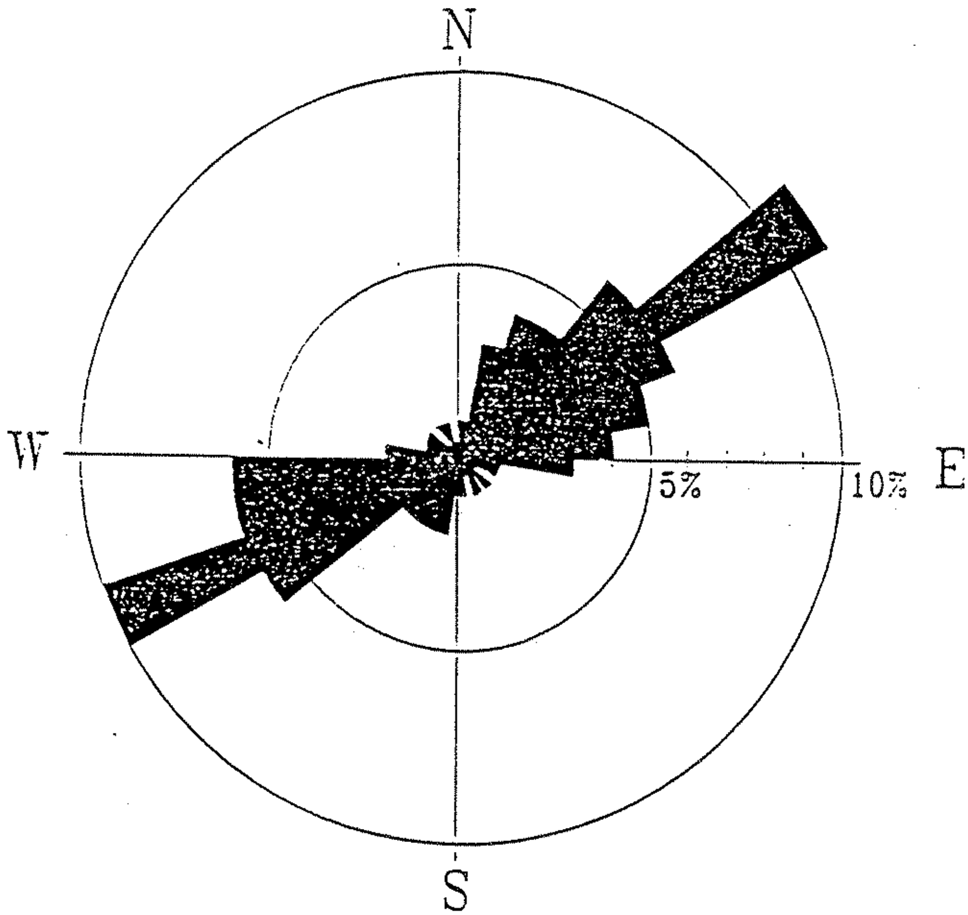


Figure 52. Rose diagram of endpoints from 5-year reverse-tracked flowpaths determined by CAPZONE/GWPATH (plotted in percent).

