MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Prepared For

Orange County Water Authority

January 1999

Prepared By

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Engineering Consulting Services
126 Monroe Turnpike

Trumbull, CT 06611

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INTRODUCTION

Following completion of Tasks 16 and 17 - Wellhead Protection Area (WHPA) delineation of municipal water supplies in Orange County, the Orange County Water Authority (OCWA) requested the development of a model Ground-Water Protection Plan (GWPP) for the local municipalities. The model GWPP is to be utilized as a guidance document for the development of local GWPPs for the municipal water supplies in the County and for educational use.

The model GWPP is to further the goal of the OCWA to play a key role in assisting in the development and implementation of County-wide GWPPs. The New York State Wellhead Protection Program (NYSDEC, 1990) recommends County agencies assist in the development and implementation of County-wide Wellhead Protection Programs and create uniform programs to protect the County's aquifers and ground-water resources. A majority of the significant aquifers in the study region cover a large areal extent extending across two or more municipal boundaries. In addition, some municipal public water supplies are developed outside the political boundaries in which the water is supplied. Therefore, the County has assisted in the development of uniform WHPA delineation approaches, regulations and administrative standards to protect the aquifers in the region.

Ground-Water Resources

Water is a precious resource, essential to all life on earth. The climate in Orange County provides abundant year-round precipitation, and large quantities of clean water are found in streams, rivers, lakes and in the ground. Orange County has seldomly been impacted by long-term water shortages, and a majority of the County's growth has not been significantly limited by a lack of water. As a result, the water resources of the County are sometimes taken for granted with little thought to where they come from and how they are affected by land use and growth.

The goal of the OCWA is to increase awareness that water supplies are not infinite resources. Like other natural resources, the County's water supplies require careful protection to provide the residences and businesses with continual use of abundant and clean water resources. As growth continues and more land is intensively developed, the risk of degradation of surface water and ground water increases. Several ground-water supplies are already reported to be contaminated in the County. In some areas where no present ground-water contamination is reported, the existing land use presents significant threats to water supplies; consequently, it is difficult to ensure long-term protection.

Ground-water supplies can become contaminated from many common and wide-spread land uses resulting from releases of hazardous chemicals or wastes to the ground. Some contaminants are filtered out by the soil, but many are dispersed into the underlying ground-water aquifer system. Once ground water is contaminated, it is usually difficult and costly to clean up. Public water supplies are tested on a regular basis for contaminants, however, most domestic water supplies are not tested regularly, if at all. Consequently, contaminants with no odor or taste may go undetected for a long period of time. Even when ground-water contamination is detected in a well, it is sometimes extremely difficult to accurately identify its source. Unfortunately, following removal and clean up of a contamination source, the contamination remains in the ground water for many years.

Preventing contamination is the single-most effective way to protect the ground-water resource in the County. To accomplish this, the municipalities, citizens, and businesses in the County must recognize where ground water comes from and develop a GWPP which can reduce and prevent ground-water contamination.

The GWPP will give local municipal officials and citizens the tools to understand the need for ground protection on a local level and ultimately develop a County-wide GWPP.

GROUND-WATER UTILIZATION

The previous plan to develop a large-scale water supply for the County considered the development of a large surface-water supply and distribution of the water throughout the Orange County Water Loop. The OCWA does not consider this plan to be a viable alternative for development of water supply for the present and foreseeable future demands for the County. Ground water is considered a feasible and favorable alternative for water-supply development and is sufficient for meeting future water demands of the County.

Ground water is widely used and is available throughout Orange County. It is estimated that there are about 35,000 wells currently withdrawing ground water throughout Orange County (United States Bureau of Census, 1990). Water for domestic use, farms and small commercial development in rural areas is commonly derived from individual wells. Typically, such small water demands range from 300 to 2,500 gpd (gallons per day). Residential, commercial and industrial developments in the cities/villages and urbanized areas of the towns in Orange County generally obtain water from public and private water-supply systems. Public water-supply systems use ground-water and surface-water supplies, or both (LBG, 1995).

Private Supplies

The "Environmental Health Water Program Single Line Inventory Report, for all Community Water Supplies", dated December 1994, was prepared by the Orange County Department of Health (OCDOH). That report indicates 239,849 people (78 percent) of the total population of about 307,647 people for the County (United States Bureau of the Census, 1990) are estimated to be supplied water from public water supplies (surface-water and ground-water supplies). Therefore, 22 percent of the population or 68,000 people utilize ground water from the individual well supplies. Studies conducted by the United States Environmental Protection Agency (USEPA) estimated average daily domestic water consumption to be about 55 gpd per person. Average daily water consumption throughout the County is generally estimated to be 75 gpd per person (New York State Department of Health (NYSDOH) Guidelines) for metered public water supplies. That is considered to be a generous estimate for people on individual domestic supplies in the County. Utilizing the estimate of 75 gpd per person for the 68,000 people, the

present demand for individual well supplies in rural areas not supplied by public water systems is estimated to be about 5 mgd (million gallons per day). It is likely about 95 percent of the 5 mgd, or about 4.7 mgd, is developed from ground-water supplies and mostly from wells completed in the bedrock aquifers in the County (LBG, 1995).

Public Supplies

There are 168 public water-supply systems in Orange County; 137 utilize ground water; 17 use surface water; 4 use both ground water and surface water; and 10 purchase water (from both surface and ground-water sources). A total of 412 wells were inventoried in the Existing Conditions Report (LBG, 1995) for existing and proposed public ground-water supply systems in Orange County. The total estimated yield capacity is about 31.8 mgd from 108 sand and gravel wells, 23.6 mgd from 280 bedrock wells, and less than 2.9 mgd from the 27 wells where data does not indicate the aquifer material the well is completed in. The total yield capacity of public water systems in Orange County is about 58.3 mgd (LBG, 1995).

The present yield withdrawn from the public ground-water systems in the County is much less than the total yield capacity. About 17.1 mgd of ground water is presently withdrawn from the sand and gravel aquifers, 53 percent of the total estimated yield capacity (31.8 mgd) of wells completed in the sand and gravel aquifers. About 9 mgd is presently withdrawn from the bedrock aquifer, about 38 percent of the total estimated yield capacity (23.6 mgd) of wells completed in the bedrock aquifers. Finally, about 0.3 mgd is withdrawn from wells completed in unknown aquifer types, about 10 percent of the total estimated yield capacity from wells completed in the unknown aquifer types. The present ground-water withdrawal from public water systems in the County is about 26.4 mgd, only 45 percent of the total estimated yield (58.3 mgd) of the well's developed. This excess yield capacity provides the ability to meet peak and future water demands (LBG, 1995).

Table 1 indicates the estimated total present withdrawal of ground water in Orange County from both individual well supplies in rural areas and public water supplies in the County total about 31.1 mgd (LBG, 1995).

Future Withdrawal

The total withdrawal of ground water in the County by the year 2020 will likely exceed 50 mgd, about 6.7 mgd for individual well supplies and 44 mgd for public water supplies (LBG, 1995).

OCCURRENCE AND MOVEMENT OF GROUND WATER

An aquifer is a saturated bed, formation or a group of formations which yields water in sufficient quantities to be economically useful. An aquifer may be capable of yielding enough water to serve a city or may be limited to yields sufficient for a household. Ground water in Orange County is developed from both unconsolidated sand and gravel aquifers and consolidated bedrock aquifers (figure 1). The shape of the openings in rocks or sediments, their size, volume and interconnection are the significant factors which determine their potential to yield water. Water is introduced into the underground system by infiltration of precipitation.

An aquifer performs two important functions, the storage and movement of ground water. The interstices (openings) in a water-bearing formation allow storage and act as part of a network of openings for ground-water movement. Ground water is constantly moving through these openings driven by the local hydraulic gradient, which is the elevation difference or water pressure difference between two points. Natural ground-water movement occurs at rates of a few feet per year to several feet per day. Water in an aquifer is being held in moving storage, and if not used, eventually will be discharged to lakes, streams or oceans (Driscoll, 1986).

Ground-water environments generally comprise three general classes:

1. porus media interstices between individual particles in sand and gravel and sandstone formations;
2. fractures, crevices, joints, faults and bedding planes in bedrock formations; and
3. solution channels (generally fractures enlarged by dissolution of soluble rock).

Ground water occurs underground in two states, unconfined or water-table aquifers and confined or artesian/semi-artesian aquifers (figure 1). The physical state of the water in the aquifer determines what forms of energy or hydrostatic pressure the water possesses (Driscoll, 1986). The sand and gravel aquifers in Orange County exist in both unconfined and confined environments. The bedrock aquifers in the County are usually considered confined or semi-confined aquifers. A majority of the bedrock aquifers are overlain by confining layers of till or low-permeable materials. Bedrock aquifers can, but rarely do, exist in unconfined environments. In addition, some sand and gravel and bedrock aquifers in the County are partially overlain by a confining layer and exhibit both confined and unconfined characteristics.

SURFICIAL SOILS

The Ground-Water Resource Study (GWRS) (1995) reviewed the Soils Survey of Orange County, New York (Olson, 1981) to delineate surficial soils which could possibly indicate underlying sand and gravel aquifers and/or permeable sand and gravel deposits which would readily recharge underlying or adjacent sand and gravel or bedrock aquifer units in sensitive aquifer areas. The summary of the surficial sand and gravel deposits from the Soil Survey of Orange County is listed on table 2. The map of the selected soils was electronically overlaid on the sand and gravel aquifer maps (Map Set 1) included in the May 1995, LBG report entitled, "Orange County, New York, Ground-Water Resource Study" (GWRS). The selected soils on table 2 are represented on the map legend and respective map sets as "sand and gravel deposits at land surface, vertical thickness unknown" and labeled with brown cross-hatch pattern and unnumbered.

AQUIFER TYPES

Ground water in Orange County is developed from two aquifer types, sand and gravel and bedrock aquifers. The sand and gravel aquifers in Orange County supply a majority of the ground water presently

used in Orange County. The sand and gravel aquifers are the most prolific in the County. Although not as prolific as sand and gravel aquifer units, the bedrock aquifers in Orange County are utilized for development of both domestic water and larger municipal public water supplies, which yield in excess of 1 mgd (i.e., Town of Woodbury and Village of Kiryas Joel). The bedrock aquifers in Orange County are a dependable and suitable ground-water supply source for developing high-yielding wells (LBG, 1995).

Sand and Gravel Aquifers

In Orange County, sand and gravel aquifers, also called unconsolidated deposits, are the best source for development of large quantities of ground water. However, the sand and gravel aquifers which are capable of developing high-yielding wells are of limited areal extent within the County. Sand and gravel aquifers available for development in the respective Towns of Orange County are presented on table 3.

The unconsolidated deposits must contain pores or open spaces which can fill with water, and these openings must be large enough to permit water to move through them toward wells at an adequate rate. Individual pores in a fine-grained material like clay or silt are extremely small and, consequently, water cannot move readily through the tiny pore spaces. This means clay and silt formations will not yield adequate water for development of high-yielding wells.

Coarser sand and gravel material contains larger open spaces through which water can move readily. Therefore, saturated coarse sand and gravel formations are more suitable for development of high-yield wells. The legend and Map Set 1 for the GWRS delineates the sand and gravel aquifer material and saturation conditions likely to be encountered during drilling of the aquifer materials. It should be understood that not all of the mapped sand and gravel deposits would be suitable for ground-water supply development.

The unconsolidated sand and gravel deposits have been mapped as follows:

C Stratified Sand and Gravel at Land Surface and Below the Water Table - These sand and gravel aquifer units are labeled by a red cross-hatch pattern and the numeral 1 on the respective map sets.

These aquifer units consist of unconfined sand and gravel aquifer units exposed at land surface and likely extend below the water table. These aquifer units have excellent potential to develop high-yielding wells if the sand and gravel material has adequate horizontal and vertical extent for recharge and storage capacities, and are adjacent to surface-water bodies to receive induced filtration. The potential of this aquifer unit varies throughout the County and has good potential for development of high-yielding wells.

C Stratified Sand and Gravel Below Clay or Silt and the Water Table - These confined sand and gravel aquifer units are labeled by a blue cross-hatch pattern and the numeral 2 on the respective map sets. These aquifer units have good potential for development of high-yielding wells if aquifer material consists of coarse sand and gravel materials, has adequate horizontal and vertical extent for recharge and storage capacities, and the confining clay or silt layers allow adequate recharge and are not continuous throughout the aquifer. The potential of this aquifer varies greatly throughout the County and has fair to good potential for development of high-yielding wells.

C Stratified Clay and Silt with Thin to No Layers of Sand and Gravel at Land Surface and Below the Water Table - The confined or semi-confined aquifer units are labeled by a yellow cross-hatch pattern and the numeral 3 on the respective map sets. The clay and silty sand and gravel units will not typically yield adequate water for development of high-yielding wells. However, in small, isolated sand and gravel aquifer units, the yield potential is low to moderate and likely to yield less than 100 gpm (gallons per minute). The aquifer unit generally has poor potential for developing high-yielding wells.

C Stratified Sand and Gravel at Land Surface and Above the Water Table - The unconsolidated sand and gravel deposits are labeled by a green cross-hatch pattern and the numeral 4 on the respective map sets. These sand and gravel deposits are likely unsaturated and, as a result, have poor

potential for development. However, these sand and gravel deposits usually exhibit good permeability and adsorb any direct precipitation and runoff from surrounding till-covered uplands. Consequently, these deposits recharge adjacent sand and gravel aquifers and/or underlying bedrock aquifers.

C Stratified Sand and Gravel at Land Surface, Vertical Thickness Unknown - These sand and gravel deposits are labeled by a brown reverse-hatch pattern and are unnumbered. These aquifer units have good potential for development of high-yielding wells if aquifer material consists of coarse sand and gravel material with adequate horizontal and vertical extent for recharge and storage capacities. Consequently, sand and gravel deposits from this unit have greater potential for development of high-yielding wells when located adjacent to a significant sand and gravel unit or adjacent to surface-water bodies to receive induced infiltration. These aquifer units exhibit good permeability and adsorb any direct precipitation and runoff from surrounding till-covered uplands. Consequently, these units recharge underlying and adjacent sand and gravel and bedrock aquifers. Small, isolated sand and gravel deposits of the unit would likely be of limited horizontal and vertical extent and, as a result, have poor potential for developing high-yielding wells.

Bedrock Aquifers

Ground water also occurs in the bedrock units underlying Orange County. The bedrock units may be a high-yield aquifer if there is sufficient porosity and permeability. The bedrock aquifers occur throughout the County and some possess excellent water-bearing properties. Bedrock aquifers available for development in the respective Towns of Orange County are presented on table 4.

Ground water occurs in bedrock units in pores, joints, fractures, solution cavities and fault zones and other secondary openings. The yield of bedrock aquifers varies greatly, depending on the porosity and permeability of the bedrock units. The permeability of the bedrock unit depends on the degree of interconnection of fractures, joints and other secondary openings. Bedrock aquifers in Orange County are

developed from sedimentary, igneous and metamorphic rocks. The legend and Map Sets 2 and 3 in the GWRS delineate bedrock aquifers likely to be encountered during drilling in Orange County.

GROUND-WATER AVAILABILITY

Hydrologic Cycle

The earth's water cycle, or hydrologic cycle, is the continuous circulation of moisture and water on the planet. The continuous cycle commonly begins with waters of the ocean and cycles the water back to the oceans.

The following hydrologic cycle (figure 2) summarizes the source and movement of ground water. Orange County is a small segment of the world's hydrologic cycle which consists of constant evaporation, predominantly from global oceans, precipitation, runoff and infiltration. Eventually, on a larger scale, all ground water not utilized by plants (transpiration), evaporated or consumed by humans or animals finds its way back to the oceans. The time frame of the cycle locally in Orange County can take anywhere from several hours to as long as tens of millions of years to complete its course.

The available ground water in both sand and gravel and bedrock aquifers is a renewable resource that is continuously replenished by precipitation on the local watersheds in Orange County. The sand and gravel aquifers in the County are recharged from precipitation which falls directly on the surface of the aquifer, from ground-water flow from surrounding hills, mountains and, most importantly, some aquifers are recharged from overlying surface-water bodies (rivers, lakes and ponds). Bedrock aquifers are recharged from precipitation which falls directly on bedrock outcrops exposed at land surface and some portion of the precipitation that infiltrates the soil and overburden materials eventually recharges the bedrock fracture systems and is available from capture by bedrock water wells (figure 2).

The hydrologic cycle continually replenishes ground water in Orange County by precipitation. There are precipitation data available from three rain gage stations in Orange County located in Gardnersville, Middletown and Port Jervis. These data were utilized to prepare probability distributions

of annual precipitation at the three stations. The probability distributions were used to estimate average annual precipitation and precipitation during a one-year-in-thirty drought (3.3-percent probability) to the study watersheds in the County. For Orange County, the Gardnersville, Middletown and Port Jervis gaging stations indicate average annual precipitation of 41.5 inches, 44 inches and 43 inches per year, respectively (figure 3, 4 and 5). The average rainfall report from the three stations is about 43 inches per year. The difference in rainfall at the respective localities is likely related to topography of the region and location with respect to the Hudson River Valley (LBG, 1995).

Outflow from the hydrologic cycle is runoff and evaporation of precipitation. Runoff occurs if precipitation occurs in sufficient quantities to result in overland flow to streams and other surface-water bodies. Many sediment materials adjacent to or underlying streams and lakes are relatively permeable, and water can flow easily into the ground-water system once the streams and lakes have temporarily risen above the water table. Inflow to a stream during a storm may consist not only of overland flow but also direct channel precipitation and interflow (Driscoll, 1986). Interflow is the water that moves toward a stream above the ground-water table, but underneath the soil-water zone (ibid). The soil-water zone is just below the surface and provides water for plant growth (ibid). Water is lost from this zone by transpiration, evaporation and percolation when oversaturation occurs. Streams recharge the ground water during the same time after storms. Evaporation results when water molecules on the earth's surface acquire sufficient energy from solar radiation to vaporize. Transpiration results from moisture given off by plants and returned to the atmosphere.

Baseflow is the amount of ground water recharging a stream, not including direct precipitation and runoff. The hydrologic cycle ends and begins again with rivers and ground water flowing into the oceans (figure 2).

Watershed Areas

In Orange County, ground-water flow is generally predictable enough that flow patterns can delineate into hydrologic land units commonly call watershed areas. A watershed can be thought as a larger

bathtub. The rim of the tub would be compared to topographic highs (hill tops) were as the topographic lows (streams or lakes) can be compared to the drain in the tub. All the water in the watershed arrives as rain or snow. This same water will eventually exit as either water vapor transpired by plants or directly evaporated from the land surface, or as runoff, leaving the stream (the basin outlet) just like a bathtub water flows out the drain. Figure 6 shows a typical watershed area setting for Orange County.

Under natural conditions, the ground-water table generally is a subdued replica of land-surface topography, flowing from areas of topographic highs at the ground-water divide to topographic lows, likely discharging into a stream, lake or wetland.

Major watershed areas and boundaries are delineated by the United States Geological Survey (USGS) and OCWA. In addition, the smaller watershed areas for the Villages in the County which rely on ground water from bedrock aquifers were delineated by LBG to conduct water-budget analyses comparing the recharge to the watershed from the respective Villages to their projected water demands (LBG, 1995). Figure 7 presents the significant watershed areas mapped in Orange County for the GWRS (1995).