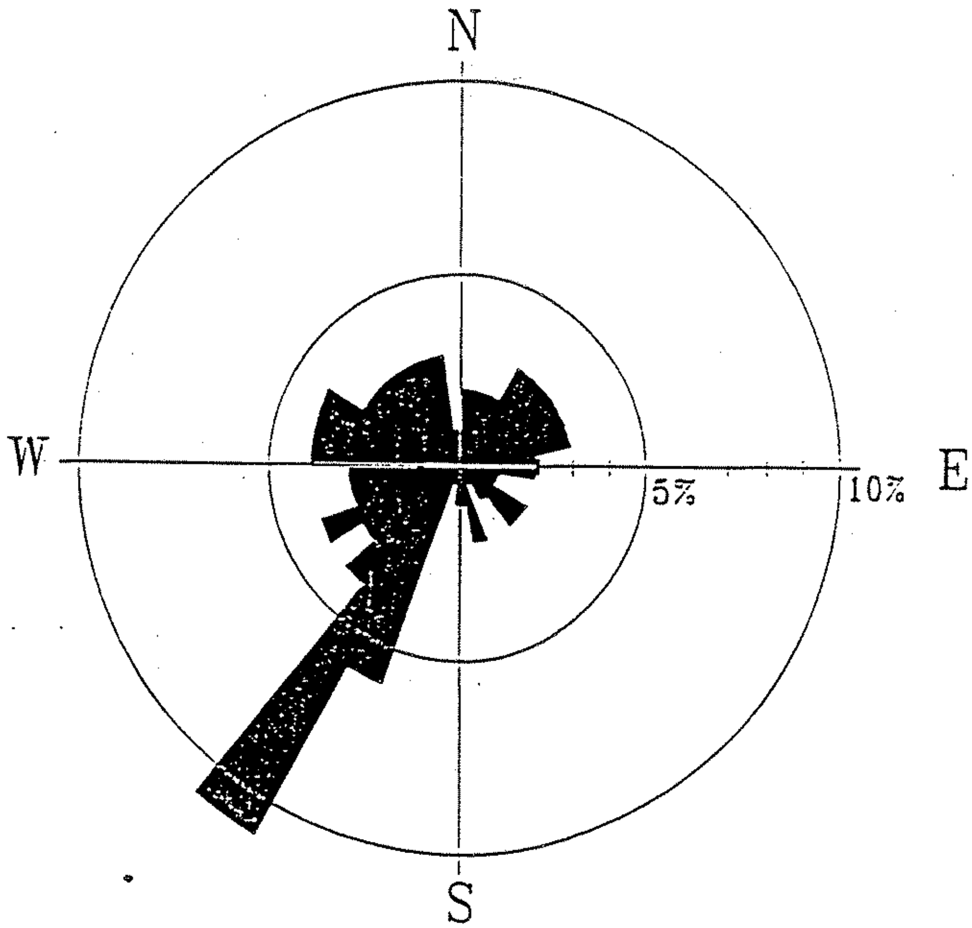


Figure 53. Rose diagram of endpoints from 5-year reverse-tracked flowpaths determined by MODFLOW/MODPATH (plotted in percent).

Comparison of 5-Year Capture Zones

Before the differences and similarities of the capture zones are discussed, it is helpful to review some the assumptions and properties of the three modeling methods. This review is synthesized in table 7.

The four capture zones can be separated into two groups. The first set includes the 5-year capture zones determined using the calculated-fixed radius method (volumetric-flow equation) and the analytical method (RESSQ model). These two capture zones are the largest and have essentially the same size and shape. These similarities are due to the analytical equations in RESSQ defaulting to a form of the volumetric-flow equation when the regional ground-water velocity is set to zero.

The rose diagram of endpoint locations for the RESSQ (fig 51) shows the nearly radial pattern of flow moving toward the wells which is a consequence of this method when there is no regional hydraulic gradient. The additional flowpaths ending to the east and west are the result of the well interference caused by the 300-ft spacing between wells N4 and N5.

The second set of 5-year capture zones includes those determined using the CAPZONE/GWPATH semianalytical model and the MODFLOW/MODPATH numerical model. These capture zones are about half the size of the capture zones in the first set mainly due to the fact that the semianalytical and the

Table 7.

Properties of the different models.

Properties	RESSQ	CAPZONE	MODFLOW
Uniform flow field	x	x	x
Nonuniform flow field		x	x
Two-dimensional flow	x	x	x
Three-dimensional flow			x
Isotropic and homogeneous hydraulic properties	x	x	x
Spatially varying hydraulic properties			x
Leakage across confining layers		x	x
Recharge from precipitation			x
Recharge or barrier boundaries		x	x
Non-linear boundaries			x
Complex boundary conditions			x
Single model layer	x	x	x
Multiple model layers			x
Model calibration (comparison of heads)		x	x
Model verification (comparison of heads)			x

numerical methods account for vertical leakage from the overlying sand and gravel into the carbonate aquifer. This leakage causes less drawdown in the carbonate aquifer than predicted by the Theis equation on which the RESSQ model is based, resulting in a smaller cone of depression with flatter hydraulic gradients and lower ground-water flow velocities.

The differences between the capture zones from the semianalytical and numerical methods are mostly due to the differences in the velocity fields through which the particles are tracked. GWPATH computes reverse-tracked particle trajectories based on a pumping potentiometric surface (fig. 29b) created by CAPZONE from the measured head distribution (fig. 22). MODPATH computes the trajectories of reverse-tracked particles based on a potentiometric surface (fig. 41) from a MODFLOW simulation incorporating the pumping stress. Because the MODFLOW simulated surface has higher heads northwest of the New Wellfield (shown in fig. 40 for nonpumping conditions) the capture zone determined by MODPATH extends farther in this direction than the capture zone determined using CAPZONE/GWPATH. Similarly, the capture zone determined using MODFLOW/MODPATH does not extend as far northeast as the capture zone determined using CAPZONE/GWPATH because of the slightly lower heads predicted by MODFLOW.

The differences between the capture zones computed using the semianalytical method and the numerical method are highlighted on the rose diagrams of the endpoint distributions of the 5-year reverse-tracked flowpaths (figs. 52 and 53). The distribution of endpoints from the semianalytical method is strongly influenced by the northeast and southwest up-gradient flow directions. The distribution of endpoints from the numerical method also shows a cluster of endpoints to the northeast, however, because the other upgradient direction is in more of a general westerly direction, the endpoints are more evenly distributed to the west than those from the semi-analytical method.

The distribution of endpoints of the 5-year flowpaths from the numerical method is skewed by the endpoints from flowpaths which terminate in Richwood Lake. This is because the lake is simulated with head-dependent flux cells which allow the head in the cell to remain constant under a constant pumping stress, as observed during the aquifer test. The lake is a ground-water mound which steepens local hydraulic gradients causing greater flow velocities and convergence of reverse-tracked flowpaths to this recharge feature. The distribution of endpoints also is skewed towards the lake because the reverse-tracked flowpaths stop when they encounter this source of recharge. In the semi-analytical method these flowpaths continue further to the west because the lake could not be incorporated into the model.

Conclusions

From the summary of model properties given on table 7, it is clear that the MODFLOW numerical model is the best approximation of the actual flow system because it can incorporate spatial variations in physical and hydraulic properties as well as complex boundary conditions. However, many of the advantages that MODFLOW has over the CAPZONE semianalytical model may not be critical for WPA delineation at Richwood. The flow system at Richwood is conceptualized as having vertical variations in hydraulic properties among the different model layers but no horizontal variations within individual layers except for the lake cells and recharge fluxes specified in model layer 1. The vertical and horizontal variations do not appear to be significant in terms of delineation of traveltime-related capture zones for several reasons:

1) A traveltime-related WPA is a two-dimensional areal feature determined by projecting reverse-tracked flowpaths to the land surface regardless of their vertical position in the flow system.

2) Although the hydraulic properties of carbonate units vary, they are conceptualized to behave as a single unit in which the horizontal hydraulic conductivities are different, but the vertical conductivities are the same. As a result, the cone of depression at the New Wellfield simulated using MODFLOW is very similar to the cone of depression simulated using CAPZONE which was based on an average hydraulic conductivity but the same total transmissivity.

3) Vertical flow into the cone of depression from the overlying glacial deposits (leakage) is controlled by the vertical hydraulic conductivity of the confining layer, not the recharge flux assigned to layer 1 in the MODFLOW model. Because leakage does

not vary except at the lake, the Hantush-Jacob equation used in CAPZONE represents the effect of leakage to the cone of depression nearly as well as MODFLOW.

4) Because Richwood Lake acts as a small ground-water mound, reverse-tracked flowpaths terminate when they reach this source of recharge. When the lake is not simulated, as is the case in the semianalytical and analytical models, flowpaths pass through this area resulting in a slightly larger capture zone. However, this larger area just includes more of the lake which already should be part of an overall wellhead-protection plan.

The fact that the capture zones determined by the calculated-fixed radius method and analytical method are larger than and encompass the capture zones determined by the more sophisticated semianalytical and numerical methods may be reasonable from a regulators point-of-view because all of the areas that need to be protected regardless of delineation method will be included in the wellhead-protection program. Serendipitously the WPA determined by 1000-foot arbitrary-fixed radius (fig. 23) successfully covers much of the 5-year capture zones determined by the more sophisticated methods, however, important areas of contribution to the southwest have been ignored.