Water-Supply Management

The review of basic ground-water hydrogeology highlights a number of concepts needed to be understood on how to manage water resources wisely:

- ground-water supplies are finite;
- their quality and quantity can be affected by human activities and land use;
- ground water and surface water are interrelated and their flow patterns are organized into natural hydrologic areas called watersheds;
- ground water may be much more readily available in some areas than others depending on the kinds of geologic formations present;
- high-yielding stratified-drift aquifers are of limited areal extent, and are the principal water source for many communities. Sand and gravel aquifers are the most vulnerable ground-water resource;
- existing public supply wells and potential locations to develop help yielding wells in the future should be considered for protection strategies;
- wells drawing ground water from aquifers can be contaminated as a result of land-use activities within their recharge areas (WHPA); and
- bedrock aquifers may be more difficult to protect, however, the significant yield and use of a ground-water source make it equally essential to protect.

Management of ground-water resources which serve the diverse and growing needs of Orange County's population is a complex task. This report expands on the GWRS and previous tasks related to wellhead protection to develop a uniform model wellhead protection program and strategy for public water supplies in Orange County.

GROUND-WATER CONTAMINATION

Ground-water contamination is nearly always the result of human activity. In Orange County, where population density and land use are rising, ground water is likely vulnerable. A significant number of human activities use chemicals or generate wastes and have the potential to contaminate the ground water. In an effort to protect ground water, we must understand the many variables associated with the transport of

these contaminants into the ground water. Most ground-water contamination results from spills, leaks or other releases at the surface and underground.

Several processes affect the environmental fate of contaminants in soil and ground water. Some contaminants are broken down to non-toxic substances by exposure to light and air. Volatile contaminants like gasoline evaporate readily if spilled aboveground. However, once a substance penetrates the surface, there is much less of an opportunity for an attenuation (elimination) process without the aid of light and air.

Subsurface soils are a good treatment system for many pollutants, such as sewage wastes from properly installed and maintained septic systems. Soil acts as a filter for large particles such as bacteria and sediment. Soils with very fine particles (e.g., clay), commonly a constituent of soils in the Orange County, and large amounts of organic humas are very effective in trapping pollutants as compared to coarse-grained sands and gravels typically associated with sand and gravel aquifers. Contaminants can also be taken up by plant roots and broken down by micro-organisms in the soil, a process called biodegradation. Contaminants can also become physically or chemically bound to soil particles as a result of sorption or ion exchange. A good example of this process are metals, which can be a serious problem to surface-water supplies, are readily bound to soil particles and not a common cause of ground-water contamination.

The travel time of contaminants through unsaturated soil can vary greatly. Gasoline, for example, moves rapidly and relatively unaltered through unsaturated soil. More viscous substances like fuel oil moves slowly through the porous space in soils and may persist in the unsaturated soil zone and enter ground water at a slow rate over a long period of time. Substances which are highly soluble in water such as road salt become dissolved in precipitation and move freely through soil and into the ground water rather rapidly.

When contamination reaches the saturated zone and enters ground water, it is likely to become a serious and persistent problem because there is little opportunity for further attenuation. Chemical breakdown and additional attenuation processes, discussed above, require light and air which are not present in the saturated zone. A few substances may react with water to form less hazardous products, such as certain pesticides. In addition, certain anaerobic micro-organisms can also break down pollutants

in the absence of free oxygen. For the most part, once a contaminant reaches ground water the only significant natural attenuation is dilution and dispersion by flow of ground water through the aquifer.

Ground water moves at a relatively slow rate and movement within an aquifer allows little mixing. Therefore, ground-water pollution creates a discrete plume of contamination flowing out from the source (i.e., landfill or leaky storage tank) along the ground-water flow pattern. The movement of the plume depends primarily on the properties of the contaminant and the aquifer transporting the contaminant.

As the ground-water contaminant moves further from its source, it slowing becomes diluted, dispersed and less concentrated. Consequently, at some distance from the pollution source, the ground water may be considered safe for drinking again. A good example of this is the minimum separation distance between public and domestic wells from septic systems as required by the NYSDOH.

Sources of Ground-Water Contamination

The most common causes of ground-water contamination in Orange County are from improper handling, storage, and disposal of solvents; leakage from buried petroleum storage tanks; leachate from solid-waste disposal sites; and improper storage and application of road salt. As a result, many of these contaminants are better controlled and regulated as compared to the past decades. The best examples are the regulation of landfill sites and changes in landfill construction; regulation, registration of aboveground and underground storage tanks and construction; and regulations applied to road salt storage having changed dramatically in the last 10 years. However, ground-water contamination continues to be reported as a result of earlier land-use practices being detected from more recent investigation; from more current accidental spills or leaks; or from improper disposal of hazardous wastes by violators.

To protect wellhead areas, a Wellhead Protection Plan (WHPP) must identify all potential sources of contamination which may contaminate ground water. Presently, there is no one practical approach that is suitable for meeting this general goal. Each WHPP must develop its own rational approach. Knowledge of contamination properties is essential for understanding the level of risk to ground-water supplies from

different types of contaminants and the adequacy of WHPA delineation to the wellhead (USEPA, 1987).

The contaminants of most concern in the development of a WHPP are classified as inorganic and organic chemical compounds and elements, bacteria and viruses. It is important to identify the level of health risks and understand the nature and mobility of contaminants in assessing their significance in WHPA delineation.

Common chemicals which cause ground-water contamination are listed on table 5. The sources range from large-scale commercial and industrial land uses to the use of household hazardous materials. The land-use category and associated chemicals and compounds which can become ground-water contaminants are shown on table 6. Table 7 can be used as a preliminary guide to evaluate various land uses of concern and the associated risks. In addition, table 7 can accurately indicate whether the use should be banned or regulated with WHPAs.

The risk to ground water associated with various land use categories is presented in Appendix I. In addition, an inspection guide for inspecting facilities which may present a risk to ground water in sensitive aquifer areas WHPAs is presented in Appendix II.

Inorganic Chemicals

Inorganic chemicals are some of the most common and mobile contaminants impacting ground water. Common inorganic chemical constituents which present ground-water problems include nitrates, ammonia, sodium, chlorides and heavy metals. A majority of these inorganic chemicals, including sodium and chlorides, are highly soluble and, consequently, can easily impact ground water. Examples of ground-water contamination include nitrate contamination from individual septic systems and agricultural practices. Salt-water problems can result from highway deicing, salt storage and disposal of brine backwash from water softeners into underground septic systems.

Heavy metals can be discharged to the ground from sources including metal finishing and metal working industries; waste discharge containing metal impurities; and pesticides applied to turf grasses and

orchard trees. Metals are commonly bound to soil particles and are not a common cause of ground-water contamination in Orange County.

Organic Chemicals

Synthetic organic chemicals (SOCs) and hydrocarbons present the most significant concern in ground-water protection efforts. The most common organic contaminants include synthetic solvents, hydrocarbon fuels and lubricants, pesticides and polychlorinated biphenyls (PCBs) (USEPA, 1987). The most common ground-water contamination problem of organic chemicals is petroleum hydrocarbon spills and tank leaks from gasoline stations. Certain organic chemicals (i.e., benzene) are known carcinogens and present significant health risks and a small leak or spill can contaminate a large volume of water. Methyl tertiary-butyl ether, a gasoline additive, is extremely mobile, and can be detected at great distances from the source. Drinking water standards have been established for only a handful of the SOCs. The standards are usually very low, less than 5 ppb (parts per billion), which is the equivalent of about one drop in a swimming pool. Consequently, trace amounts of these chemicals in drinking water can present a significant health risk. The SOCs and hydrocarbons are the most persistent in soil and water and once a source is contaminated, it is impacted for many years. The cost to treat a ground-water source contaminated by either SOCs or hydrocarbons, over the long-term, can easily be millions of dollars.

Bacteria and Viruses

The survival of pathogenic bacteria and viruses in the subsurface environment has been a long-standing public health concern for drinking water for both domestic and public water supplies. Bacteria and viruses are usually eliminated in the subsurface environment in a short period of time. However, under an optimal environment, oxygen with proper pH and temperature, pathogenic bacteria can survive for fairly long periods (greater than six months). The sources of pathogenic contaminants include sewage disposal areas and landfills. The sewage disposal of greatest concern includes disposal of waste in underground septic systems.

OVERVIEW OF GROUND-WATER FLOW SYSTEMS

The following is a summary of basic ground-water flow systems under natural (non-pumping) and pumping conditions. The basic understanding is important to understanding contaminant transport in its relationship to delineation of WHPAs.

As discussed above, under natural conditions, the ground-water table generally is a subdued replica of land-surface topography, flowing from areas of topographic highs at the ground-water divide (high head) to topographic lows, likely discharging into a stream or wetland (low head). The equipotential lines shown in figure 8 represent lines along which the total head is equal. The flow lines, which are at right angles to the contours, indicate the ground-water flow direction under a state of equilibrium (USEPA, 1987).

Ground-water withdrawal from a well alters the natural state of equilibrium in an aquifer. The withdrawal of water from a well results in the drawdown (lowering) of water levels in the aquifer around the well. The affected area is referred to as the cone of depression or zone of influence (ZOI) (figure 9) (USEPA, 1987). The equipotential and flow lines of natural conditions are distorted under pumping conditions, and are directed toward the well (figure 9). This distortion indicates the ZOI to the pumping well. The pumping does not affect the flow lines outside the ZOI. Pumping conditions cause some ground water downgradient of the well to reverse and flow back in the direction of the well. The entire area recharging in or contributing water to the well or well field is defined as the zone of contribution (ZOC) or capture zone (figure 9). The areal extent of the ZOC can increase with time as the well is continually pumped (USEPA, 1987).

The ZOI and ZOC are significant to WHPA delineation. The ZOC is of greater importance because any contaminants in the ZOC will eventually reach the well.

The above discussion focuses on ground-water flow through porous, saturated, unconfined sand and gravel aquifer material. Ground-water flow in the bedrock aquifer system primarily flows through fractures, fault zones, joints, solution cavities and other secondary openings. The permeability of a bedrock unit depends on the degree of interconnection of fractures, joints and other secondary openings. As a

result, there is no sound basis to accurately predict the ZOI and ZOC for a pumping well completed in bedrock aquifers.

DELINEATION OF WELLHEAD PROTECTION AREAS

The delineation of WHPAs in the County utilizes a portion of the baseline delineation advocated by the New York State Wellhead Protection Program (NYSDEC, 1990) combined with further subdivision of the WHPAs as required for differentiated management objectives. The Draft Wellhead Protection Area Delineation report (Task 15) prepared by LBG (March 13, 1996) recommends the following delineation of WHPAs in the County. The proposed delineation allows flexibility for refinement or revisions due to the variability in hydrogeologic setting, data availability, and the threat of contamination to the Study public water supplies in Orange County. In addition, the WHPA delineation allows the concept of gradually implementing more sophisticated approaches as needed.

LBG has also completed reports for Tasks 16 and 17 which included WHPA delineation of existing municipal water supplies in Orange County including both baseline and alternative WHPA delineation methods. Copies of these reports for Tasks 15, 16 and 17 are available through the OCWA and copies have been provided to the respective Towns/Villages in the County. The WHPA's where delineated for the municipal ground-water supplies in Orange County shown on tables 8 (Task 16) and 9 (Task 17).

The available hydrogeologic data and mapping conducted for the OCWA Ground-Water Resources Study (LBG, 1995) and the Orange County Ground-Water Study, Existing Conditions Report (LBG, 1995) provide adequate foundation for the delineation of WHPAs. With a model baseline WHPA delineation and existing hydrogeologic mapping and data available, various alternative delineation methods can be utilized to refine the baseline delineation on a site-by-site basis.

Bedrock Wells

For bedrock wells, the baseline boundaries of WHPAs for the Remedial Action Area (RAA) were assigned a fixed 200-foot radius from the wellhead and the Well Field Management Area (WMA) was assigned a fixed 1,500-foot radius from the wellhead (NYSDEC, 1990). This baseline WHPA delineation for bedrock wells is a rational approach for bedrock wells in areas of the County where the bedrock is overlain by till or silt/clay overburden material. In addition, it is difficult to accurately delineate the precise recharge locations to a bedrock aquifer. A majority of the public water supplies in Orange County are developed from moderately deep bedrock wells (average depth 325 feet; LBG, 1995), and movement of ground water primarily occurs along fault zones, fracture zones, joints and other secondary openings in the bedrock units. Recharge from precipitation to the bedrock aquifer occurs regionally within the watershed area and upgradient from the well(s). Consequently, ground water can move along fracture zones and fault zones from great distances. The degree of interconnection and ground-water movement within the fault zones, fracture zones and the areal extent of these fractures are not visible at surface. Therefore, it is generally too difficult and costly to accurately predict the recharge area for bedrock wells, unless a substantial body of pumping test data is available.

The baseline WHPA delineation can be modified on a site-by-site basis to allow additional layers of protection for bedrock wells at risk. Bedrock wells which should be considered for additional layers of protection and possible expansion of the 1,500-foot radius WMA are as follows:

- wells completed in bedrock overlain by permeable, unsaturated, unconsolidated material and/or saturated sand and gravel material
- wells located on highly-fractured fault zones or significant regional fracture traces
- high-yielding bedrock wells
- combination of any of the above

Alternative WHPA delineation methods which are applicable for the expansion of the arbitrarily fixed 1,500-foot radius WMA are as follows, in order of increasing accuracy:

- arbitrary fixed-radius (arbitrarily increasing the radius)
- calculated fixed-radius (based on the well's pumping rate and generic aquifer characteristics)
- hydrogeologic mapping combined with calculated fixed radius (expands radius to include fractures that intersect radius)

In addition to the above, hydrogeologic-conditions data collected during pumping tests on a bedrock well with an offsite well monitoring program conducted to determine offsite water-level interference effects on wells in the study region may indicate drawdown and provide additional data to delineate a more precise recharge area to the bedrock well(s).

If data clearly indicate a well is at risk, the 1,500-foot radius WMA can be extended to include fault and fracture zones and permeable sand and gravel deposits. For high-yielding bedrock wells, the WMA radius can be extended utilizing the calculated fixed-radius delineation method combined with inclusion of significant faults and fracture zones and permeable sand and gravel units, if applicable. The proposed WHPA delineation for bedrock wells in Orange County is summarized on table 10.

Plate 1 shows the WHPAs delineation applied to bedrock wells for the Village of Harriman.

Sand and Gravel Wells

For sand and gravel wells, the baseline boundaries of the WHPAs for the RAA was assigned a fixed 200-foot radius from the wellhead. The RAAs can be modified where appropriate, if available data clearly indicates a well is at higher risk. Sand and gravel wells which should be considered for expansion of the 200-foot radius RAA from the wellhead are as follows:

- shallow wells completed in a highly permeable unconfined aquifer
- high yield wells completed in an unconfined aquifer

The New York State Wellhead Protection baseline delineation of a WMA for a sand and gravel well includes the areal extent of the sand and gravel aquifer boundaries the well or well field is completed in. However, a majority of the significant sand and gravel aquifers in the County extend continually over several miles (for example, Wallkill River Valley and Woodbury Creek Valley sand and gravel aquifers). Consequently, a majority of the WMAs for the sand and gravel wells would be too large for practical application of WHPA management efforts. The State's baseline delineation approach must be modified where aquifers are broad regional systems or where aquifers are not well characterized. For large aquifers in Orange County, it is recommended the baseline approach be the calculated fixed-radius method. However, if sand and gravel aquifer boundaries are of limited areal extent, the application of WMAs coinciding with the aquifer boundary would generally include important recharge areas within their boundaries and further subdivision of WHPAs can be conducted in the future as risks to the aquifer increase and as additional hydrogeologic data are collected.

WHPA delineation is an evolutionary process. Large significant sand and gravel aquifers need further subdivision of the total WHPA and WMA, as required for differentiated management objectives. The subdivision of the initial WMA into a Primary Recharge Area (Zone II) and a Secondary Recharge Area (Zone III) will allow application of various levels of management objectives for recharge areas.

The Primary Recharge Area (Zone II) should be mapped to include the portions of the zone of contribution (ZOC) within the unconsolidated sand and gravel aquifer contributing ground water to the RAA (Zone I) utilizing alternative delineation methods. Alternative methods recommended for Orange County to delineate the ZOC to a pumping well would include the following, in order of increasing accuracy:

- calculated fixed-radius (based on pumping rate and drawdown)
- analytical flow modeling
- numerical flow/transport models

The Secondary Recharge Area (Zone III) should include the portions of the ZOC within the upland till or bedrock which contributes ground-water flow directly to the primary recharge area. Watershed areas drained by perennial streams in the upland areas are excluded from the secondary recharge area. The draft WHPA delineation conducted for this task does not include the delineation of the secondary recharge areas for the study well fields.

The proposed delineation of WHPAs of sand and gravel wells in Orange County is summarized on table 10.

Alternative WHPA Delineation

Tables 8 and 9 list municipal ground-water supplies in Orange County selected for the application of alternative WHPA delineation methods. The ground-water supplies were selected due to risk (vulnerability) from contamination sources, density of development and existing land use adjacent to wells or well fields. In addition, priority was considered for principal sources of ground-water supply for large populations in the County.

Calculated Fixed Radius

The calculated fixed-radius approach for delineation of a WHPA utilizes pumping rates and aquifer characteristics data. This information is utilized to calculate a radius using an analytical equation that is based on the volume of water that will be drawn to a well in the specified time or to calculate the radius of influence (limit of drawdown) at a specified time.

Advantage

This method is easy to apply with minimal effort and is relatively inexpensive. The method can be utilized to delineate a large number of wells in a short period of time and may offer an increase in accuracy over the fixed-radius method. The equation requires data which are commonly available.

Disadvantages

The calculated fixed-radius method may be inaccurate considering this method does not account for many factors that influence contaminant transport, particularly in aquifers where significant hydraulic boundaries are present and have a sloping water table. This can particularly be true of heterogenous and non-isotropic hydrogeology or where significant hydrologic boundaries are present. Consequently, this method may also tend to over- or under-protect well recharge areas.

The calculated fixed radius approach was applied to appropriate sand and gravel supply wells in this study for baseline delineation of WHPAs. The WMA was defined as a circle of a radius (r) calculated using a volumetric equation with a five-year time of travel (TOT) criterion. The specified times generally used in WHPA delineation calculations are one-year, five-year and ten-year TOTs. The one-year TOT would delineate WHPAs with a short travel time to the well source and would possibly under-protect the well supply. The ten-year TOT would delineate WHPAs with a long travel time to the well source and would possibly over-protect the well source. LBG utilized the five-year TOT which would delineate a more moderate travel time to the well source. The five-year TOT criterion is utilized in the USEPA

Guideline for Delineation of Wellhead Protection Areas for example wells utilizing the calculated fixed-radius method (USEPA, 1987).

In the absence of laboratory analysis to determine the aquifer porosity, values of 0.1 to 0.3 are typically assigned. LBG selected the conservative values of 0.2 and 0.3 (Lau et al., 1957). The case study cited referenced similar unconsolidated sediments as described in many of the OCWA well field driller logs within the screen-setting zones.

The use of the calculated fixed-radius delineation method is a valid approach when limited information and funding are available. This method can be used as a baseline delineation and allows the implementation of more sophisticated approaches as needed and as additional funding is available.

Model Development

Ground-water models were developed or recalibrated for the selected well fields to estimate the ground-water flow and extent of the capture zone. The models were developed using the "Modular Three-Dimensional Finite-Difference Ground Water Flow Model" (MODFLOW), by McDonald and Harbaugh, a well-documented and accepted three-dimensional USGS numerical ground-water flow model.

Each model was constructed using data obtained from the individual water districts, including pumping test data, well records and geological well logs. A site visit was conducted at each of the well fields to obtain additional information such as water-level data, spatial distances between wells and nearby rivers, and current river stages. Additional data for each well field were obtained from the January 1995 LBG report entitled "Orange County Ground-Water Study, Existing Conditions" (Existing Conditions Report) and the May 1995 LBG GWRS report.

Advantages

MODFLOW is a numerical ground-water flow model that allows the incorporation of vertical leakage to and from surface-water bodies. The program also incorporates the impact of stratified drift-till boundaries and variations in aquifer thickness which are difficult to incorporate into an analytical ground-

water flow model. MODFLOW can account for numerous different boundary conditions. Furthermore, the software has time and again proven it can accurately simulate ground-water flow within a sand and gravel media. In addition, the advent of new pre- and post-processor computer programs have drastically reduced the time needed to develop and calibrate numerical ground-water flow models, thus making them more cost effective.

Disadvantages

As with any computer simulation, the capture zone calculated using MODFLOW is only as accurate as the data available for input. For this study, data related to the water-table configuration, streambed leakage and aquifer thickness beyond the well field areas were limited. Because the orientation of the water-table and aquifer thickness have a great influence on the size and shape of the area of capture, the calculated capture zone should be used with caution. For a more refined delineation of the 5- and 10-year capture zones, a comprehensive study at each well field is recommended. This would include obtaining stream-gage data and current water-level data that would provide the current water-table orientation. As a result, the current data would allow a more precise delineation of the capture areas (LBG, 1998).

A detailed summary of the WHPA delineation of the study well fields utilizing baseline delineation and ground-water models is included in the reports for Tasks 16 and 17 (LBG 1996 and 1998).

Plate 2 shows an example of the WHPA delineation for the sand and gravel wells for the Cornwall well field. The plate shows a comparison of the delineation of the WMA utilizing the calculated fixed-radius approach and the approximate capture area (WMA) delineated for a 5-year and 10-year period utilizing a ground-water flow model. The model results for a major study well field including Cornwall indicates the WMA delineation using the calculated fixed method area to be vastly different with respect to upgradient and downgradient extent of the sand and gravel 5- and 10-year capture areas (WMA).

The comparison of the two delineation methods indicates the calculated fixed-radius method tends to either over- or under-protect the aquifers. WMA delineation utilizing a ground-water model to determine the capture zone better defines the WHPA to sand and gravel wells.

TOOLS FOR LOCAL GROUND-WATER MANAGEMENT

There are many ways to build a County-wide Ground-Water Protection Program (GWPP). Unfortunately, no single method can easily be applied to protecting ground water in the County. The goal of the OCWA is to play a key role in assisting the development and implementation of a County-wide GWPP and to create a uniform program to protect the County's aquifers and ground-water resources. This report allows the local municipalities to select a variety of measures that can address specific water-supply concerns and use them to build an appropriate and effective program. Some approaches tend to be simplified and can be implemented with minimal cost. Other approaches are more complex and require a greater effort and time to apply and consequently are usually more costly. When adequate information and funding are available, the more sophisticated and most "legally defensible" approaches should be applied to the more sensitive and critical aquifers.

Tasks 16 and 17 completed the Wellhead Protection Area (WHPA) delineation of the existing municipal water supplies in the County and recommends WHPA delineation approaches for future supplies to be developed. In addition, sources of contamination have been inventoried and assessed for the Orange County Ground-Water Study, Existing Conditions Report (LBG 1995). However, this task may require an updated survey within the respective municipalities and study WHPAs.

The next step is to determine the types of management controls that may be used to protect the ground-water source. This includes managing land-use activities through regulatory measures such as zoning and other town ordinances (i.e., watershed rules and regulations, rezoning, cluster zoning, etc.). These measures may be used to address the most pressing threats of ground-water contamination; to

provide maximum protection of the most sensitive aquifer areas; and to control specific activities that can pose high risks for contaminating underlying aquifers.

Non-regulatory programs require public commitment by the Town. Public education and participation is the cornerstone of every community's GWPP. Additional programs include water-quality monitoring, household hazardous waste collection, extensions of sewer and water services and acquisition of land in sensitive aquifer areas.

This section will outline a broad range of regulatory measures, local ordinances and non-regulatory programs that may be used in the development of the local GWPP. A comprehensive approach for the protection and management of the ground-water resource is much more effective than the use of individual techniques.

REGULATORY MEASURES

Planning and Zoning

Zoning is one of the most powerful and effective tools local municipalities have to control the land use and protect ground water. The major purpose is to protect the public health and welfare by preventing inappropriate or incompatible land use in areas of critical aquifers including WHPAs.

The Town of Wallkill and Village of Maybrook are examples of local municipalities in Orange County which have enacted local regulations to protect their ground water.

Zoning regulations have been used to segregate different and possibly conflicting activities into different areas of a community. The authority for cities, towns and villages to adopt zoning is provided in the following enabling statutes: a) General City Law, § 20, § 28(a), § 03, and § 01; b) Town Law § 261-267, § 272(a); and c) Village Law Article 7, § 700, § 702, § 704, § 706, § 708, § 710, § 712, and § 722. Many of the state's communities have recognized the limitations of this segregation approach as is relates to resource protection, particularly because state statues provide extremely broad "grandfather" protection to a myriad of uses, structures, and lands. Nonetheless, several tools are available to communities which

may be used to adopt comprehensive land-use controls in WHPAs which are aimed to minimizing the threat of water resource degradation (Horsley, Witten, Hegemman, 1993).

Aquifer/Wellhead Overlay Zone

One of the most effective ways to impose special use restrictions and other protective regulations within a sensitive aquifer area is the overlay zone. The overlay zone delineates the boundaries of aquifer and recharge areas, or WHPAs if known, on the town zoning map and specifies measures for their protection without changing the underlying zoning districts. Specific high-risk uses can be prohibited in the aquifer zone even if they are permitted in the underlying district. Zoning applications within the aquifer zone may be required to meet designated standards, undergo special review, or obtain an aquifer protection permit prior to approval. A model aquifer overlay zone regulation is included in Appendix III, including overlay zones regulations enacted by the Town of Bedford an Somers in Westchester County, New York.

An aquifer overlay zone is most effective where significant ground-water resources exist, risk of ground-water contamination is high, and the boundaries of the sensitive area can be mapped accurately, such as high-yield stratified drift aquifers. Another possible approach is to designate two aquifer protection zones, providing the highest degree of protection and review within the recharge area of public supply wells or aquifers, and imposing less stringent restrictions on areas where private wells are utilized.

Rezoning

In some cases, it may be desirable to change the underlying zoning district. This approach is appropriate when a sensitive aquifer area is already zoned for a highly inappropriate land use, such as industry, and other available areas within the municipal boundaries are located in less sensitive aquifer areas. With an aquifer protection overlay that prohibits high risk uses, land use in an industrial zone may be extremely restricted. Rezoning to a residential, limited commercial, or mixed-use zone can provide land-use opportunities compatible with ground-water protection.

Zoning changes to protect public wells may increase the pressure to locate high-risk uses in more rural areas with private wells. When an aquifer overlay zone is adopted, the municipality may want to rezone other areas to provide the best locations for necessary high risk uses.

Large-Lot Zoning and Buildable Land

Another type of zoning modification that may help to protect ground water is increasing lot sizes to decrease the density of use. In residential areas not served by public water and sewers, large lots (two acres or more) may be appropriate where soil conditions dictate. Other zoning tools that are more helpful include pro-rating lots by excluding areas of unsuitable soils and wetlands from the calculation of minimum lot size, referred to as buildable land criteria. In nonresidential areas, an additional means of controlling density may be to establish a standard for maximum coverage of the lot by impervious surfaces, including parking lots and roads, or to require that a minimum percentage of each lot remaining vegetated (undisturbed) open space.

Cluster Zoning

In many circumstances, cluster zoning is a more conductive than large-lot zoning for ground-water protection. "Cluster zoning" here refers to provisions in the zoning regulations that allow units to be constructed on smaller lots, provided that a portion of the property remains in open space; it does NOT mean increasing overall density permitted on a parcel, although in some cases a small density bonus may be included as an incentive to developers to use cluster design. Unlike zoning for larger lot sizes, cluster zoning does not reduce the number of units that can be built on a given piece of property and, therefore, does not negatively affect land values.

Clustering may make it possible to place construction where it is least likely to impact ground-water resources, and to locate wells and sewage treatment systems in the most suitable areas. Clustering in some cases gives a strong incentive to develop a community rather than individual septic systems and wells. Proper cluster subdivision designs can greatly reduce the length of roads serving a development and the

amount of lawn that may be treated with pesticides and fertilizers, while preserving large areas of natural vegetation that provide the greatest protection to ground water and reduce development costs. Cluster regulations are typically more difficult to administer.

Cluster zoning is generally applicable to subdivision development on fairly large parcels of land. It may be desirable to make clustering mandatory in certain areas, unless waived by the zoning commission, or to include incentives to design cluster rather than conventional subdivisions. Most important, if cluster zoning is intended as a method of protecting water quality, that objective should be stated in the regulation, and site plans should be reviewed critically to determine whether adequate protection measures are included in the proposal.

Design and Performance Standards

Zoning regulations can incorporate specific standards to prevent contamination of ground water. These may specify structural measures to be incorporated in the design of a facility, such as requiring that chemical storage areas be roofed and enclosed to contain leaked or spilled material. Alternatively, they may specify required performance criteria, such as requiring a system capable of preventing ground and surface-water contamination. A combination of these standards usually is the best approach. Appendix IV includes an example of recommended design and performance standards for aquifer protection.

Permitting Procedures

The procedure for granting zoning permits in aquifer areas or town wide can make ground-water protection a decision criterion. In sensitive areas, proposed uses could be reviewed on a case-by-case basis to evaluate how it may affect ground water.

Some uses are typically subject to site plan review by the planning and zoning board to verify that they meet specific requirements. This type of review is appropriate when the review criteria can be stated in terms of very specific design standards.

When the planning and zoning board must exercise a greater degree of judgement in determining whether a specific use is appropriate for a particular location, a special permit could be required. The special permit procedure gives the planning board more discretion in deciding whether to grant a permit based on whether it meets stated zoning objectives and criteria.

Zoning permits are ordinarily required for a newly-proposed development, and subsequently provides limited control over changes of use in a building when it is occupied. Some towns have addressed this problem by requiring change of use permits within aquifer areas.

Appendix V includes an example of special permit requirements for aquifer protection.

Subdivision Regulations

These regulations provide for the manner in which land can be divided for building purposes. Ground-water protection can be included in the public health and environmental provisions of these regulations including measures for adequate sewage disposal, adequate and safe water supply, stormwater management and open space dedication for sensitive areas.

Transfer of Development Rights

Some towns have zoning provisions that permit transfer of development rights (TDR). This allows developers to develop noncritical lands at higher densities by transferring permitted development rights from more sensitive areas, which remain undeveloped and become permanently protected. The system can be very flexible for uses the landowner and the easement holder agree upon. Administration can be cumbersome. Suffolk County has utilized TDR successfully to protect sensitive recharge areas for Long Island's sole source aquifer.

Prohibition of Various Land Uses

Many municipalities have adopted certain zoning prohibitions for various land uses from portions of the municipality; or completely not allowed within the municipal boundaries. In most cases, the rationale

behind such prohibition is not related to protecting sensitive aquifers or WHPAs, however, it can be a useful tool. The "not in my backyard" philosophy has generated prohibition of land uses such as gasoline stations, junk yards, landfills and sewage treatment plants, etc. These can also include prohibitions of the use, storage and disposal of toxic and hazardous materials.

Growth Controls/Timing

Growth controls are techniques that are used to slow or guide a community's growth, competitive with its ability to "support" growth. The term "support" has been broadly defined, and can include issues ranging from a city or town's physical and financial ability to provide public facilities (roads, water, sewer, schools and public safety) to its ability to retain its once rural, historic character. Growth controls vary in their application and have included outright moratoria to limitations on numbers of building permits issued in any 12-month period. One of the most widely referenced examples of growth control is the 1969 Ramapo, New York, ordinance that limited growth and development in the community to a rate commensurate with the town's ability to provide services to new and existing residents (Horsley and Witten, 1993). In Orange County, the ongoing moratoria for any additional hookups to the Orange County Sewer District No. 1 is due to the facility's inability to handle additional sewage flows.

Environmental Impact Assessment

Developers of proposed subdivisions which exceed a minimum lot size (i.e., 10 lots) may be required by the municipality to prepare an environmental impact assessment (EIA) report. The applicant would be required to address standard issues including water resource protection goals. Proposed subdivision within WHPAs would be required to conduct a more detailed evaluation of possible impacts to ground-water supply source(s) within the WHPAs (Horsley and Witten, 1993).

Critical Aquifer Designation

Critical aquifers should be inventoried on both a County and local level. Critical aquifer designation should include aquifers highly susceptible to contamination, sensitive recharge areas, sole-source aquifers for regional areas and high-yield aquifers, or a combination of the above. A town may choose to form the efforts on a local level in these areas. The zoning office, fire marshal, building inspector and water department personnel could concentrate their inspections and oversight of the critical aquifer area(s). The County or Town could also jointly develop enforcement efforts in such areas. Targeting critical areas will be particularly valuable when Town-wide ordinances aimed at ground-water protection have been enacted. Time, lack of personnel and funding do not usually allow for widespread, vigorous town-wide enforcement and inspection of large-high risk aquifers; consequently, the town may need to concentrate on specific areas as a necessary part of an effective WHPP.

State Environmental Quality Review

State Environmental Quality Review (SEQR) is a required review process for all levels of government within the state for considering the environmental impact of various decisions early in the planning stages. It applies to actions which are undertaken, funded and/or approved by State, regional and local government agencies.

A particular feature of SEQR which may have use in wellhead protection and ground-water management is the provision for designation of Critical Environmental Areas (CEAs). Any unlisted action proposed in a CEA must be reviewed as a Type I action under SEQR. This means that any state or local agency action within or contiguous to the area will be more likely to be considered environmentally significant and requires the preparation of a full environmental assessment form and coordinated review. This provision of SEQR has potential application in areas with sensitive ground-water resources, especially WHPAs. The Division of Regulatory Affairs in the NYSDEC oversees the SEQR program and provides training and assistance concerning SEQR procedures (NYSDEC, 1990).

Watershed Rules and Regulations

Watershed rules and regulations (WRR) are promulgated by the NYSDOH upon initiation by local water purveyors to protect drinking water supplies. The law requires the water purveyors to develop the proposed WRR to be adopted by the Commissioner of Health. Orange County Department of Health can provide technical assistance and also reviews the proposed WRR prior to the state promulgation by the NYSDOH. The state regulations require the regulation of land use must be segregated into three distant land areas which may impact the well. The NYSDOH requires minimum standards for protection be included in the development of the WRR. This can be one of the most powerful tools to protect ground-water supplies. WRR must be consistent with other state and local laws and not contradict existing NYSDEC programs. WRR requires significant interest, cooperation and must ultimately be adoption by the local municipality.

Modeling watershed rules and regulations similar to programs approved by the regulatory agencies (NYSDOH and NYSDEC) would enhance their acceptance and would result in a more defensible program. LBG reviewed the Village of Millbrook and Schnectady Intermunicipal WRR (LBG, 1995). At least two municipalities in Orange County, Town of Wallkill and Village of Maybrook have adopted WRR, however, the NYSDOH has not promulgated the WRR to date. Kevin Roberts of the NYSDEC recommends WRR to be developed by a water surveyor should be modeled from the Village of Millbrook's WRR (Roberts, 1998). Appendix VI includes the model WRRs promulgated by the Village of Millbrook.

At the present time, due to budget restrictions, the NYSDOH is not reviewing or promulgating any proposed WRR. It is hoped that this will be resolved in the near future.

Local Ordinances

Planning and zoning controls can effectively reduce ground-water risks from newly-proposed facilities, however, other methods are needed to deal with existing facilities and uses. Local ordinances can regulate certain uses town-wide, not just in specific ground-water protection zones. This can be particularly useful in municipalities where much of the water source is developed from bedrock wells.

Hazardous Materials

New York State regulates approximately 1,000 different hazardous substances. Any listed hazardous substance that is stored aboveground in a tank with a total storage capacity of 185 gallons or greater or any listed hazardous substance that is stored underground in a tank with any storage capacity, is regulated by NYSDEC under 6 NYCRR Part 595-597 for chemical bulk storage.

NYSDEC chemical bulk regulations do not cover all types of tanks or uses which include:

- Chemical process tanks
- Assembly line tanks and accessory equipment that is greater than 90 percent above the ground surface
- Non-stationary tank used to store 2,200 pounds or more of hazardous substance for a period of 90 consecutive days or more
- Septic tank, storm water or wastewater collection system
- Capacitators or transformers
- Any aboveground storage tank on an operating farm used solely to store or contain a hazardous substance which will be used for agricultural purposes on such a farm

A local hazardous materials ordinance can be an important component of local ground-water protection programs. Present state and federal regulations do not completely control the storage or handling of hazardous materials as virgin products, and controls over low-volume generators of hazardous wastes are limited. Because of the great number of facilities that use hazardous materials, state agency regulation of all of these facilities is not feasible or possible.

Local regulations, however, can provide a substantial degree of protection through a hazardous materials ordinance, either town-wide or restricted to specific aquifer areas (WHPAs). The ordinance should include a definition of the hazardous materials being regulated, generally by citing federal or state definitions of hazardous materials. The ordinance may specify storage and spill containment requirements for hazardous materials meeting state and federal hazardous waste storage standards. The ordinance can

also require that facilities use appropriate Best Management Practices (BMPs) in the handling and use of hazardous materials. Various regulatory agencies and industries have developed specific BMPs for a wide range of facilities, from manufacturing to agricultural operations, including many small commercial activities that involve chemical usage. BMPs are discussed earlier in this section of this report.

Enforcement mechanisms may include a registration requirement and the submission of "as-built" plans. Education and inspections are essential components of a successful hazardous materials ordinance.

An example Hazardous Materials Storage Model Ordinance for the City of Waterbury, Connecticut is provided in Appendix VII.

Underground/Aboveground Storage Tanks

Underground storage of fuels and hazardous materials represent a potential threat to ground-water quality. Well contamination problems have resulted from leaks in underground tanks and transmission lines. Federal and state regulations govern the design and monitoring requirements of large commercial underground fuel tanks. In addition, petroleum bulk storage is regulated by NYSDEC under 6 NYCRR Part 612-614 and applies to all facilities with above and underground petroleum storage tanks with a combined storage capacity over 1,100 gallons but less than 400,000 gallons. Under Part 612, owners must register petroleum storage facilities with the DEC, notify the DEC of substantial modifications to a facility, re-register when facility ownership changes and renew registration every five years.