By examining the differences among the 5-year capture zones for each method and the sensitivity analyzes from the semianalytical method (Chapter 5), it can be concluded that the most important model parameters for wellhead protection of the municipal wells at Richwood are the steady-state prepumping potentiometric surface, vertical leakage to the carbonate aquifer from the overlying glacial deposits, and the value of effective porosity. Although all four methods of delineating traveltime-related capture zones incorporate the same value of effective porosity, only the CAPZONE semianalytical model and the MODFLOW numerical model are able to incorporate the nonuniform regional flow field and vertical leakage into the carbonate aquifer.

Considering the existing field data, the time of implementation, and the technical expertise required for each delineation method, the semianalytical method is far-and-above the best method to use for WPA delineation at Richwood. If sufficient finances were available, the apparent advantages of using a numerical model could have been better utilized by drilling several observation wells around the perimeter of the semianalytically-derived capture zones to assess any variations in vertical leakage and to improve the accuracy of the potentiometric surface. Through regular water-quality sampling these observation wells would become an integral part of a wellhead-protection program by detecting potential contaminants moving toward the wellfield.

Observation wells should be placed in accordance with the endpoint distributions of the reverse-tracked flowpaths from the numerical and semianalytical methods (figs. 52 and 53). Other water-quality monitoring locations that should be included in a comprehensive wellhead-protection plan include Richwood Lake, the glacial deposits beneath the agricultural fields, and the intersections of Mulvane Road with State Route 37 and Grove Street.

A wellhead protection education program should be set up with people from North Union High School where a variety of solvents are used and with local farmers who mix and apply agricultural chemicals.

APPENDIX 4

SPRINGFIELD WHP DEMONSTRATION PROJECT - MANAGEMENT OPTIONS

Agriculture

* Require reporting of chemical use on a field by field basis within the one and five year TOT zones.

* Provide maps and/or post the boundaries of the TOT zones for farmers information.

* Establish ground water monitoring in key areas to evaluate potential effects of agricultural activities.

* Assist Soil and Water Conservation District personnel in educating farmers on the concepts of wellhead protection and in the latest management practices that maximize crop yield and minimize chemical application.

* Require back-siphoning prevention devices on wells used to mix agri-chemicals or fill dispensing equipment.

* Require use of impermeable pads with collection dikes for cleaning dispensing equipment.

* Prohibit the storage and disposal through land application of animal waste, sewage sludge and septage within the one year TOT zone.

* Limit the storage, transportation and mixing of substantial amounts of agriculture chemicals within the one year TOT zone.

Transportation Routes

* Post all roadways to indicate when entering the WHP zone and provide an emergency number to call in the event of an accident or spill.

* Establish an emergency action plan to coordinate appropriate agencies in the event of a spill.

* Restrict or prohibit trucks carrying hazardous or other deleterious materials from using Eagle City Road.

* Reduce the speed limit for highways and railroads that run through or near the WHPA.

* Monitor existing transportation routes for vehicles transporting hazardous materials and develop recommended alternative routes away from the WHPA.

* Limit the application of road salt and other de-icing agents within the WHPA by utilizing street plowing as much as possible and mixing salt with other materials such as sand, fine gravel or cinders to reduce salt content.

* Maintain records of salt usage within the WHPA

* Conduct education programs to inform businesses, industry and the public about deicing methods and materials that minimize possible ground water impacts.

Underground Storage Tanks

* Coordinate with the Ohio Department of Commerce, Bureau of Underground Storage Tank Regulation (BUSTR) to insure compliance with all underground storage tank regulations.
* Require proper identification for all underground storage containers including size and stored material.
* Require regular inspection, testing and maintenance programs for all underground storage tanks and associated piping within the WHPA.
* Require that records of deliveries and consumption be reconciled daily against measured inventory to detect product loss.
* Require monitoring of the areas adjacent to tanks within the WHPA to detect any subsurface leaks. This may include electronic leak detection devices.
* Require perimeter containment structures to contain spills or overflows (1-YR TOT). This may include a sump and equipment for removing released product.
* Prohibit installation of any new underground storage tanks within the one year TOT.
* Due to the shallow depth to ground water installation of new underground storage tanks should be prohibited from the five year TOT unless plans are submitted showing that the tank will meet all rules and regulations of the BUSTR program and meet all of the requirements for new and existing tanks.
* Require all tanks to be equipped with overfill protection.
* Require secondary containment systems that are capable of holding at least 110% of the storage vessel (1-Yr TOT).
* Require development and posting of emergency response procedures in event of a leak or spill.