NYSDEC petroleum bulk storage regulations only apply to liquid non-waste petroleum based oils suitable for use as a fuel to produce heat or energy or as a motor lubricant. This includes gasoline, heating oil, heavy residual fuel oils, kerosene or reprocessed waste oil used as a fuel or lubricant. With the exception of tanks used strictly for heating oil, the regulations are applicable to a property storing different types of petroleum liquid if the combined storage capacity of the individual tanks is greater than 1,100 gallons. For bulk storage of heating oil, only tanks with a storage capacity of 1,100 gallons or greater are subject to the regulations. Therefore, multiple tanks that are less than 1,100 gallons that are used for heating oil storage are not regulated by the State.

NYSDEC petroleum bulk storage regulations do not cover all types of tanks or uses which include:

- Oil production facilities
- Crude oils, cutting oils and processing oils
- Some chemical liquids not classified as oil or petroleum (some are regulated under the federal CERCLA).
- Heating oil storage less than 1,100 gallons stored under or aboveground

In sensitive aquifers, which include watercourses or wetlands, reservoirs, reservoir stems or controlled lakes, it is generally encouraged to prohibit the installation of any new underground storage tanks, except for replacing existing tanks that would present a fire hazard if located above ground. The fire marshal or NYSDEC Regional Office should be involved in any modifications of fuel storage requirements. Underground and aboveground storage tanks can be regulated by setting standards and requiring a registration and monitoring program comparable to the state underground/aboveground fuel regulations for tanks with a storage capacity greater than 1,100 gallons and requiring secondary containment for all aboveground tanks. A registration requirement could provide the town or village with an inventory of the type of materials being stored, where they are buried, and the types and ages of the tanks.

Septic System and Maintenance

The maintenance of onsite septic systems is frequently overlooked. The result is typically an overloading of solids moving to the leaching facility, resulting in clogging. When this occurs, the system needs to be rehabilitated. Counties and municipalities may adopt regulations requiring pumping of septic systems periodically (typically, every two to five years) or upon real estate transfer.

In addition, local municipalities should prohibit the discharge of salt brine solution from water softeners into subsurface sewage system. The Connecticut Department of Health (CTDOH) regulations prohibit this. Salt brine concentrations typically build up in ground water and contaminate wells.

Septic System Cleaner Bans

Use of septic system cleaners are typically used to mitigate improper maintenance of septic systems. When septic systems fail, strong acids or organic solvents are often used to clear failed systems. These chemicals are ground-water contaminants and can degrade water quality in downgradient wells. Septic system cleaners are prohibited on Long Island, New York.

Wetland Ordinance/Regulations

Wetlands are a critical environmental component in the protection and recharge of surface water and ground water. Wetlands absorb and contain surface-water runoff and remove significant quantities of pollutants through a continuation of physical, chemical and biological processes. Wetlands also pay a significant role in recharging underlying sand and gravel or bedrock aquifers. Protection of wetlands is a significant step in protecting ground water. The municipality should inventory state and federal wetlands and ensure enforcement of state and federal wetland regulations to their fullest. Municipalities should consider adopting local wetland ordinances to protect smaller wetlands not regulated by state regulations.

NON-REGULATORY PROGRAMS

Regulatory techniques to protect ground-water resources within a Town or Village require public support and awareness. The best tools for this include public education associated with such programs as water-quality monitoring, household hazardous waste collection, modifications of salt storage and use practices, extensions of sewer and water service, acquisition of land in sensitive aquifer areas, land acquisition, land donation, conservation easements and contingency planning.

Public Education and Participation

Public education is the cornerstone of every community ground-water protection program (GWPP). It plays a key role in developing a GWPP and is helpful as a catalyst to bring about the adoption

of needed regulations, and is necessary to generate understanding of new regulatory requirements to protect ground water. It will also assist in promoting voluntary action to protect ground water in the form of many activities and land uses throughout Orange County that cannot be regulated effectively.

The planning process affords a incomparable opportunity for community education. After the plan is adopted, you can keep this momentum going as you build your ground-water protection program, including the development of additional regulations and generate funding and support for non-regulatory programs.

Ground-water issues are often complex and far-reaching. In building a ground-water protection program, there is a great need to communicate a great deal of information to the community. Some of the issues to cover in public educational activities include:

- a basic understanding of the community's ground-water resources and how they can be contaminated;
- proper handling, use, and disposal of chemicals, including household hazardous wastes;
- underground fuel storage;
- alternative to toxic chemicals used by households, farms and businesses;
- proper septic system use and maintenance;
- water conservation measures;
- the content and rationale of proposed or newly-adopted ground-water protection regulations;
- posting signs to identify sensitive aquifer or WHPAs; and
- protection of private wells.

There are many avenues for public education. Media coverage is essential and should include inviting reporters to planning meetings; write feature stories on the community's water supply for the local paper, distribute press release about milestones in your ground-water protection program. Public meetings

and educational programs are also invaluable, such as special-focus workshops for small businesses or farmers on handling of toxic chemicals.

Regular ongoing communications are critical. Venues for communication can include setting up an exhibit or distribute information on ground-water protection in the library or town/village halls; posting road signs to inform people when they are entering sensitive aquifer areas (WHPAs); or do a town-wide mailing to distribute information of special importance. If the Town/Village is served by a public water utility, distribute information on ground-water protection as inserts in water bills. Fact sheets for educational material for aquifer protection which can be utilized to distribute information or included as inserts in water/sewer bills are included in Appendix VIII and are as follows:

- septic system;
- underground heating-oil storage tank;
- well protection tips; and
- pollution prevention tips for commercial businesses

An ongoing educational program is available through the OCWA for schools on ground-water resources, protection and water conservation. This affords knowledge and awareness at a young age in upcoming generations and is a good opportunity for children to bring home literature and ideals that can influence the whole household unit. For more information on the school education program, contact the OCWA. Public education should be a continuing priority in building your ground-water management program: every plan, regulation, ordinance or publicly-funded program needing community support is a further opportunity for community learning.

Some of these programs incur minimal cost and effort to implement, and can be the most effective way to achieve key ground-water protection goals. Undertaking such programs is a strong and clear signal that the community is committed to protection of this water resource. They offer an opportunity to generate support for water protection efforts and help to convince landowners in sensitive aquifer areas that the community is committed and willing to share the financial burden of protection. A demonstrated

commitment to ground-water protection can be an individual town's strengths in seeking funding through state and federal programs. Cleaning up an aquifer that has become contaminated is likely to incur a much greater cost for the community.

The OCWA and eight municipalities in Orange County are members of the Ground-Water Foundation and have been recognized as Ground-Water Guardian Communities by the Foundation. The Ground-Water Guardian, a program of the Ground-Water Foundation, is designed to encourage citizen involvement in ground-water protection projects in their communities. Ground-Water Guardian activities range from education and awareness programs to full implementation of wellhead protection plans and local land-use ordinances. Each community's Ground-Water Guardian team determines what projects are most needed in their area and the Foundation supports these efforts. The Ground-Water Foundation serves as the catalyst and organizer, but the participating communities are required to develop and implement their own program, resulting in life-long benefits (OCWA, 1998).

Water-Quality Monitoring

Water-quality monitoring is an approach which can determine if the water quality in some areas of the town/village is contaminated or being impacted from various land uses. Local municipalities can develop a monitoring well network and sampling program to identify problem areas. Monitoring wells can be installed between public water-supply wells and potential contamination sources to effectively monitor ground-water and contamination migrating towards the ground-water supply sources. In addition, land owners with land uses which have the potential to impact water quality can be required to install monitoring wells on their property to sample these wells regularly to determine potential ground-water quality impact. Such monitoring programs are implemented in several communities in Orange County including the Village of Harriman.

Taking an active role in monitoring and inspecting land uses which present a potential threat to impacting ground water is probably a more useful tool and would probably incur less cost than the implementation of a water-quality monitoring program. Both regulatory and non-regulatory programs

should be developed for inspecting and monitoring high risk activities which make these businesses become more aware of their activities which can possibly impact ground water. BMP's, discussed in more detail in a latter section, should be utilized to educate and significantly reduce the potential of contaminated ground water. WHPAs should be included in regular monitoring and inspections, as required.

Household Hazardous Materials

Many household activities including cleaning, maintenance, furniture finishing and lawn care involve the use of hazardous materials. Waste motor oil, gasoline, pesticides, fertilizers, paint strippers and thinners, and household cleaning agents/solvents are the most common hazardous products used in homes in every community. Surplus or old products poured into drains and into septic systems or dumped "out back" or in storm drains can cause contamination of ground water. To help avoid these scenarios, communities in Orange County have implemented hazardous waste collection several times a year. The programs should be implemented frequently enough and provide proper and adequate notice so these programs can be utilized. For more information regarding existing household hazardous waste collection, contact your local Town/Village clerk or the Environmental Facilities and Service Department for the County.

In addition to collection, residences and homeowners should be educated to avoid the use of hazardous products whenever possible, to store them safely, follow proper application/use, and dispose of the waste safely.

Agriculture

If agriculture is a significant part of the land use in a sensitive aquifer or WHPA, the GWPP should include the development of a program covering agricultural practices. The GWPP should incorporate BMPs for use of pesticides and other chemicals and storage of manure and fertilizers. Agricultural operations could prepare a management plan to minimize potential threats to ground water. A wide range of BMPs are available for agriculture including information available through the Cornell's cooperative extension.

Salt Storage and Use

Municipal salt storage and use are a significant but controllable source of ground-water pollution. The implementation of BMPs consistent with state guidelines can reduce the likelihood of problems. Storage of road salt and salt-sand mixtures in sensitive aquifer areas and WHPAs should be avoided. A program of reduced salt use or substitution of alternative de-icing agents in these areas should be considered. As part of the town's education efforts, roadside signs can be used at the boundaries of aquifer protection areas to inform motorists that minimum road salt is used in these areas.

Sewer and Water Service

To solve existing or potential water-quality problems or to meet planning goals, a municipality may be required to provide sanitary sewer or public water service. In areas where there is a ground-water contamination problem, or in areas with low-yielding wells, connection to a public water supply or developing a public water-supply source outside the impacted area is usually the most economical approach compared to the option of treating the contaminated sources. Public sewers can help reduce some of the surface and ground-water risks from existing and proposed industrial and commercial uses and high-density residential development. Public sewers, however, will not remove the threats such as chemical storage, handling and improper disposal. Consequently, intensifying land-use type/density can ultimately degrade regional water quality.

Municipalities should prepare water-supply sources and service area maps to indicate existing and future sources of public drinking water that have been identified, including information available in the GWRS. The map will show areas in the municipalities that are dependent on private wells and will likely remain reliant on this type of supply for the foreseeable future. The maps should also include surface-water supplies, if utilized. The actual area the municipality presently serves by public water supply and any future areas proposed for service should also be mapped. The map should include location/size of distribution lines, fire hydrants, shutoff valves and storage tank locations. Locations that do not fall within the existing and proposed service area will be dependent on privately-owned community water-supply systems or

individual wells. Additional maps should be prepared to evaluate the degree of risk from land uses in both existing and future sewer service areas.

Land Acquisition, Land Donation, and Conservation Easements

Land acquisitions, land donations, and conservation easements are all management techniques that may be more efficiently conducted by nonprofit land conservation organization than by municipalities. These organizations are frequently created as land trusts for particular towns, counties or watersheds. These organizations are tax-exempt, not-for-profit entities. Donations and bargain sales to the conservation trust are usually considered charitable donations and may have positive federal and state tax consequences for the donors. These organizations can provide expertise in: arranging land transfers; drafting conservation easement; explaining advantages and disadvantages of real estate transfer to both land purchasers and sellers; coordinating with and soliciting aid from various foundations; and, in some cases, providing funds for acquisition or to serve as land owners and stewards. Some of these organizations can serve only as temporary landowners while others may hold lands permanently (Witten et al., 1995).

Land Acquisition - Land acquisition programs may focus on land within WHPAs. There are four general ways that a community or land trust can purchase property outright (Witten et al., 1995).

- Purchase at fair-market value. The buyer (community or conservation group) pays the seller the fair-market value for the property.
- Bargain purchase. The purchase of property below fair-market value by a conservation organization or municipality. The difference between fair-market value and the reduced price may qualify as a charitable deduction from income taxes for the seller.
- Installment purchase. The property is purchased over a period of years. Installment purchases allow the buyer to spread the purchase costs over a number of years.

- Purchase with a reserved life estate. The property is transferred to the buyer upon the death of the individual land owner. This option allows landowners to sell now but to continue to sell their property during their lifetime and/or the lifetimes of other members of their immediate family. Because of the continued use, the purchase price may be lower than fair-market value.

An innovative technique for land acquisition is the land bank. Land banks receive a percentage of fees generated by real estate transfers and use this money to fund land acquisition. Land banks are usually created by the state legislature and may apply to specific regions or statewide.

A more traditional (although sometimes controversial) form of land acquisition is the use of eminent domain powers. If a community can demonstrate the value of a given parcel for the public good, it can physically take title to that parcel. Compensation must be paid to the landowner. Since public money is spent to compensate the previous owner, public approval is required for eminent domain action. Eminent domain takings are frequently contested by the owner of the land being claimed. Owners usually argue that the land being claimed is worth more than is being offered by the community. Eminent domain takings should not be confused with a regulatory takings claim, in which a land owner challenges a jurisdiction that a zoning regulation precludes all uses of the land (i.e., the land has effectively been taken without compensation) (Witten et al., 1995).

Land donation - Land owners are often in the position of being able to donate a piece of land either to the community or a nonprofit organization, such as a local land trust. If so, they will find that donation of the land for preservation costs provides a variety of tax savings.

The initial benefit to the person donating the land comes in the elimination of estate or capital gains taxes. In addition, real estate taxes and insurance and maintenance costs are avoided. The entire value of the donation can be deducted, over time, from federal and, in many cases, state income tax obligations. Donations of land within coastal aquifer areas or WHPAs can be a particularly important technique for resource protection (Witten et al., 1995).

Conservation easements - Easements can effectively assist a community in protecting land from development by restricting all or a portion of the property to open space or limited development uses. The granting of a conservation easement does not involve the transfer of ownership of the land; instead, it means giving up certain development rights of the property. For example, a conservation easement may restrict the number of houses to be built upon a parcel; restrict the types of development allowed on the parcel; or specify that portions of the parcel remain undeveloped in perpetuity (Witten et al., 1995).

Establishing Contingency Plans

State regulations require community water systems to prepare and maintain a contingency plan for providing safe drinking water during emergency conditions. The plans should include difference levels of response for chemical releases within WHPAs, depending on the risk to the water supply and the magnitude of the release. To prevent disruption of service, the supplier is required to have previously identified both short- and long-term alternative sources of water supply.

Best Management Practices and Guidance

To supplement regulatory oversight, best management documents and other types of guidance may be development and distributed to specifically targeted types of facilities or operations, concerning risk reduction and other forms of protection against ground-water contamination. These approaches may require follow-through, redistribution special training to maintain or enhance their effectiveness (NYSDEC, 1990).

Building a Successful Wellhead Protection Plan

A successful WHPP will utilize a combination of the management tools outlined above. Each municipality must customize its GWPP which best protects its ground-water resource and evaluates the need to do so. An effective program will require consistent enforcement of regulations enacted and periodic review and revisions to met the goals of the program. This would include the protection of new

source and possible changes to the protection area delineated as regulations change and additional data becomes available to better understand the aquifer boundaries and flow conditions.

The goal of the OCWA is to create a reasonable management approach and uniform programs adopted by the local municipalities to protect the County's aquifers and ground-water resources.

CONCLUSIONS AND RECOMMENDATIONS

Delineation of WHPA's

Following a review of the hydrogeologic conditions in Orange County and review of available WHPA delineation options, LBG recommends the approaches presented in table 1 and conducted in Tasks 16 and 17. It is important to understand the hydrogeologic conditions, areal extent of the aquifer recharge areas, zoning and land use, and sensitivity of each aquifer to apply the appropriate WHPA delineation method and additional WHPA strategies.

Tasks 16 and 17 were designed to provide the delineation of WHPAs for public water supplies in the County to be utilized by the municipality to develop a wellhead protection program for these supplies. This study is an illustrated example of an umbrella WHPA including WHPA delineation. The local municipalities which are supplied water from the Study well fields should consider adoption of the WHPAs and developing additional strategies (i.e., aquifer overlay districts and educational programs). Water supplies and aquifers of significant regional importance (i.e., Wallkill River aquifer) should expand on existing water-supply protection programs including more sophisticated WHPA delineation approaches to better define recharge areas (i.e., computer modeling). All public water supplies should conduct at least baseline WHPA delineation to better define likely recharge areas to wellheads. The recommended baseline approach tends to simplify many hydrologic factors and, consequently, may tend to over- or under-protect well recharge areas. When adequate information and funding are available, the more sophisticated approach (e.g., computer modeling) should be implemented to better define the recharge area for the more sensitive and critical aquifers.

Potential Contamination Sources

To protect wellhead areas, a Wellhead Protection Plan (WHPP) must identify all potential sources of contamination which contaminates ground water. Presently, there is no one practical approach that is suitable for meeting this general goal. Each WHPP must develop its own rational approach. Knowledge of contamination properties is essential for understanding the level of risk to ground-water supplies from different types of contaminants and the adequacy of WHPA delineation to the wellhead (USEPA, 1987).

The contaminants of most concern in the development of a WHPP are classified as inorganic and organic chemical compounds and elements, bacteria and viruses. It is important to identify the level of health risks and understand the nature and mobility of contaminants in assessing their significance in WHPA delineation.

Common chemicals which cause ground-water contamination are listed on table 5. The sources range from large-scale commercial and industrial land uses to the use of household hazardous materials. The land-use category and associated chemicals and compounds which can become ground-water contaminants are shown on table 6. Table 7 can be used as a preliminary guide to evaluate land uses of concern and associated risks. In addition, table 7 can accurately indicate whether the use should be banned or regulated with WHPAs.

The risk to ground water associated with various land use categories is located in Appendix I. In addition, an inspection guide for inspecting facilities which may present a risk to ground water in sensitive aquifer areas WHPAs is located in Appendix II.

Existing and potential contamination sources within the WHPAs of a well field presents the most direct risk to contaminate ground-water supplies.

Uniform Wellhead Protection Programs and Strategies

The OCWA and Orange County Department of Health should play key roles in assisting in the development and implementation of county-wide WHPAs. The New York State Wellhead

Protection Program (NYSDEC, 1990) recommends county agencies assist in the development and implementation of county-wide Wellhead Protection Programs and create uniform programs to protect a county's aquifers and ground-water resources. Considering that a majority of the significant aquifers in the study region cover a large areal extent extending across two or more municipal boundaries, and some municipal public water supplies are developed outside the political boundaries in which the water is supplied, the County should develop uniform WHPA delineation approaches, regulations and administrative standards to protect the aquifers in the region.