Transmission Lines

* Obtain copies of maps showing precise location of pipelines and require regular inventory reports of substances that pass through the WHPA.
* Establish emergency response procedures designed to prevent or minimize ground water contamination resulting from the release of product.
* Compile and maintain a list of pipeline operator emergency response telephone numbers.
* Perform routine periodic testing to determine if leakage is occurring within the WHPA.

Sanitary Sewer Lines

* Cooperate with the Ohio EPA and other appropriate agencies to insure compliance with all existing pretreatment and discharge regulations.
* Maintain maps showing precise location of all sanitary sewers.
* Perform periodic testing and inspections for exfiltration.

Automotive Dealers, Repair Shops and Misc. Manufacturing Firms

* Coordinate with Ohio EPA and other appropriate agencies to insure that all materials use, handling, storage, reporting and other safety regulations are enforced.
* Provide signs or posters, to be posted in work areas, that indicate that the entity is located within a designated wellhead protection area and promote cautionary measures.
* Promote regular educational programs for facility personnel to supply information and training relative to the WHPA and materials used on the premises including handling procedures and precautions.
* Require proper labeling of all hazardous materials and other deleterious materials present on the premises.
* Require materials safety data sheets be posted or otherwise readily accessible that present health and safety data, chemical properties and emergency response procedures for all potentially threatening materials.
* Require that records be kept of potentially threatening materials brought into the work areas by type, total amounts entered, total amounts used and require reconciliation with records of waste products leaving the work area.
* Require hazardous materials management plans addressing all aspects of the use, storage and handling of each material on the premises.
* Perform periodic inspections of the premises including all interior and exterior areas to insure that requirements are being met and that proper practices and precautions are being followed.
* Require regular inspection and maintenance programs for all pipes, drains, traps, vessels and other equipment used to store or transport hazardous or deleterious materials.
* Require emergency response plans specifying procedures and responsibilities in the event of an accidental spill or other unauthorized release of all potentially threatening materials present on the premises.

Automotive Dealers, Repair Shops and Misc. Manufacturing Firms (continued)

* Revise building codes to require additional ground water protection measures. This could include:

  Prohibiting the discharge of floor drains, piping or other channels to on-lot disposal system;

  Installation of floor drain collection systems to direct and contain all hazardous or deleterious materials released during normal operations or from accidents and spills;

  Adequate building and site security methods and systems;

  Perimeter containment systems capable of preventing hazardous materials from migrating off-site; mechanical protection against overfilling of tanks or other vessels used for any deleterious materials; and, secondary containment systems that are capable of holding at least 110% of containers used to store hazardous materials;

  Require the use of containment methods in all transport and transfer areas to contain minor spills. This could include impervious pavement and curbs.

* Establish routine ground water monitoring using on-site production wells and properly constructed monitoring wells hydraulically down gradient from potential contaminant sources.

Septic Tanks and Leach Systems

* Extend the city's sanitary sewer to those residential subdevelopments and commercial establishments along Route 68 currently using on-lot disposal systems and require hook-up to centralized sanitary sewer wherever feasible.

* Provide home and business owners with information concerning the proper operation and maintenance of septic systems and the possible negative affects on ground water of using septic systems for the disposal of cleaners, degreasers, solvents and other deleterious household and industrial products.

* Prohibit the discharge of hazardous materials or other deleterious materials into any on-site septic systems.

* Require septic tanks to be pumped out and inspected on a routine basis and prior to transfer of property.

* Coordinate with State and Local Health Departments to assure that all siting and installation requirements are met within the five year TOT zone..

* Adopt siting, design, installation and inspection requirements that are more stringent than the state requirements for the one year TOT zone.

Septic Tanks and Leach Systems (continued)

* Set permit-to-install fees at a level sufficient to support a rigorous inspection and enforcement program.
* Recommend that water softeners are not used in combination with septic systems.
* Require housing developments to maintain suitable densities of septic systems (e.g. 1/AC).