Comparison of WHPA Delineation Methods Utilizing Ground-Water Model Versus Calculated Fixed Radius Method

The comparison of the two delineation methods for Tasks 16 and 17 indicates the calculated fixed-radius method tends to over- and under-protect the aquifers (i.e., Village of Chester and Cornwall). WMA delineation utilizing a ground-water model to determine the capture zone better defines the wellhead protection area to sand and gravel wells.

Refinement of WHPA Delineation

For a more refined delineation of the 5- and 10-year capture areas, a comprehensive study at each well field is recommended. This would include obtaining stream gage data and current water-level data that would provide the current water-table orientation. For most well fields, installation of additional regional monitor wells would be recommended to more accurately define bedrock elevation, water-table orientation, water-table gradient and extent of saturated unconsolidated materials. The collection of additional data would allow a more precise delineation of the capture areas.

Program Implementation

It is a fact a majority of the water supply in Orange County is developed from ground water. To protect a preserve clean, safe drinking water, the residences and businesses in the County must become more aware of the land-use activities which can effect ground-water sources. The municipalities in Orange County must join the OCWA and develop a GWPP that assures protection of existing and future ground-water supply sources in the respective communities. Although the OCWA has developed a model GWPP is must be tailored to protect the specific ground-water resource in each municipality and meet the community's needs and goals. The municipalities should evaluate the existing information available in the GWRS and GWPP developed by the OCWA and create a specific management plan to protect their ground-water resources.

This guidance manual is provided to assist municipalities in implementing a program to protect ground-water supplies. The program may follow one of several models. The approaches include regulatory measures (i.e., watershed rules and regulations), local zoning ordinance (i.e., aquifer overlay zone) and several non-regulatory approaches (i.e., public education, land acquisition). The local municipalities must designate a local office or develop a committee to take the lead in initiating the development of a GWPP.

It should be understood that not all protection mechanisms will be suitable for use at WHPAs and sensitive aquifer areas. The most effective GWPP developed by the municipalities will utilize a combination

of both regulatory and non-regulatory measures. Considering the diverse hydrogeologic setting and development in the County, no single protection strategy will appropriately protect a ground-water resource. Thus, it is impossible for the OCWA to provide a step-by-step instruction which would be uniformly applicable in every community. The guidance document provides a framework necessary for the development of a successful GWPP.

A local GWPP is formulated by initiating a planning process and developing appropriate regulatory and non-regulatory strategies and phasing in the selected strategies to be implemented. The planning process should continually evaluate the effectiveness of the proposed program. Key considerations in developing a program is the following:

- programs designed without an appreciation of the need and understanding of the technical approaches to protect ground water will likely be difficult to adopt and implemented.
- financial capability to administer a program over the long-term.
- enforcement capabilities of regulations and/or ordinance enacted.
- success will require a program to build and sustain support from elected officials and the public.
- finally, programs are likely to be more effective if designed and implementation are viewed as an evolutionary process in which the program is revised as new information and strategies become available and political conditions change.

The OCWA should continue its role in the GWPP by establishing a partnership with a strong interest in developing a GWPP on a local level. Kevin Roberts from the Bureau of Watershed Management, Division of Water, NYSDOH advocates the partnership approach to assist the local municipalities to identify alternatives and to better understand the practical aspects of implementing various management options, whether regulatory or non-regulatory. The OCWA should continue to be an excellent resource, a sounding board, a review panel and, very importantly, a part of the outreach to assist in developing uniform WHPP in the County (Roberts, 1996).

Prior to finalizing this draft report, LBG recommends the WHPP be reviewed with the appropriate regulatory personnel at the NYSDOH and NYSDEC for endorsement. In addition, address the issue of the municipalities legal authority to regulate certain activities and land use possibly pre-empted by state law (i.e., adoption of aquifer/wellhead overlay district).

LEGGETTE, BRASHEARS & GRAHAM, INC.

Thomas P. Cusack, CPG
Associate

Reviewed by:

R. G. Slayback, CPG
Chairman

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January 22, 1999
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MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

AQUIFER PROTECTION OVERLAY ZONE

Following is a format for developing the most common ground-water protection regulation: an aquifer protection overlay zone. This is a "performance" zone used as an "overlay" in which present zoning remains in place but certain uses are restricted or controlled based on their potential impacts to the aquifer. The zoning district boundaries are related to the hydrogeologic characteristics of the aquifer (aquifer area, recharge areas, well field, etc.) you want to protect. This model has been designed for a typical stratified drift aquifer which is or has potential to be a public water-supply source.

NOTE: The terms and mechanisms discussed in the regulation are based on typical zoning tools. These tools include: prohibiting or restricting certain land uses; a special permit or special exception for uses requiring a more detailed review; conditionally allowing uses subject to specific conditions.

NOTE: The model has been written as a guide to develop a specific local regulation. It is recommended each town have their regulation reviewed by their local counsel prior to adoption.

The main components of the aquifer protection zone regulation are:

- Title and Purpose
- Authority
- Definitions
- Applicability
- Designation of the Zone
- Use Regulations (permitted, prohibited, special or conditional)
- Permit Requirements
- Performance or Design Standards

PURPOSE, STATEMENT OF INTENT

The purpose of this regulation is to protect and preserve ground-water quality within stratified-drift aquifers which are existing or potential public drinking water supplies. These ground-water resources have been shown to be easily contaminated by many land uses and activities and it is necessary that specific controls over land use be exercised within these areas to protect ground-water quality.

NOTE: Specific aquifers, aquifer areas or well fields areas may be identified.

AUTHORITY

[INSERT]

DEFINITIONS

NOTE: below is a list of key terms which may need to be defined. Other specific definitions may be needed.

Aquifer

A geological unit capable of yielding usable amounts of water to wells.

Ground Water

Water below the land surface, in the saturated zone.

Hazardous Material

Any virgin or waste substance which because of its physical, chemical or infectious characteristics poses an actual or potential hazard to human health or drinking water quality when improperly managed. Generally the material has the following characteristics: toxic, flammable, corrosive or reactive. (Included are substances, wastes and chemicals listed as hazardous under the following laws or regulations-hazardous material as defined in 49 CFI 171.8 and includes each material listed in 49 CFR 172.101, any hazardous substance as defined in 40 CFR 302.4 and listed therein at table 302.4, or any hazardous waste as defined in Section 22a-115 of the general statues. Excluded are those which do not pose a threat to water quality.

Recharge Area (for stratified-drift aquifers)

The area overlying the aquifer and adjacent stratified drift and till/bedrock areas in which ground water flows directly into the aquifer.

NOTE: till and bedrock areas which provide direct ground water inflow to stratified drift areas are sometimes referred to as secondary recharge areas.

Well Field

An area containing one or more pumping water supply wells in close proximity.

Well Field Recharge Area

The area from which ground water flows directly to the well field.

Stratified Drift

Predominantly sorted sediment deposited by glacial meltwater consisting of gravel, sand, silt or clay in layers of similar grain size.

APPLICABILITY

The provisions of these regulations shall apply to all land within the area designated on the zoning map. This zone is established as an overlay and these regulations shall be in addition to the underlying zone or other underlying regulations. In the case of conflict, the most restrictive regulation shall apply.

DESIGNATION OF THE ZONE

The aquifer protection zone consists of the stratified-drift aquifer and its recharge areas. Where the boundary of the zone is in doubt or dispute, the commission may amend the boundary. The burden of proof for amendment shall be on the applicant or petitioner questioning the boundary to demonstrate why and where the boundary should be amended. A petition for amendment shall be in the form of maps and information sufficient to justify the change based on the zone boundary as defined and shall be in accordance with procedures for amending the zoning map.

NOTE: In some cases, specific hydrogeologic information or mapping may be available which define existing or proposed well fields and their recharge areas. Where this information is complete for an aquifer or portion of it, it can be used to designate the protection area boundary. This will more accurately define the actual portion of the aquifer that supplies water to a well and is called a wellhead protection area.

USE REGULATIONS

Uses which are permitted in the existing underlying zones are permitted except as prohibited or restricted by the following provisions:

NOTE: Appendix ___ lists land uses and activities of concern to ground-water quality and notes the recommended control. This should be used, based on the existing underlying zone, to complete the use categories below. High risk uses should be prohibited, other commercial and industrial uses allowed only

after a special permit review and approval, and other uses may be allowed conditionally. It may be more desirable to use a table of permitted uses, if one exists in the town regulations, to indicate specific uses allowed as opposed to a long list of those prohibited. If not, a table similar to that below could be used to list specific uses. All uses, except one or two family residential, can be subject to Site Plan Approval to allow the local commission or official to determine conformity of the proposed uses with the regulations, especially the performance and design standards.

PROHIBITED USES

The following uses are prohibited:

NOTE: The following general use category(a) should precede specific listed uses.

a. Any use in which the manufacture, use, handling, storage, or disposal of hazardous materials is a principal activity.

b. Gasoline service stations

c. Dry cleaners

d. . . . .

SPECIAL PERMIT USES

The following uses are permitted subject to approval of a Special Permit:

NOTE: Some uses are a moderate risk and need a more detailed review, for example.

a. Light industrial, assembly or fabrication only

b. Lumber, hardware stores

c. . . . . .

CONDITIONAL USES

The following uses are permitted subject to the conditions listed:

NOTE: Some uses may be appropriate if certain measures or conditions are in place, such as connection to public sewers. For example the following uses are allowed only if connected to public sewers.

a. Medical, dental offices

b. Commercial laundries

c. . . . .

SPECIAL PERMIT REQUIREMENTS

NOTE: See Appendix _____ Special Permit Requirements.

PERFORMANCE AND DESIGN STANDARDS

NOTE: See Supplement ____ Performance and Design Standards. The extent to which you will need these will depend on what you choose to prohibit versus allow.

NON-CONFORMING USES

All pre-existing uses which do not conform to these regulations upon the effective adoption date shall be subject to review by the zoning agent and allowed only if found to be in compliance with the intent of these regulations.

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

ASSESSING LAND-USE RISKS

GUIDELINES TO INVENTORY LAND-USE RISKS

An inventory of existing land use is a good way to identify existing threats to water quality and help determine activities that should be further examined. The inventory can include two layers of information, or you can use one or the other. The first method is to map general land-use areas by typical planning categories (open space to industrial). The other is to map the particular high risk use or activity as numbered points and list basic information about it on an index. If you have existing general land-use mapping, you may want to use it and add high risk point information. Below is guidance on how to do each type of mapping, and suggested methods and sources of information.

GENERAL LAND-USE CATEGORIES TO BE MAPPED

Land-use categories can be mapped as: open space, residential, agricultural, commercial, institutions, industrial, utilities, transportation, and waste disposal. These land-use types are listed in general order of increasing risk to ground-water quality. Every land-use type can, however, encompass both high and low risk activities.

Different land-use categories have been indicated on the maps prepared by the OCWA for the respective Towns, Villages and Cities. The land-use categories have been identified on the maps by color codes and are as follows:

- Agricultural
- Commercial
- Community Service
- Industrial
- Possible Subdivision
- Office
- Parks
- Public Service
- Residential
- Vacant
- Body of Water
- Roads

Land-use categories should be mapped to at least a five-acre level of detail and down to a two-acre level of detail. Municipalities may also map some or all of the subcategories indicated; however, such detail is optional.

Open Space

1. Water utility-owned land, dedicated natural areas, state parks and forests.
2. Landscaped parks or open spaces (including cemeteries, golf courses, playing fields, public gardens, and city parks).
3. Undeveloped, vacant land.

Residential

1. Low density (one or fewer dwelling units per acre).
2. Medium density (two to eight dwelling units per acre).
3. High density (more than eight dwelling unites per acre).

Agricultural

Permanent pasture land, hayfields, row crops, orchards, nurseries, Christmas tree plantations, greenhouses, animal husbandry (livestock, dairy, poultry, etc.).

Commercial

Retail, trades, and services; includes most offices and stores, as well as service businesses.

Institutional

Public buildings and facilities, government offices including the municipal hall, libraries, churches, schools, prisons, hospitals, fire stations, public works garages, etc.

Industrial

1. Lower risk industry (no materials processing, just assembly; no bulk storage or chemicals or scrap, or onsite disposal).
2. Resource extraction (rock quarrying, sand and gravel excavation).
3. Higher risk industry (any industry involving materials processing or primary manufacturing; especially chemical, metal plating, finishing, or other processing).

Utilities

Power stations, water-supply treatment facilities, etc.

Transportation

Airports, highway maintenance facilities and municipal garages, rail stations, rail stations and yards, bus terminals.

Waste Disposal, Treatment of Handling

- Landfills, transfer stations
- Bulky wastes
- Sewage treatment and sewage sludge disposal
- Special waste, such as seepage and industrial waste
- Hazardous waste
- Recycling processing area
- Junk or salvage yards
- Historic and closed waste sites of all kinds
- Resource recovery facilities

HIGHER RISK ACTIVITIES AND FACILITIES

The activities listed below can be mapped as numbered points on the base map, with business name, type, and address shown in an attached index. Use an "**>**" to show the location of the high risk use, with the center of the **>** on the center of the use. The listing by land-use category below is intended to provide a general guide; any use related to or similar to those listed should also be identified. Where known, former high risk sites (such as gas stations, mills, and factories) should be mapped as high-risk points and labeled as vacant in the index.

Open Space - Higher Risk Activities Include:

- Golf courses
- Cemeteries

Residential - Higher Risk Activities Include:

- Unsewered high and moderate density residential development.
- Certain home occupations (see higher risk commercial uses listed below).

Agricultural -Higher Risk Activities Include:

- Nurseries and greenhouses, row crops, orchards, tree plantations, intensive livestock areas.

Commercial - Higher Risk Activities Include:

- All automotive sales or services (any car, truck bus, recreational vehicle, marine, or heavy equipment facility including gas and service stations, body and general repair shops, dealerships, rental or leasing operations, washes, etc.
- machine shops
- junk or salvage yards

- certain retail trades including: fuel oil distributors or dealers, lumber yards, hardware stores, auto and home supply stores, garden centers, department stores, heavy construction businesses
- personal and repair services including: dry cleaners; launderers and laundromats; lawn care businesses; photo processors; equipment rental; pharmacies; printers; funeral parlors and crematories; medical, dental, and veterinary offices; furniture strippers and finishers; reupholsterers; electrical, radio, and television repair; appliance, lawnmower, and small engine repair; heating and cooling equipment service; pesticide applicators and exterminators; etc.
- research or testing laboratories
- large uncovered parking areas (more than 100 spaces), parking garages with open roofs
- underground fuel and chemical storage

Institutional - Higher Risk Activities Include:

- garages and vehicle or equipment service areas
- fuel storage and dispensing facilities
- salt storage areas
- hospitals
- secondary schools and colleges with workshops or laboratories
- prisons with workshops or laboratories

Manufacturing & Industrial - Higher Risk Activities Include:

- All manufacturing and processing facilities except: simple assembly involving no processing, and warehousing of durable tools (no chemicals).
- Warehousing, storage, or distribution of: chemicals, fertilizers; pesticides and allied products; petroleum, coal and other fuels; and hazardous materials.
- mining (rock quarries and sand and gravel excavation).

Utilities - Higher Risk Activities Include:

- Electric power generation
- Oil or chemical pipelines

Transportation -Higher Risk Activities Include:

- Airports
- Highway maintenance facilities, including road salt storage
- Truck, rail, or bus terminals, stations, or maintenance facilities

Waste - All Waste Disposal, Treatment or Handling Sites Should Be Identified as Higher Risk Activities, Including:

- Mixed waste landfills
- Soil-waste transfer stations
- Bulky waste landfills
- Sewage treatment plants, sewage sludge disposal
- Special waste, such as septage and industrial waste
- Hazardous waste
- Recycling processing center
- Junk and salvage yards
- Resource recovery facilities
- Historic and closed waste sites of all kinds

This list contains the more common higher risk uses. Any activity involving the handling, use, storage, or disposal or large quantities of solvents, petroleum products, pesticides, or hazardous chemicals constitutes and higher risk activity.

SUGGESTED INFORMATION SOURCES AND INVENTORY METHODOLOGIES

There are several possible ways for determining the locations of high risk activities. Municipalities are urged to combine several approaches, rather than relying completely on one source or method.

- Windshield survey - Although driving through town and visually noting higher risk uses is fairly time-consuming, this technique is generally acknowledged to be the most reliable and complete method for identifying land uses.
- Municipal officials, especially highway superintendents, building inspectors, fire marshals, planners, and zoning enforcement officials - can help identify or confirm land-use variances and higher risk activities.
- Water utility or municipal water department inspectors and managers - are often aware of higher risk uses threatening water supplies.
- Emergency Response Plan - Under the Federal Superfund Amendments and Re-authorization Act (SARA Title 3), facilities that manufacture, use and/or store hazardous materials are required to report to the local Emergency Planning Committee and local fire department. Reporting is required to aid municipalities in emergency response planning for the possibility of fires or spills involving such materials. The businesses identified in these Emergency Response Plans will almost all prove to be higher risk activities.
- FOILS request from the New York State Department of Environmental Conservation (NYSDEC) including the following list of existing or potential contamination sites
  - Inactive hazardous waste sites
  - Remediation projects
  - NYSDEC Spill Response
  - Solid waste sites
  - RCRA sites
- Land use data from the Orange County, New York Real Property Tax Assessment database.

- Orange County Ground-Water Study Existing Conditions, January 1995, prepared by LBG for the OCWA. This report includes an inventory of existing and potential ground-water contamination problem for each town/village in Orange County. Survey was conducted in 1994.
- A search of U.S. Environmental Protection Agency (USEPA) and NYSDEC database can be completed by an independent firm. Search radii, Geographic Information System (GIS) maps of the appropriate database, and copies of database reports can easily be attained relatively fast and relatively in expensive considering the available search engine potential.

  These are the current USEAP and NYSDEC records typically searched, including:

  1. National Priority List (NPL);
  2. NPL Deletions (Delisted NPL), Target Property (TP);
  3. Resource Conservation and Recovery Information System (RCRIS-TDS);
  4. State Hazardous Waste Site (SHWS);
  5. Comprehensive Environmental Response, Compensation, Liability System (CERCLIS);
  6. CERCLIS No Further Remedial Action Planned (CERCLIS-NFRAP), TP;
  7. Corrective Action Report (CORRACTS);
  8. Solid Waste Facility Directory (State Landfill);
  9. Leaking Underground Storage Tanks (LUST);
  10. Registered USTs;
  11. Registered Aboveground Storage Tanks (ASTs), TP;
  12. RCRA Administrative Action Tracking System (RAATS), TP;
  13. RCRIS Small Quantity Generators (RCRIS Sm. Quan. Gen.);
  14. RCRIS Large Quantity Generators (RCRIS Lg. Quan. Gen.);
  15. Hazardous Materials Information Reporting System (HMIRS), TP;
  16. PCB Activity Database System (PADS), TP;
  17. Emergency Response Notification System (ERNS), TP;
  18. Facility Index System (FINDS), TP;
  19. Toxic Chemical Release Inventory System (TRIS), TP;

20. Federal Superfund Liens (NPL Liens), TP;
21. Toxic Substances Control Act (TSCA), TP;
22. Material Licensing Tracking System (MLTS), TP;
23. Spills reported to the NYSDEC (NY SPILLS);
24. Records of Decisions (RODS),
25. Superfund (CERCLA) Consent Decrees (CONSENTs), and;
26. Former Manufactured Gas (Coal Gas) Sites.

- Aerial photographs - Aerial photos are most helpful when interpreted by people with air photo experience.
- Yellow pages.
- Chamber of Commerce industry and commerce listings.
- Regional planning organizations - may have additional information from previously conducted inventories.

Adopted from State of Connecticut Department of Environmental Bulletin No. 26

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

PERFORMANCE AND DESIGN STANDARDS

NOTE: Below are typical aquifer protection standards which can be applied to overlay zones or special areas of concern to set design and operation standards to minimize ground-water pollution. They could be applied in some modified form to all areas, but you should consider the limitation you may be placing on some necessary land uses or activities.

Uses shall conform to the following standards. The purpose of the standards is to prevent or minimize potential ground-water pollution from improper waste disposal, releases of hazardous materials, and other sources. An alternative standard or protection method may be approved if it is clearly demonstrated to provide equivalent protection of that listed.

Exemption: the storage and use of hazardous materials associated with customary residential use (except underground fuel storage) is exempt from these standards.

1. Stormwater Management

- No wastewater discharges shall be connected to the stormwater system.
- Stormwater from developed site areas shall be directed to an aboveground outlet point (swales, basins, surface waters). Discharges to drywells or other subsurface leaching structures may be allowed for the recharge of clean stormwater only, such as clean roof drainage.
- Stormwater contact with sources of pollution shall be prevented with roofs, covers, berms and directing runoff away from sources.
- Parking, storage, loading and other areas where releases can occur shall be an impervious surface.
- The use of sodium chloride as a de-icing agent shall be minimized.
- Apply engineering methods in keeping with the New York State Department of Environmental Conservation recommendations for reducing the impact of stormwater runoff from new developments. Additional application of the Metropolitan Washington Council of Governments Department of Environmental Programs proposal of stormwater management and urban

stormwater pollution runoff controls be designed with nature. This includes analyzing the site's limitations and development constraints and employing control facilities that can be accommodated by the site, the development, and the natural surroundings of the property.

2. Wastewater Discharges

No wastewater shall discharge to the ground other than approved domestic sewage systems or other certain discharges approved by state wastewater discharge regulations.

3. Floor Drains

No floor drains shall discharge to the ground. Floor drain discharges may be connected to public sanitary sewers in accordance with NYSDEP (or local authorized agent) approval. Exemption: bathroom and kitchen drains connected to a septic system in accordance with the public health code.

NOTE: Generally floor drains should be discouraged and strict materials management required instead. Where necessary, approved holding tanks are an option.

4. Storage Use and Handling of Hazardous Materials

All areas and facilities where hazardous materials are stored, used or handled shall be designed and constructed to prevent ground-water contamination, including provisions of the control of inadvertent or accidental spills, leaks or other discharges. The following standards shall apply:

a. Manufacturing, processing, or other activities using hazardous materials shall only be conducted on flooring impervious to the material being used and within a building or structure. If floor drains are present, they shall conform to the standards of Section 2.

b. Underground storage tanks and distribution lines for hazardous materials are prohibited.

NOTE: If for some extreme overriding reason underground storage must be allowed, the following standards may be required: Tanks shall be double-walled fiberglass reinforced plastic, or a double-walled steel cathodically protected; piping and distribution lines shall be protected against corrosion and constructed of double-wall pipe or within a secondary containment pipe or conduit; a monitoring or failure detection system; an overfill prevention device or containment area.

c. Aboveground storage tanks, containers, or drums shall be within a building or structure meeting the following requirements.

1. Have an impervious floor and containment area or dike of adequate size to contain 30 percent of the total stored volume or 110 percent of the largest tank (whichever is larger).

2. Area shall be protected by a roof and adequate sides to prevent exposure to precipitation.

3. Tank overfill protection devices shall be designed to prevent release of overfill outside the storage area.

4. Storage areas shall be located outside flood zones or flood prone areas or be flood proofed.

5. Have no floor drains.

d. Venting systems of evaporation or distillation of hazardous materials shall be designed with a recovery system to prevent the discharge of contaminated condensate or drippage.

e. Loading or transfer activities shall be conducted on impervious surfaces, roofed, and diked to capture and control any spills or leaks.

NOTE: The onsite disposal of hazardous waste is a prohibited activity (listed in the use regulations) for any use. Hazardous waste is managed under state and federal regulations, and businesses which generate a hazardous waste must store, handle, as well as dispose of it accordingly. The above standards apply to both virgin substances and waste (definition of hazardous material).

5. Bulk Material and Solid-Waste Storage

a. Bulk storage facilities of non-hazardous materials which may leach into the ground such as de-icing salt, sludge, manure, or silage shall have an impervious floor and roof, and be raised or designed to prevent surface-water runoff from entering.

b. Solid-waste dumpsters shall be on a concrete pad, covered and be plugged so as to be water tight.

6. Security and Emergency Spill Contingency Plan for Hazardous Materials

A plan and procedure shall be submitted that identifies the following:

- Security and inspection measures to control vandalism or accident.
- Procedures to contain and clean up spills or leaks of hazardous materials.
- Procedures for notification of local and state officials.
- Schedule of update when any changes in materials or procedure occur.
- Procedure to control hazardous materials released in case of total structure loss because of fire.

7. Pesticide and Fertilizer Use

Any use which includes more than five acres of land used for crop, lawn, garden or landscaping, requiring regular applications of chemical pesticides or fertilizers shall be accompanied by a management plan. The management plan shall indicate types of materials, application schedule and conformance with applicable best management practices.

8. Monitoring

If it is determined that additional safety measures and monitoring are needed because of hydrogeologic conditions or high potential contamination, then a monitoring program may be required which may consist of :

- Installation of monitoring wells.
- Periodic sampling.
- Report of analysis.

Adapted from: State of Connecticut Department of Environmental Protection Bulletin No. 26

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

SPECIAL PERMIT REQUIREMENTS

NOTE: If potential high risk industrial or commercial uses are allowed, the local commission may want to exercise a greater degree of review such as a zoning special permit. The permit review should consider the specific use, its location, and potential impact to water resources. The information required here is in addition to that contained in the underlying zone requirements.

Uses subject to a special permit shall submit an application for permit. The application shall be accompanied by required information, and subject to the evaluation below.

Required Information

The following written and mapped information shall be submitted.

- Description of proposed use; type of use or activity; commercial (trades and services), industrial (manufacturing and processing); product produced; Standard Industrial Code (S.I.C.) If applicable.
- A complete list of the types and volumes of all hazardous materials (including fuels) used, stored, processed, handled or disposed, other than those volumes and types associated with normal household use.
- Description of types of wastes generated and method of disposal including: solid wastes, hazardous wastes, sewage and non-sewage wastewater discharges.
- Location of adjacent (within 200 feet of property line) private drinking water supply wells. Location of public water supply wells within 1,000 feet.
- Provisions for management of stormwater runoff.
- A site plan and building plan showing; hazardous materials loading, storage, handling and process areas; floor drains; process plants; sewage disposal; and waste storage or disposal areas.

- Other additional information as may be required by reviewing agencies regarding: the proposed use, its potential impact to water quality, hydrogeology information, monitoring, and mitigation measures.

Evaluation Criteria and Considerations

In considering a special permit the commission shall consider the following:

- The type of use and the area in which the use is proposed.
- The degree of threat to ground-water quality caused by the proposed use.
- Compliance with the performance and design standards.
- The commission may attached conditions to a permit to insure the protection of ground-water quality.

Adapted from: State of Connecticut Department of Environmental Protection Bulletin No. 26

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

HAZARDOUS MATERIALS STORAGE MODEL ORDINANCE

Purposes

The purpose of this article is to provide a continuing source of current information concerning hazardous substances and chemicals being utilized in the Town/Village of _____ to protect the general health and safety of the public, and to enable emergency personnel to respond safely and speedily to emergency situations which may arise.

Definitions

For purposes of this article, the following terms shall be defined as follows:

Hazardous substances - those substances identified by the U.S. Environmental Protection Agency in table 117.3,40 CFR, Section 117.3 (1982) or in any subsequent update thereto. Said term shall induce oil and oil-based derivatives as listed in 40 CFR, Section 112.2 (1982) or in any subsequent update thereto.

Significant quantity - the amount of any hazardous substances equivalent to the "reportable quantity" of such substance as listed in tables 117.3, 40 CFR, Section 117.3 (1982) or in any subsequent update thereto. A significant quantity of oil or oil-based derivative shall be any "quantity" of such substances exceeding those listed in 40 CFR, Section 112.1 (d)(2)(i)(ii)(1982) or in any subsequent update thereto.

Storage area - shall be defined in 40 CFR (1980) or in any subsequent update thereto and in accordance with all applicable city and state fire code regulations.

Environmental authority of the Town/Village - of _____. The (building inspector/town engineer of the Town/Village of _____.

Application (Sec. ___)

(a) The provisions of this article shall apply to any person or entity, including government entities, storing, treating, mixing, using or producing a significant quantity of a hazardous substances or substances within the corporate limits of the Town of _____.

(b) The provisions of this article shall not apply to any person or entity, including government entities, storing hazardous substances within the corporate limits of the Town of _____ for purposes of retail consumer sale or individual private use unless the environmental authority of the Town of _____ determines that such storage presents a real or potential danger to the public health and safety and notifies the person or entity of that determination in writing.

(c) Any person or entity subject to the provisions of this article may, for valid reasons, request an exemption from any or all provisions thereof on a form provided by the environmental authority. The environmental authority may, in its sole discretion grant such exemption(s) based on the information provided by the applicant if the environmental authority determines valid reasons for such exemption(s) exist and that there is no significant health or safety hazard present.

Emergency Response Plan (Sec. ___)

(a) Any person or entity subject to the provisions of this article upon its effective date shall submit, as to such person or entity, an emergency response plan to the environmental authority of the Town of _____ on or before the effective date. The emergency response plan shall include the following elements:

(1) A map of the site showing the buildings thereon which shall describe hazardous substance storage areas and indicate their normal location; and

(2) A hazard identification and emergency action statement which shall include a concise procedure for responding to emergency situations in each area; and

(3) A procedure for the submitter for reporting fires, chemical spills, or other emergency situations, including procedures for notifying police, figure, health, and civil preparedness departments of the Town/Village of _____; and

(4) A fire response plan, as required by OSHA, identifying the level of fire response which shall be implemented by personnel as outlined in 29 CFR, Section 1910(L) (1981) or in any subsequent update thereto; and

(5) An evacuation plan including a list of those persons who are trained in the implementation of a response plan and in the supervision of evacuation procedures. The plan shall also include a system for accounting for all personnel in an evacuation; and

(6) A spill prevention, control and counter-measure plan designed to prevent or minimize the release into the environment of any hazardous substance stored, treated, used, mixed, or produced on the site. This plan shall be based on the types and quantities of hazardous substances which are on the property as well as the location and design of the major storage and use areas. The plan shall designate at least one person and an alternate, one of whom shall be onsite during all working hours and who shall be responsible for implementing the spill control procedures. The plan shall also specify construction features design to control and contain spills from hazardous substances storage areas. These control features shall include one or more of the following systems or their equivalents:

a. Dikes, berms or retaining walls which are sufficiently impervious to contain spills of hazardous substances;
b. Weirs, booms, curbing or other barriers;
c. Culverting, guttering or other drainage system which leads to a contained impervious area;
d. Sorbent materials;
e. Sumps and collection ponds;
f. Retention ponds.

(b) Each spill prevention, control and countermeasure plan required hereunder shall be implemented within ninety (90) days of receipt of approval from the environmental authority of the Town/Village of _____.

Rejection of Plan (Sec.)

The environmental authority of the Town/Village of _____ may, in his or her sole discretion reject any plan or plans found to be inappropriate when considering the types, quantities or locations of hazardous substances on the site.. Any plan so rejected shall be returned to the submitted with written suggestion for compliance and specific reasons for rejection of the plan. Thereafter, a modified plan incorporating the environmental authority's suggestions shall be submitted to the environmental authority within thirty (30) days of receipt of a notice of rejection. If said revised plan is not agreeable to the environmental authority, it may also be rejected and the submitter shall thereafter comply with any and all orders imposed by the environmental authority subject to the appeal rights available herein.

To Whom Plans Shall be Submitted (Sec.)

The environmental authority of the Town/Village of _____ shall distribute all emergency response plans submitted in accordance with Section _____ of this article to the Town/Village Fire Marshal. The environmental authority may distribute any such emergency response plan to the director of civil preparedness, the city engineer, the city planner and/or the building official of the Town/Village of _____ as needed.

When plans is to be Submitted (Sec.)

Any person or entity that begins storing, treating, mixing, using or producing a significant quantity of a hazardous substances or substances within the corporate limits of the Town of _____ on or after the effective date of this article shall submit a plan as required in Section _____ prior to the commencement of such activity and thereafter continue to comply within the other provisions of the article.

Inspection of Hazardous Sites (Sec.)

The environmental authority of the Town/Village of _____ or this or her designee may inspect any sites where a hazardous substance or substances are stored, treated, used, missed or produced during all reasonable business hours to establish compliance with the provisions hereof. Emergency inspections may be made at any time where the environmental authority has reason to suspect imminent danger or an obvious infraction of the previsions of this article.

Notification of Hazardous Substances Storage Areas (Sec.)

Each submitter of emergency response plans shall identify the location of their hazardous substance storage areas using the National Fire Protection Association (NFPA) 704m marking system. The intent of this paragraph is not to require labeling of individual barrels or small containers, but rather to require the labeling of large containers or areas on any given site.

Change in Storage Areas or Types of Hazardous Substances (Sec.)

In the event of either a change in the design or normal location of hazardous substance storage areas or a change in, or addition to the type or types of a hazardous substance or substances being stored, treated, used, mixed or produced on a site by an amount equal to a reportable quantity for which an emergency response plan has been submitted, the plan shall be revised and resubmitted within thirty (30) days of any change and implemented with ninety (90) days of receipt of notice of approval. Upon the resubmittal of an emergency response plan, the environmental authority shall have the same powers and discretion, and shall follow the same procedures as set forth in Section ____ of this article. Any person or entity exempted from any or all provisions of this article, having undergone a change as contemplated in this paragraph, shall resubmit an emergency response plan as required herein and/or a new request for exemptions pursuant to Section _____ hereof.

Documentation of Liability Insurance (Sec.)

After review of any emergency response plan submitted pursuant to this article, the environmental authority of the Town/Village of _____ may require any submitter to submit, as part of its emergency response plan, documentation of appropriate liability insurance.

Emergency Response Plan Shall be Sworn to (Sec.)

The emergency response plan shall be submitted together with an affidavit on a form provided by the environmental authority of the Town/Village of _____ as to the truth and accuracy of the plan. This affidavit shall be signed under penalty of false statement by the person or, in the case of an entity, a duly authorized representative of the firm, partnership, corporation or other entity required to report hereunder.

Penalty (Sec.)

Any person or entity required to report or act hereunder who does not comply with the provisions hereof within thirty (30) days of either the required reporting date or the date any act is required to be done such time as either the report is received by the environmental authority or the act is performed. Each day such report is not submitted or such act is not performed shall constitute a separate violation. No such fine shall be levied during the process of an appeal filed pursuant to this article.

Appeal (Sec.)

(a) For purposes of this article, an appeals board is hereby created consisting of the fire marshal, the building official, the town planner, the town engineer, two (2) members of the board of aldermen of the Town/Village of _____, one from the majority party, one from nominees submitted by the persons or entities regulated by this article, who shall serve of one year. Any vacancy of this board shall be filed for the remainder of the original term.

(b) Any person or entity aggrieved by any order or decision made in accordance with the provisions of this article may, within fifteen (15) days of the date of mailing of the order or decisions, appeal therefrom to the appeals board in writing. Said appeal shall be filed with the environmental authority. The appeals board shall convene to hear said appeal within ten (10) days of its filing, shall hear said appeal *de novo*, and shall render a written decision thereon within fifteen (15) days of conclusion of the hearing. At least 72-hour notice of the date, time and place of an appeal herein shall be given to the appellant. The

appeals board shall act upon an appeal by a majority vote of its membership present and voting, so long as a quorum exists. Four (4) members shall constitute a quorum.

(c) Any person or entity aggrieved by an appeals board decision may appeal said decision to the superior court for the judicial district of the Town/Village within twenty (20) days of the date of said decision.

(d) The filing of an appeal to the appeals board shall stay enforcement of the environmental authority's order or decision. The filing of an appeal to the superior court for the judicial district of the Town/Village shall not of itself stay enforcement of the appeals board decision. The reviewing court may order a stay upon appropriate terms.

Disclosure of Information (Sec.)

Nothing herein shall be construed to require disclosure of information which is deemed confidential of constituting a trade secret. Any information submitted in accordance with this article shall only be disturbed or released on a need-to-know basis.

Conflict with State and/or Federal Law (Sec.)

In the event this article or any part thereof is found to be in conflict with any state or federal law or regulation, the more stringent of the two (2) shall prevail.

Effective date (Sec.)

This article shall become effective six (6) months from the date of passage.

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

INSPECTION GUIDE

1. Site Background Information

Name:

Address:

Type of Business:

Contact Person and Phone No.:

Inspector:

Date:

2. General Site Information (attached simple site sketch if necessary)

Description of Site Activities:

Building facility has:
- ❍ office areas
- ❍ storage areas
- ❍ boiler room
- ❍ transformer room
- ❍ other

General Age of Building _____

Site History:

Water and Sewage Facilities:

❍ onsite septic system OR ❍ public sewer

❍ onsite well OR ❍ public water supply

Facility power by:

Transformer

“ onsite or “ offsite

“ pole or “ pad-mounted

Owner:_____ ID: _____ Staining:_____

Description of back-up generator (if present)

Pad-mounted _____ Staining _____

3. Site Checklist of Potential Pollution Sources

Wastes/Wastewaters Present	Disposal/Handling Method
“ hazardous wastes	
“ non-domestic wastewaters	
“ floor drains	
“ sewage	
“ dumpsters, soil waste storage	
“ drums	
“ other (list)	

Facility heated by: “ natural gas “ oil “ electricity

Fuel-oil stored: “ aboveground “ secondary containment “ underground

Size: _____ Registered: _____

Fuel and Chemical Storage Present:

Type of Fuel/Chemical	Volume	Aboveground	Underground	Containment
_____	_____	_____	_____	_____

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____

Vents/Fill Pipes Observed on Property:

Topography (site slope):

Stormwater Drainage (location of drains):

Potential Pollution Source	Comment
“ exposed materials/storage	
“ unauthorized connections	
“ discharge to drywell or subsurface leaching structure	
“ large parking or pavement areas	
“ deicing salt	

Other Potential Site Hazards	Comment
“ spills/leaks	
“ illegal dumping	
“ oil/chemical stained areas	
“ outside work or transfer areas	
“ pesticide or chemical applications	
“ floor construction	
“ cracked floor	
“ floor drains	
“ floor staining	
“ fluorescent lighting	

- asbestos containing material present (size, location, description)
- other

Description of surrounding properties:

North:

East:

South:

West:

4. Inspection Information

Violations/Problems

1.

2.

3.

Referral:

1.

2.

3.