Domestic Chemical Waste

* Develop and maintain public information/education programs that identify household chemicals and proper use, storage and handling methods.
* Require that household waste be separated from other wastes.
* Conduct special collection programs for hazardous household waste on a periodic basis.
* Develop holding stations where hazardous household wastes can be dropped and then properly disposed of.
* Develop and operate a used motor oil recycling network to collect waste through commercial and/or municipal garages.

Miscellaneous Recommendations

* Install fencing to limit access to the wellfield, quarries and borrow pits surrounding the wellfield, to deter vandalism and unauthorized dumping.
* Coordinate with the Ohio EPA to restrict upstream discharges to the Mad River and its tributaries that could affect the quality of water recharging the aquifer.
* Perform routine water quality sampling of the Mad River immediately upstream of the wellfield.
* Maintain and enforce regulations prohibiting dumping or depositing materials in unauthorized locations.
* Coordinate with the local Health departments to insure that all abandoned wells are located and properly plugged.
* Plan and install a network of monitoring of monitoring wells to insure early detection and response to contaminants moving toward the wellfield.

Future Development:

* Require pre-development ground water monitoring at proposed sites to establish baseline conditions for water quality data.

* Conduct public hearings for all proposed development within the wellhead protection area at which detailed information is presented concerning the proposed development of a facility, its operation, procedures and process chemical usage, and plans for ensuring environmental and public safety.

* Coordinate with County and Townships to change current industrial zoning within the one year TOT zoning and to assure appropriate zoning for the future.

* Initiate program to purchase property or development rights surrounding the wellfield to control any future development.

APPENDIX 5

CONTINGENCY PLAN

3745-85 CONTINGENCY PLANS

3745-85-01 Definitions.

As used in this chapter of the Administrative Code, "community water system" and "director" have the same meanings as ascribed to such terms in rule 3745-81-01 of the Administrative Code.

(Adopted October 9, 1980; effective November 26, 1980)

3745-85-02 Contingency plan required.

Each community water system shall prepare and maintain a written contingency plan for providing safe drinking water to its service area under emergency conditions. The first edition of such plan shall be completed by July 1, 1982.

(Adopted October 9, 1980; effective November 26, 1980)

3745-85-03 Location of copies.

(A) One copy of the contingency plan shall be kept at the water treatment plant, if there is a plant, and another shall be kept in the water system administrator's office.

(B) Public water systems serving a population of more than two hundred fifty shall keep three additional copies of the plan at various accessible, secure locations in the service area.

(C) A copy of the contingency plan shall be available for inspection by representatives of the director.

(Adopted October 9, 1980; effective November 26, 1980)

3745-85-04 Contents of contingency plan.

The contingency plan shall contain:

(A) A map of the distribution system, detailed locations for each valve in the system including references to aid in location of valves, and for water systems using a well source, a map of the well field;

(B) A statement of amounts budgeted for emergency use along with a statement showing who can authorize expenditures for such purpose, and under what conditions such authorization and expenditure can occur;

(C) A determination of not less than ten of the most likely emergencies that will affect the water system and a description of the procedures to be followed and actions necessary to provide service during the emergencies. For systems serving fewer than one thousand five hundred people, the following emergency circumstances shall be included in such outline:

(1) Short-term power failure (time of interruption less than two hours);

(2) Extended power failure (two hours or more);

(3) Pump or motor failure;

(4) Loss of water from a well or other water source;

(5) Major water main break;

(6) Unplanned absence of operator;

(D) A description of the method that will be used to transport water from an alternate source should such procedure become necessary, and a description of at least three possible alternate sources of water and the method of disinfection that will be used for each source;

(E) A list of water users having critical needs for a continuous supply of water;

(F) The methods of notification of users that an emergency exists;

(G) If depressurization of the water system has occurred, the procedure that will be used to return the system to normal service;

(H) Twenty-four-hour telephone numbers for:

(1) The Ohio environmental protection agency, office of public water supply;

(2) Police;

(3) Fire;

(4) The local disaster services agency;

(5) All water supply personnel;

(6) Municipal administrative personnel;

(7) Contractors for line breaks, "first call" and "second call;"

(8) Electric power supplier;

(9) Electricians, "first call" and "second call;"

(10) Well drilling and pump service contractors, "first call" and "second call;"

(11) Plant mechanical contractors, "first call" and "second call;"

(12) All suppliers of equipment and chemicals normally used;

(13) Hospital, emergency squad, medical assistance.