Recommendations:

1.

2.

3.

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

TOWN OF BEDFORD, WESTCHESTER COUNTY, NEW YORK
ZONING

§ 125-29.4 Aquifer Protection Zone (added 1-28-1986)

A. Findings. The Town of Bedford finds that:

(1) The ground water underlying the town is a major source of its existing and future water supply, including drinking water.

(2) The ground-water aquifers are integrally connected with the flow into the surface waters, lakes and streams, which constitute a major source of drinking water for New York City or for parts of the State of Connecticut.

(3) Accidental Spills and discharges of toxic and hazardous materials have threatened the quality of such ground-water supplies and related water resources in the town, poising potential public health and safety hazards.

(4) Unless preventive measures are adopted to control the discharge and storage of toxic and hazardous materials within the town, further spills and discharges of such materials will predictably occur and with greater frequency and degree of hazard by reason of increasing construction, commercial and industrial development, population and vehicular traffic in the town.

(5) The foregoing conclusions are confirmed by findings set forth in the Water Quality Management Plan of Westchester County, prepared pursuant to Section 208 of the Federal Clean Water Act, and by town-commissioned studies.

(6) There is also a growing concern for control of nitrate-nitrogen in the aquifer within tolerable amounts.

B. Purpose. The purpose of this section is to protect the public health, safety and welfare through the preservation of the town's major ground-water resources to ensure a future supply of safe and healthful drinking water for the Town of Bedford, local residents and employees and the general public. The designation of Aquifer Protection Zones and careful regulation of developmetn activities within these zones can reduce the potential for ground-water contamination. The purpose of this section is to protect areas having a high potential for use as a water supply and thereby to maintain the existing quality and improve the future quality of the ground waters of the Town of Bedford.

C. Aquifer Protection Zone: location; applicability.

(1) These regulations shall apply to all land and uses encompasssed within the Aquifer Protection zone as designated on a map entitled, "Town of Bedford, New York Aquifer Map", dated December 5, 1985, which map is hereby made a part of these regulations.[1]

(2) These regulations shall be in addition to other requirements for the zoning districts designated on the Zoning map of the Town of Bedford and shall apply irrespective of other sections of this code.[2]

D. Use Regulations for Aquifer Protection Zones.

(1) Permitted principal and accessory uses. All uses which are permitted under the existing zoning regulations are permitted in the Aquifer Protection Zone unless otherwise identified in Subsection D(2), (3) and (4) below, including the following:

(a) Onsite sewage disposal systems, provided that no such system shall discharge more than three hundred (300) gallons of wastewater per acre per day, as determined by the following schedule:

Use	**Wastewater Equivalent* (gallons per day)**
Single-family dwelling	300
Efficiency apartments and hotel/motel units	100 per unit, plus food service
Efficiency apartments and hotel/motel units over 400 square feet in area	150, plus food service
1-bedroom apartments/condominiums	150
2-bedroom apartments/condominiums	225
3-bedroom apartments/condominiums	300
1-bedroom planned retirement apartments/ condominiums	100 per bedroom
Tourist camps	60 per site
Trailer parks	150 per trailer
Theaters	1.5 per occupant
Drive-in theaters	5 per parking space
Bowling alleys and racquetball or tennis courts	100 per court or alley
Day schools	5 per occupant, plus food service
Boarding schools or boarding homes	75 per occupant
Office space	12 per occupant

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1 Editor's Note: The New York Aqufier Map is on file in the office of the Town Clerk.

2 Editor's Note: The consolidated Zoning Map is on file in the office of the Town Clerk.

Use	Wastewater Equivalent* (gallons per day)
Industrial storage/waterhouses	0.04 per square foot of building area
Spas, beaches or country clubs	15 per occupant, plus food service
Medical arts	225 per suite
Hospitals	300 per bed
Nursing homes	150 per occupant
Proprietary homes	110 per bed
Public gathering places	15 per occupant
Eating places	30 per occupant
Bars	15 per occupant, plus food service
Catering halls	7.5 per occupant
Markets and wet stores	0.05 per square foot of building floor area
Delicatessen and food processing	0.15 per square foot of building floor area
Dry stores	0.03 per square foot of building floor area
Take-out eating	1.5 per square foot of building floor area
Churches	1.5 per occupant
Bathhouses	5 per occupant
Laundry facilities	400 per washing machine
Light industrial uses	0.03 per square foot of building floor area

NOTE: these figures are to be used only for the purposes of the Aquifer Protection Zone; they are not the standards of the Westchester County Department of Health.

(b) Onsite storage of heating oil in tank of less than one thousand one hundred (1,100) gallons installed below ground, provided that such tanks are designed and constructed in accordance with the standards of the New York State Department of Environmental Conservation rules and regulations for bulk storage (6 NYCRR 614). Replacement tanks must meet the requirement of this section.

(2) Special permit uses.

(a) Within the Aquifer Protection Zone, each use below requires the issuance of a special permit by the Planning Board pursuant to the requirements of §§ 125-57 through 125-65:

[1] Onsite sewage disposal systems that discharge more than three hundred (300) gallons of wastewater per acre per day as measured by the criteria of §125-29.4D(1)(a).

[2] The use of common septic fields or sewage treatment plants for residential development under the provision of §§125-51 through 125-45 (conservation development) and §107-22B and C (conservation subdivision) of this Code.

[3] The handling and storage of road salt and deicing materials, provided that structural and nonstructural measures are implemented to prevent leachate contamination. Such measures may include, but are not limited to, building enclosures, impervious pads and pavements, self-contained drainage systems, detention basins, filters, separators or other devices and other management practices.

[4] Ground-water heat pumps supplying heating and cooling for other than a one-family detached dwelling unit, provided that such systems are designed to treat, if necessary, and return discharged water to the ground water.

(b) As stated in §125-61, the Planning Board may at each such conditions and safeguards to any special permit as are, in its opinion, necessary to ensure initial and continued conformance to all applicable standards and requirements. Such conditions may include, but are not limited to, monitoring wells and the requirement of additional setbacks from sewage disposal systems to downgradient property lines.

(3) Prohibited uses. The following uses are prohibited uses within the Aquifer Protection Zone:

(a) The disposal of hazardous materials or solid waste.
(b) The treatment of hazardous materials, but not including rehabilitation programs authorized by a government agency for treating existing hazardous materials.
(c) The storage of hazardous materials, except in sealed or unopened containers for resale or in containers normal for household use.
(d) The creation of hazardous materials.
(e) Dry-cleaning and dyeing establishments and laundries that utilize cleaning solvents.
(f) Printing and photo processing establishments.
(g) Furniture and finish stripping establishments.
(h) The storage of hydrocarbon products except for heating oil and vehicle fuel stored in vehicle tanks.
(i) Oil, gasoline or hazardous material pipelines.
(j) Disposal of septic sludge.

(k) Uses otherwise allowed in the zone which may discharge hazardous materials into the ground water.

(l) Automotive service stations; public garages.

(4) Nonconforming uses or structures. Any lawful use of a structure or of land, existing as of the effective date of this section, shall be deemed nonconforming and may be continued subject to the provisions of §125.11.

E. Aquifer impact assessment. All applications for a special permit pursuant to §125-29.4D(2) shall include an aquifer impact assessment. The purpose of this assessment shall be to demonstrate that no activities will be conducted upon the property that will result in ground-water infiltration into a designated aquifer such that, at a confidence level of ninety percent (90%), the New York State Drinking Water Standards (10 NYCRR 5) will not be violated at the property line. Said assessment shall be prepared by a qualified hydrogeologist at the expense of the applicant. The cost to the town of hydrogeologic review of such assessment shall be paid by the applicant. The aquifer impact assessment shall include, insofar as is pertinent to the application:

(1) Aquifer flow characteristics, including a delineation of the primary recharge area, distribution of transmissivity and details of the hydrologic budget, including natural and man-induced sources of recharge and withdrawal. Existing data from town studies on the aquifer areas may be used in the aquifer impact assessment.

(2) Details of the proposed aquifer usage, including static conditions of the potentiometric surface, range of withdrawals anticipated and the potentiometric surface at critical points in that range. An estimate of the quantity of induced surface flows at each critical point in the range shall also be detailed.

(3) Potential impacts resulting from the planned discharges or withdrawals, including impacts to other users of the aquifer (wells, surface expressions of ground water, etc.) in terms of levels, quantity of water available and induced quality changes. The impacts resulting from induced infiltration, including quantity implication to both the ground-water and surface-water systems, shall be addressed.

(4) Proposed measures to mitigate any adverse impacts, the system for monitoring quantity, quality or any other aspect deemed important, including monitoring wells, and a reporting schedule, shall be specified.

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

TOWN OF SOMERS, WESTCHESTER COUNTY, NEW YORK
GROUND-WATER PROTECTION OVERLAY GP DISTRICTS

170-32.A.1 - Purpose

The purpose of the Ground-Water Protection Overlay GP District is to protect the public health, safety and general welfare by preserving the quality and quantity of the Town's major ground-water resources in order to ensure an adequate and safe water supply for present and future residents, employees and the general public. The designation of ground-water protection overlay districts and the establishment of use regulations in such districts will further preservation of ground-water resources currently in use and those aquifers having a potential for use as a source for substantial public or private water supply.

170-32.A.2 - Findings

In continuation of the ground-water and aquifer policy adopted in December 1984 and set forth in Chapter 165 of the Code, the Town Board of the Town of Somers has reviewed a Planning Board commissioned report on the status and location of the Town's ground water titled, "Groundwater Supply Overview of the Town of Somers, New York", prepared by Leggette, Brashears & Graham, Inc. and dated December 1988, and hereby finds that:

A. The ground-water underlying the Town is a major source of existing and potential future water supply, including drinking water, and, as such, should be protected from contamination.

B. Unregulated development in areas with sensitive hydrogeologic formations of stratified drift aquifer and their primary recharge areas in addition to accidental spills and discharge of hazardous and toxic materials in those areas, can threaten the quality of the ground-water supplies and related water resources in the Town, posing potential health and safety hazards.

C. Preventive measures and regulations should be adopted to control the development of land and to control the discharge and storage of hazardous materials within the hydrogeologic formations to limit the potential adverse impact that such development and discharge can create.

D. The foregoing conclusions are set forth in the "Water Quality Management Plan of Westchester County" prepared pursuant to Section 208 of the Federal Clean Water Act and in Town-commissioned studies.

E. The Town has the power through zoning to effectuate regulations that promote the public health, safety and general welfare.

170-32.A.3 - Application of Ground-Water Protection Overlay Districts

A. Lands. the provisions of this article shall apply to all real property lying within a Ground-Water Protection Overlay district. The "Ground-Water Protection Overlay District" is defined as an area designated on the Town of Somers Zoning Map containing a primary recharge area for a stratified drift deposit known or believed to be an aquifer. The boundaries of the district are indicated on the official Zoning Map. The Ground-Water Protection Overlay District is based on the maps and report titled, "Groundwater Supply Overview of the Town of Somers, New York", prepared by Leggette, Brashears & Graham, Inc. and dated December 1988.

B. District mapping. The Ground-Water Protection Overlay District line shall be determined by the use of the scale appearing on the Zoning Map. From time to time and to reflect new information of a site-specific nature, the Town Board may make amendments to the mapping of Ground-Water Protection Overlay districts.

C. Uses. The provisions, requirements and regulations of this article shall apply to all uses of land within Ground-Water Protection Overlay districts and no land shall be used except in compliance with the provisions, requirements and regulations of this article.

170-32.A.4 - General Provisions

A. Relation to other regulations. The provisions in this article do not repeal, abrogate or annul any portion of the Code or regulations of the Town of Somers, New York State or federal regulations or existing private or public services. In any case where there are conflicting regulations, which ever regulation imposes the more stringent restriction shall apply.

B. Relation to underlying district. Nothing in this article shall be construed to permit any use which is not currently permitted in the applicable underlying zoning district as established and regulated by Chapter 170.

C. Types of uses. All uses within the Ground-Water Protection Overlay District shall be deemed to fit into one of three categories of uses:

(1) Uses permitted without regulation under 170-32.A and not requiring a special exception use permit.
(2) Uses permitted subject to regulation under 170.32.A and requiring a special exception use permit.
(3) Prohibited uses.

D. Nonconforming uses. Any use existing as a lawful use at the effective date of this article shall be deemed a nonconforming use. The nonconforming use may be continued subject to the provisions of Article XVI of this chapter.

170-32.A.4 - Uses Permitted Without Regulation Under 170-32.A

The following uses are permitted without regulation under this section:

A. The subdivision of a property into no more than two (2) lots of at least 40,000 square feet each for one-family detached dwellings with roads that are designed to mitigate water-quality impacts of first flush runoff.

B. The construction of a one-family detached dwelling on a lot containing at least 40,000 square feet in an area complete with a sanitary sewage disposal system, well and permitted accessory uses as specified in 170-11.

170-32.A.6 - Uses permitted subject to regulation under 170-32.A

Uses permitted in the underlying district by other section of Chapter 170 and not listed in 170.32.A.5 as a use permitted without regulation under 170-32.A and not listed in 170.32.A.7 as a prohibited use, shall require a special exception use permit from the Planning Board pursuant to 170-32.A.8, 170-115, Article XI and Article XVIII.

170-32.A.7 - Prohibited Uses

The following uses are prohibited uses within the Ground-Water Protection Overlay District:

A. The disposal, storage or treatment of hazardous material and solid or liquid waste material, except the storage of such hazardous material in sealed containers for retail sale or for normal household use.

Hazardous material shall be defined as material which is a present or potential danger to health or the environment when improperly stored, transported, disposed or otherwise managed and also as any other toxic, caustic or corrosive chemicals, radioactive materials or other substance listed in Title 40 of the Code of Federal Regulations or Part 366 of Title

Six (6) of the Official Compilation of Codes, Rules and Regulations of the State of New York.

B. The creation or manufacturing of any hazardous material.

C. Dry wells directly connected to any floor drain, garage drain, wash basin or sink.

D. Gasoline service and filling stations and automobile service and repair facilities.

E. Dry-cleaning and dyeing establishments and laundries that use cleaning solvents.

F. Photographic printing and processing labs.

G. Furniture stripping and refinishing establishments.

H. The storage of hydrocarbon products except those necessary for residential use in homes and vehicles provided that such products are stored in appropriate containers.

I. Disposal of hazardous materials used in medical and dental office operations.

J. Disposal of septic or sewage sludge or ash.

K. Any storage of materials, which in the opinion of the Planning Board, has the potential to contaminate or degrade ground-water resources.

170-32.A.8 - Additional Requirements for Special Exception Use Permit

In addition to compliance with the requirements, as applicable, set forth elsewhere in the Code (in 170-114 and in Chapter 144 for site plan review, in Chapter 150 for subdivision review and in 170-115, Article XI and Article XVIII for special exception use review), as applicable, an applicant for a use subject to regulation in a Ground-Water Protection Overlay District shall prepare or have prepared a hydrogeologic analysis of the property which shall be submitted to and reviewed by the Planning Board.

A. Report purpose and content. The purpose of the hydrogeologic analysis shall be to demonstrate whether the proposed use will result in any degradation or contamination of ground water intended to be protected by the Ground-Water Protection Overlay District. Such analysis shall be prepared by a qualified hydrogeologist at the expense of the applicant. Such analysis shall include:

(1) Identification of the nature and importance of the ground-water supply and recharge aspects of the individual property upon which the use is proposed.

(2) Establishment of a ground-water protection plan which shall be implemented as part of the use. The plan, and its implementation at the time of establishment of the use, shall be such that it will mitigate any reasonable possibility of degradation or contamination of the ground water designated for protection. Particular design features to mitigate the water-quality impacts of first-flush runoff from paved surfaces shall be included in the ground-water protection plan.

(3) A showing that the use together with the implementation of the ground-water protection plan, will not result in a violation of the New York State Drinking Water Standard (10 NYCRR 5). The location of measurement/testing would be in the ground water within the downgradient property line.

For nitrate-nitrogen, which is a significant and persistent component of sewage disposed to the subsurface, the ground-water protection plan shall demonstrate that the proposed activity will not result in an average nitrate-nitrogen content exceeding 6 milligrams per liter (consistent with a 90-percent confidence level that the New York State Drinking Water Standard of 10 milligrams per liter will not be exceeded) at the downgradient property line.

(4) An analysis of installation and/or extension of a public or community sanitary sewer system as a mitigation measure and as an alternative to septic systems.

B. Planning Board Review. The Planning Board may, at the expense of the applicant, arrange for a review of the hydrogeologic analysis by a qualified professional. Such review shall be considered by the Planning Board in rendering the decision on the application.

To the greatest extent practicable, the application for a special exception use permit and the review of the hydrogeologic analysis required under this section shall be coordinated with all other review and permit procedures required by the Town of Somers, including the environmental quality review process.

C. Planning Board Action. After a review of the hydrogeologic analysis, and compliance with all other applicable procedures for the proposed use, the Planning Board shall approve, deny or approve subject to conditions the application for special use permit.

The Planning Board may attached such conditions to the issuance of a permit as it determines are reasonable and necessary to ensure the protection of the designated ground-water area. Any conditions that are placed on the approval of a special exception use permit shall be deemed to require the owner of the property to perform such action. Such conditions may include, but are not limited to:

(1) The periodic monitoring and reporting of the condition of ground water within the boundaries of the surface property.

(2) The correction of any contamination or degradation directly attributable to the use of the subject property or due to any discharge or spillage on the property.

D. Denial of Application. A denial of a special exception use permit shall not preclude an applicant from re-applying for a permit provided that the applicant has made significant changes which are designed to eliminate potential degradation or contamination of the ground water.

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MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Estimated Present (1994) Withdrawal of Ground Water from Wells in Orange County

Supply source	Estimated yield (mgd)
Rural Water Supply from Individual Well Supplies	4.7*
Public and Private Ground-Water Supply System:	
! Sand and Gravel Well	17.1
! Bedrock Well	9.0
! Well completed (unknown aquifer type)	0.3
	Subtotal: 26.4
TOTAL	**31.1**

* Mostly developed from wells completed in bedrock aquifer.
mgd Million gallons per day.

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TABLE 2

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Summary of Sand and Gravel Deposits
From the Soil Survey of Orange County[1/]

Soil Symbol	Soil Series
AdA	Allard silt loam
AdB	Allard silt loam
Ba	Barbour fine sandy loam
Be	Basher fine sandy loam
CgA	Castile gravelly silt loam
CgB	Castile gravelly silt loam
CnA	Chenango gravelly silt loam
CnB	Chenango gravelly silt loam
CnC	Chenango gravelly silt loam
Fd	Fredon loam
Ha	Halsey silt loam
HoA	Hoosic gravelly sandy loam
HoB	Hoosic gravelly sandy loam
HoC	Hoosic gravelly sandy loam
HoD	Hoosic gravelly sandy loam
My	Middlebury silt loam
OkA	Oakville loamy fine sand
OkB	Oakville loamy fine sand
OtB	Otisville gravelly sandy loam
OtC	Otisville gravelly sandy loam
OtD	Otisville gravelly sandy loam
OVE	Otisville and Hoosic soils
RhA	Riverhead sandy loam
RhB	Riverhead sandy loam

TABLE 2
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Summary of Sand and Gravel Deposits
From the Soil Survey of Orange County

Soil Symbol	Soil Series
RhC	Riverhead sandy loam
RhD	Riverhead sandy loam
Sb	Scarboro mucky sandy loam
Tg	Tioga silt loam
UF	Udifluvents-Fluvaquents complex
UhB	Unadilla silt loam
UnC	Unadilla silt loam

1/ Olsson, 1981.