(Adopted October 9, 1980; effective November 26, 1980)

3745-85-05 Revision required.

The contingency plan required by this chapter of the Administrative Code shall be revised and updated as necessary, but at least annually.

(Adopted October 9, 1980; effective November 26, 1980)

DRINKING WATER SUPPLY

CONTINGENCY PLAN

WATER SUPPLY CONTINGENCY PLAN FOR ______________________________ MOBILE HOME PARK

LOCATED AT ______________________________, OHIO AS OF ______________
Date

COPIES OF THIS PLAN ARE AT THE FOLLOWING LOCATIONS:

PARK OFFICE - LIST EXACT LOCATION - ______________________________
(Desk, Bulletin Board, etc.)

PARK OPERATORS RESIDENCE ______________________________

PARK MAINTENANCE BUILDING ______________________________

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REVISIONS (All copies of this plan must be revised as the names, addresses and telephone numbers of personnel, suppli-rs, contractors and governmental agencies are are changed, as well as changes in the water supply system but at least annually.)

PAGE	NAME	DATE REVISED

IN ABSENCE OF PARK OWNER OR OPERATOR

The following person(s) are thoroughly familiar with the emergency plan and are authorized to make necessary repairs to the water system in absence of the owner.

NAME	ADDRESS	PHONE DURING OFFICE HOURS	IF NO ANSWER, CALL

The following person(s) are thoroughly familiar with the plan and are available under emergency circumstances.

POTENTIAL EMERGENCY CONDITIONS

Power Outage

Park manager shall take all necessary steps as to shut down the water treatment plant such as turning off the chemical feed equipment, disconnecting well pump and high service pumps, to prevent electrical damage to equipment or over feed of chemicals under certain conditions.

1. Determine the expected length of the electrical outage.
2. Determine the amount of water on hand in the distribution system storage tank.
3. Notify the park residents if necessary.

Short Term Power Failure (Less than 2 Hours)

(a) If necessary, ask for water conservation during power outage.
(b) If system pressure should drop below 20 lbs., all water for drinking and cooking shall be disinfected before use by boiling or chlorination as indicated under Emergency Disinfection.
(c) Advise the park residents when conditions are back to normal.

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EXTENDED POWER FAILURE (Two Hours or More)

(a) Restrict water use for drinking and cooking.
(b) Notify all necessary parties (see call list).
(c) Notify water users (see Emergency Notification).
(d) Provide water hauling if necessary (see Alternate Sources).
(e) Request state aid if necessary (see call list).
(f) Emergency power generating equipment.

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WELLS OUT OF SERVICE - CONTAMINATION, LOSS OF WATER TABLE, PUMP FAILURE, ETC.

1. Should any one of the wells become contaminated or deteriorated to a condition that is unable to furnish water of a satisfactory quantity and quality it shall then be taken out of service until the cause can be determined. The other well should then be placed into service.
2. If one well is out of service, depending on severity of situation, users should be notified to conserve water during well repairs if necessary.
3. If both wells are contaminated or unable to pump water due to the water table level, shut-down the wells, treatment plant and close the main line finished water valve.
4. Notify Ohio E.P.A. and Park Owner.

5. Obtain and analyze water samples at ______________________________.
6. Make necessary repairs and disinfect per Ohio E.P.A. instructions.

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TREATMENT PLANT FAILURE (Filters, Softeners, etc.)

In the event of filters or softeners, bypass the plant from the raw water main into the distribution system.

1. Immediately bypass the plant.
2. Notify Ohio E.P.A. and Park Owner.
3. Make necessary repairs and disinfect if necessary.

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WATER LINE BREAK - RAW

1. Raw water line breaks from well field.

   (a) Shut-down wells and plant. See Power Outages Section.
   (b) Isolate area of break.
   (c) Notify users of situation if necessary.
   (d) Make necessary repairs and disinfect.

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DISTRIBUTION BREAKS

1. Break in distribution main.

   (a) Immediately isolate area of break.
   (b) Check for depressurization of system.
   (c) Notify users of situation.
   (d) Make necessary repairs and disinfect.

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LOSS OF STORAGE CAPABILITY

If the storage tank is out of service due to contamination or repair, pressure relief valves shall be installed in distribution system. The well pumps can be used to maintain pressure in the system. A pressure gauge shall be installed in the system in order to monitor the system's pressure.

WATER USERS HAVING A NEED FOR CONTINUOUS WATER SUPPLY:

NAME	ADDRESS	PHONE

(Suggestion) (It would be helpful to identify these persons for health or other reasons who require a continuous water supply. (i.e. medical equipment, etc.) If this does not apply enter "NONE.")

TWENTY FOUR HOUR PHONE NUMBERS

NAME	ADDRESS	PHONE DURING OFFICE HOURS	IF NO ANSWER, CALL
OHIO EPA DISTRICT OFFICE			1-800-282-9378
SHERIFF'S OFFICE			
FIRE DEPARTMENT			
COUNTY DISASTER AGENCY			
ELECTRIC CO.			
PHONE CO.			
LOCAL RADIO STATION			
HOSPITAL			
EMERGENCY SQUAD			
OHIO UTILITIES PROTECTION SERVICE			1-800-362-2764
OTHER PHONE NUMBERS			
MATERIALS (Repair Clamps, Valves, Pipe and Fittings, Feeders, etc.)			
CHEMICALS (Chlorine, Calcium Hypochlorite, etc.)			
ELECTRICIANS (Local Contractors for Equipment & Support)			

BACKHOE

NAME	ADDRESS	PHONE DURING OFFICE HOURS	IF NO ANSWER, CALL

WELL DRILLERS AND PUMP SERVICE

WATER SYSTEM MAP (Attach Copies of Maps to the Plan)
(Suggestion) (This map may be hand drawn and should show location of valves, lines, etc. with sufficient accuracy to allow others to locate the valve.)

EMERGENCY NOTIFICATION OF WATER USERS

(Suggestion) (Door-to-Door, Written Notification, etc.)

In the event of a water related emergency, public information will be provided to the residents door-to-door by the employees and on the bulletin board in the park office.

1. Notify users if emergency disinfection of drinking water is required.
2. Advise the public as to the expected duration of the emergency.
3. If necessary, ask for conservation.
4. Advise if necessary that potable water is available at the park office with limits for drinking and cooking.
5. Advise the public when water is available for sanitation.
6. Advise the public when conditions are near normal.

EMERGENCY SUPPLY OF DRINKING WATER

NAME OF SUPPLY	LOCATION TO OBTAIN WATER	CONTACT PERSON	PHONE

TRANSPORTING DRINKING WATER

(Suggestions) (Water Haulers, Milk Haulers, Fire Department, etc.)

NAME	ADDRESS	PHONE DURING OFFICE HOURS	IF NO ANSWER, CALL

1. Notify users of situation.
2. Make necessary repairs and disinfect per Ohio E.P.A. District Office instruction.

PROCEDURES TO RETURN THE SYSTEM TO SERVICE

Emergency situations could result in depressurization or contamination of the water system at a single point in the distribution system or over a larger area of the system. If depressurization occurs within a small, defined area, the system can be isolated by immediately closing valves to keep the spread of possible contamination. The following steps should be taken:

1. Determine area to be isolated and isolate area.
2. Repair damages to distribution system and disinfect if necessary.
3. If repairs are lengthy, make provisions for temporary water supply.
4. Notify users to boil all water for drinking purposes in affected area.
5. Obtain and test water samples for possible contamination.
6. Disinfect affected mains with calcium hypochlorite or other approved method, from the Ohio E.P.A. District Office.
7. If contaminated, thoroughly flush mains and services; obtain and test additional samples.
8. Notify users that problems have been corrected; open valves.

REPAIR PARTS & LOCATION (Inventory of Equipment, Spare Parts and Chemicals Required or Repair of the Water System Which are Carried in Inventory by Local Suppliers or Contractors)

PARTS AND SIZE (Valves, Pipe, Repair Clamps, Extra Pump, Motors, Chemicals, etc.)

LOCATION

EMERGENCY DISINFECTION OF DRINKING WATER

See Attached OEPA Form PWS-3

Park Owners