TABLE 3

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Sand and Gravel Aquifers Available for Development
in the Respective Towns of Orange County

Town	Aquifer	Town	Aquifer
1. Blooming Grove	Moodna Creek Valley	11. Monroe	Ramapo River Valley
2. Chester	Seeley Brook Valley Black Meadow Creek Valley	12. Montgomery	Tin Brook
3. Cornwall	Moodna Creek Valley Woodbury Creek Valley	13. Mount Hope	Shawangunk Kill Valley
4. Crawford	Pine Bush Aquifer	14. New Windsor	None
5. Deerpark	Neversink-Basherkill River Valleys	15. Newburgh	None
6. Goshen	Wallkill River Valley	16. Tuxedo	Ramapo River Valley
7. Greenville	None	17. Wallkill	Wallkill River Valley
8. Hamptonburgh	Beaverdam Brook Valley	18. Warwick	Wallkill River Valley Wawayanda Creek Valley Greenwood Lake
9. Highlands	None	19. Wawayanda	Manhagen Brook Valley Rutgers Creek Valley Wallkill River Valley
10. Minisink	Rutgers Creek Valley Wallkill River Valley	20. Woodbury	Woodbury Creek Valley Ramapo River Valley

TABLE 4

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Bedrock Aquifers Available for Development
in the Respective Towns of Orange County

Town	Bedrock	Town	Bedrock
1. Blooming Grove	On, Dh, Ds, Mu, OEw	11. Monroe	Ds, Dh, OEw, mgu
2. Chester	On, Dh, OEw, Mu	12. Montgomery	On
3. Cornwall	Mu, On, Ds, Dh, mgu, OEw	13. Mount Hope	Sbs, Srp, On
4. Crawford	On	14. New Windsor	On, OEw, mu
5. Deerpark	Dsw, Dgo, Dh, Dou, Srp, Sbs	15. Newburgh	Ogu, OEw, On, mu
6. Goshen	On, OEw	16. Tuxedo	OEw, mgu
7. Greenville	Sbs, On	17. Wallkill	On
8. Hamptonburgh	On, OEw	18. Warwick	OEw, mgu, mu, mb, On, Dh
9. Highlands	mgu	19. Wawayanda	On, OEw
10. Minisink	On, OEw	20. Woodbury	Dh, Ds, OEw, mgu

LEGEND:

Calcite and Dolomite Marble (mb)
Helderberg Group (Dhg)
Lower Walton Formation (Dsw)
Martinsburg Formation (On)
Oneonta Formation (Dgo)
Onondaga Limestone (Dou)
Undifferentiated Gneiss and Granite (mgu, mu)
Undifferentiated Hamilton Group Eastern Orange County (Dh)
Undifferentiated Hamilton Group Western Orange County (Dh)
Undifferentiated Lower Devonian and Silurian Rocks (Ds)
Undifferentiated Silurian Rock I (Srp)
Undifferentiated Silurian Rocks II (Sbs)
Wappinger Group (OEw)

TABLE 5

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Chemicals of Concern

Certain chemicals are common causes of ground-water contamination. Any activities involving the use, storage, handling, or disposal of such substances may be subject to addional controls in aquifer protection areas. A list of the chemical sources or types is presented below.

- Leachate from waste storage and disposal (this can include all the chemical groups listed below)
- Sodium chloride (uses: deicing and snow clearance, water softeners)
- Pesticides (uses: agriculture, landscaping)
- Fertilizers and animal wastes (uses: agriculture and landscaping)
- Fuel/petroleum products, constituents and byproducts (waste oil, benzene, MTBE (methyl tertiary-butyl ether), EDB (uses: transportation, heating, lubrication, power generation)
- Solvents or chlorinated hydrocarbons (see also pesticides) (common contaminants include tetrachloroethylene, trichloroethylene, trichloroethane, toluene, benzene)
  (uses: machinery and parts cleaning and degreasing, dry cleaning, industrial laundering, paint thinners)
- PCBs (uses: transformer oils)
- Phenols and creosotes (uses: wood preserving)
- Metals (uses: metal plating, dyes, paints)
- Acids (changes pH and may release contaminants)
- Alkalies (changes pH and may dissolve metals)
- Cyanides (found in industrial wastes)
- Alchohols (uses: anti-freeze)
- Pharmaceutical chemicals
- Hazardous materials
- Organic/inorganic chemicals

Source: Report of the Aquifer Protection Task Force, State of Connecticut, February 15, 1989.

TABLE 6

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Commercial/Industrial Land Uses - Hazardous Waste Generation

Business Category (SIC)*	Hazardous Materials/Wastes/Disposal Practices (if known) Potential Large-Scale Generators
Communications Equipment sludges, Manufacturer (366)	Nitric, hydrochloric, and sulfuric acid wastes, heavy metal copper-contaminated etchant (e.g., ammonium persulfate), cutting oil and degreasing solvent (trichloroethane, Freon, or trichloroethylene), waste oils, corrosive soldering flux, paint sludge, waste plating solution
Electric and Electronic Equipment Manufacturer (especially circuit boards) (367)	Cyanides, metal sludges, caustics (chromic acid), solvents, oils, alkalis, acids, paints, calcium fluoride sludges, methylene chloride, perchloroethylene, trichloroethane, acetone, methanol, toluene, PCBs, paint sludge
Fabricated Metal Products (344)	Paint wastes, acids, heavy metals, metal sludges, plating wastes, oils, solvents, explosive wastes
Machinery (354) = metalworking & machinery (359) = miscellaneous machinery (electrical)	(354) - oils, solvents (359) - metals, miscellaneous organics, sludges, oily metal (except shavings) Tool & die shops: lubricant & cutting oils, degreasers (TCE), metal marking fluids (“blueing”), mold release agents Oils and solvents may be reclaimed in shop or sold to recyclers, scrap metal sold to dealer
Plastic materials and Synthetics (282) = plastic materials & synthetics (2821) = plastics, synthetic resins, and nonvulcanized elastomers	(282) - solvents, oils, miscellaneous organics (phenols, resins), paint wastes, inorganics, cyanides, acids, alkalis, waste water treatment sludges (2821) - organic liquid wastes containing acids and alkalis, cellulose esters, surfactants, glycols, phenols, formaldehyde, peroxides, etc. May be treated onsite or hauled to a hazardous waste facility
Primary Metal Industries (3312) = blast furnaces, steelworks, rolling mills	Heavy metal waste water treatment sludge, pickling liquor, waste oil, ammonia scrubber liquor, acid tar sludge, alkaline cleaners, degreasing solvents, slag, metal dust
Trucking Terminals or Fleet Vehicles	Fuel tanks, repair shop wastes (chemical substances may be (4231) hauled
Printing, Publishing & Allied Industries (27, 731)	Solvents, inks, dyes, oils, miscellaneous organics, photographic chemicals (note that solvents with ink in them may be collected by solvent recovery firms; ink contains heavy metals and may be returned to ink supplier for recovery and reuse; silver in photographic chemicals is recoverable
Public Utilities (phone, electric power, gas) (481, 491, 492)	PCBs from transformers and capacitors, oils, solvents, sludges, acid solution, metal plating solutions (chromium, nickel, cadmium)
Sawmills and Planing (2421)	Treated wood residue and containers (use copper quinolate, mercury, sodium bazide to control stains and fungus) (use tanner gas to prevent lines from freezing. Paint sludges, solvents, creosote, coating and glueing wastes
Stone, Clay & Glass Products (32)	Solvents, oils and grease, alkalis, acetic wastes, asbestos, heavy metal sludges, phenolic solids or sludges, metal-finishing sludge
Agriculture (01)	Pesticides (containers and residues), gasoline, motor oil, welding equipment, etc. for farm machinery

TABLE 6
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Commercial/Industrial Land Uses - Hazardous Waste Generation

Business Category (SIC)*	Hazardous Materials/Wastes/Disposal Practices (if known) Potential Large-Scale Generators
Auto Repair (7538)	Waste oils, solvents, acids, paint, waste hydraulic fluids, miscellaneous cutting oils
Local & Interurban Passenger Transit (41)	Waste oil, solvents, miscellaneous wastes, gasoline storage
Gasoline Service Stations (554)	Oils, solvents, miscellaneous wastes (ask if they take back used motor oil and what is done with it)
New and Used Car Dealers (especially those with service departments)	Waste oils, solvents, miscellaneous wastes
Welders (7692)	Oxygen/acetylene tanks
Dry Cleaning (7216)	Solvents: perchloroethylene, petroleum solvents, Freon-1,1,3 - used in machines in large quantities, distilled solvent, reused spotting chemicals: trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate (residues from distillation put in garbage)
Landfills, Dumps and Junkyards	Small quantities of chemical wastes, oils, etc. (ask whether the operation has a policy on hazardous wastes if collected by mistake)
Other (Because of information found in inventory)	
Special Construction Trades (1711) - plumbing, heating, air conditioning (1721) - painting, paper hanging, decorating (1742) - plastering, drywall, acoustical insulation (1751) - carpentry (1752) - flooring (1761) - roofing and sheet metal (1795) - wrecking and demolition (1799) - other special construction trades	 (1711) - solvents, asbestos, miscellaneous (empty containers, etc.) (1721) - paints, solvents, glues, miscellaneous (1742) - solvents, adhesives, miscellaneous (waste insulation) (1751) - solvents, lacquers (1752) - paint, glues, miscellaneous (1761) tars, sealants, miscellaneous (1795) - asbestos, miscellaneous chemicals, miscellaneous (1799) - epoxy waste, solvents, asbestos, miscellaneous
Swimming Pool Cleaning & Maintenance (7399)	Free and combined chlorine, bromine, iodine, algacides (mercury-based, copper-based, or quaternary), cyanuric acid, calcium or sodium hypochlorite, muriatic acid, sodium carbonate
Miscellaneous Repair Service	Solvents, acids, alkalis, paint sludges, metals, organics, miscellaneous chemicals
Medical Facilities (8071)	X-ray developers and fixers (fixers and x-ray film contain reclaimable silver. Developer contains flutaldehyde, hydroquinone, phenedone, potassium bromide, sodium sulfite, sodium carbonate. Fixer has thiosulfates and potassium allum. Infectious wastes, radiological wastes, biological wastes, miscellaneous chemicals, disinfectants, asbestos, beryllium, acids (from dentists)

TABLE 6
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Commercial/Industrial Land Uses - Hazardous Waste Generation

Business Category (SIC)*	Hazardous Materials/Wastes/Disposal Practices (if known) Potential Large-Scale Generators
Veterinary Services	Solvents, infectious materials, vaccines, drugs, disinfectants (0742) (quaternary ammonia, hexachlorophene, peroxides, chlorhexadene chlorox) X-ray developers and fixers (fixers and x-ray film contain reclaimable silver)
Schools (821)	Solvent, chemicals, pesticides, acids, alkalis, waste oils
Furniture & Fixtures (Manufacture & Repair (2512, 7641)	Paints, sludges, solvents, empty containers, degreasing sludges, solvent recovery sludges
Funeral Services and Crematories (7261)	Formaldehyde is the main preservative used. Also use wetting agents, fumigants, solvents
Government Offices (919)	Machinery/vehicle servicing, gasoline or heating oil tanks
Home Heating Oil (5183)	Underground storage tanks, truck maintenance garage
Photo Processing Laboratory (7333, 7395)	Biosludges, silver sludges, cyanides, miscellaneous sludges
Apartment and Condominium (6513)	Swimming pool cleaning and maintenance chemicals, landscaping chemicals such as pesticides and fertilizers, onsite sewage treatment plant (hazardous household wastes)
Pharmacies (591)	Spilled and returned products
Hardware Stores (525) & Carpet (5713)	Hazardous chemical products in hardware and parts stores' Stores inventories. Carpet stores use glues and similar adhesives that are hazardous products returned to stores by customers. If forklift is used at lumber, hardware or carpet store, there may be a fuel tank or repair shop. Wood products, if stained or treated onsite, require hazardous chemicals (such as creosote)
Construction Materials (521)	Asbestos
Car Washes (7542)	Miscellaneous chemicals: soap, detergents, waxes
Beauty Shops (723 and Barber Shops (724)	Miscellaneous chemicals in rinses, perm solutions, dyes
Sports Shops (5941) and Hobby Shops (5945)	Gun powder and ammunition, rocket engine and model airplane fuel
Country Clubs (7997)	Pesticides, fertilizers, swimming pool chemicals, vehicle maintenance shops
Bowling Alleys (7933)	Epoxy, urethane-based floor finish

Note: Up to four digits are used in the SIC codes; codes that contain only two or three digits represent less specific categories and, therefore, should be treated with more caution.

Source: Wellhead Protection Tools for Local Government by Horsley & Witten, Inc. and U.S. Environmental Protection Agency, 1989.

TABLE 6
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY, NEW YORK
GOSHEN, NEW YORK

Commercial/Industrial Land Uses - Hazardous Waste Generation

TABLE 7

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
N.A.	Waste Disposal				Prohibit - recharge area.
	- Sanitary Landfills	X		Act. - Leachate generation from waste disposal	
	- Septage Lagoons	X		Chem. - Numerous chemical constituents	
	- Hazardous Waste Disposal	X			
	- Bulky & Special Waste	X			
	Disposal	X			
	- Sludge Disposal	X		Salt contamination	Prohibit discharge to ground
	- Water Softener brines		R	Chem. - Modest natural organic leachate	Site plan review, limited to immediate property needs
	- Stump Dumps				
N.A.	Septic System Discharge of Non-Domestic Waste	X		Act. - Discharge of non-biodegradable wastes to ground water. Chem. - Persistent organics and inorganics.	Prohibit. Educate citizens.
N.A.	Underground Leaching Systems for Storm Water from Large Paved Highways and Parking Areas	X		Act. - Parking lot runoff leaching systems for storm-water runoff management. Chem. - Sodium chloride, benzine and other gas, oil, or other automotive chemicals, transportation spills.	Prohibit - Prevent during site plan review process.
N.A.	Floor Drains	X		Act. - Illegal or inadvertent disposal of various pollutants through dry wells or septic systems. Chem. - Organics and inorganic contaminants.	Prohibit discharge to ground, allow floor drains where discharge is connected to public sewers or part of a regulated treatment system.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
N.A.	Waste Processing Systems - Resource Recovery Facilities for Municipal Sanitary Wastes Solid Waste Transfer Station - Recycling Processing Centers - Sewage Treatment Plants and Associated Facilities, Including Pump Station		R	Act. - Spills, leaks and possible leachate from storage and processing of wastes. Chem. - Potential organic and inorganic contaminants.	Require - design considerations for waste and process material storage and handling. Plans for increased inspections, spill response plans.
N.A.	Underground Storage or Transmission of Liquid Fuels and Hazardous Chemicals - Underground Storage Tanks - Underground Distribution Systems - Liquid Fuel Pipelines	X X X X		Act. - Tank, pipeline or joint leaks or breaks. Chem. - Liquid fuels, hazardous materials.	Prohibit
N.A.	Outdoor, Unprotected Storage of Commercial, Industrial or Institutional Chemical Products or Wastes Above Ground.	X		Act. - Exposure of materials to precipitation, and subsequent generation of leachate: spills, leaks, accidents. Chem. - Various organic and inorganic contamination.	Require indoor storage with special safeguards against spills, or special outdoor protection measures.
N.A.	Storage of Gasoline, Diesel and Fuel Oil		R	Act. - Leaks, drips, tank ruptures. Chem. - Hydrocarbons, benzene and other contaminants.	Prohibit permanent gas tanks. Diesel & fuel oil - inside storage or special outdoor aboveground protection measures required.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
82xx	Educational Facilities - Elementary & Secondary Schools - Colleges and Universities - Junior Colleges - Vocational Schools		 R R R R	Chemistry/physics/biology labs, automotive repair shops, industrial arts, hazardous material storage and use, school, lab, and shop wastes.	Site plan review, spill prevention plans, material storage and waste management.
N.A.	Prisons		R	Similar to educational facilities - see above.	Site plan review - see above.
N.A.	Road Salt Storage	X		Act. - Stockpiling of road salt for deicing of roads and parking areas. Chem. - Sodium chloride, decaking agents.	Prohibit.
N.A.	Municipal and State Garages for Highway and Public Works Departments	X		Act. - Road maintenance related equipment storage and maintenance, fuel storage. Chem. - Cleaning solvents, hydrocarbons, pesticides, and other organic chemicals.	Prohibit.
N.A.	Roads, Transportation Corridors, Institutional, Commercial or Industrial Parking Areas		R	Act. - Deicing, highway runoff, drainage systems transportation spills/accidents. Chem. - Sodium chloride, hydrocarbons, hazardous materials.	Restrict use of sodium chloride. Design review - greater environmental safeguards.
N.A.	Airports	X		Act. - Deicing, maintenance of aircraft and equipment, fuel storage and distribution. Chem. - Hydrocarbons, solvents, waste oils, deicing chemicals, and other wastes.	Prohibit.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
15xx-17xx	Construction - Highway and Street Construction - Bridge, Tunnel, Elevated Highway - Water, Sewer, and Utility Lines - Heavy Construction, NEC		 R R R R	Act. - Fuel, vehicle storage and maintenance. Chem. - Hydrocarbons, cleaning agents.	Management plan for vehicle refueling and maintenance and spill response.
01xx	Agricultural Production - Crops		R	Act. - Pesticide/fertilizer storage and application. Chem. - Nitrates and certain pesticides such as EDB that can leach into ground water.	Farm Resource Management Plan.
02xx	Agricultural Production - Livestock		R	Act. - Animal waste management. Chem. - Nitrates.	Farm Resource Management Plan.
07xx	Agricultural Services - Veterinary services, livestock - Veterinary services, specialties		 R R	Act. - Disposal of medical wastes, use of pesticides. Chem. - Pharmaceutical chemicals, pesticides, alcohols.	Site plan review to address storage and disposal of pesticides and medical waste.
10xx-14xx	Mining Activities		R	Act. - Fuel, vehicle storage and maintenance. Chem. - Hydrocarbons, cleaning solvents.	Management plan for vehicle refuel/maintenance/spill response.
20xx	Food and Kindred Products		R	Act. - Raw material storage, processing wastes. Chem. - Nitrogenous wastes, preservatives.	Site plan review and management plan for hazardous materials.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
22xx	Textile Mill Production			Act. - Storage and use of hazardous materials, equipment cleaning and hazardous wastes.	Prohibit listed uses.
	- Dyeing	X			
	- Tanning	X		Chem. - Strong acids and alkalies, solvents, metals and hydrocarbons.	
	- Textile Coating	X			
	- Fabric Printing	X			
	All Other Textile Production		R		Site plan review and management plan for critical chemicals.
23xx	Apparel and Other Textile Products			Act. - Storage and use of hazardous materials, equipment cleaning and hazardous wastes.	Prohibit banned uses.
	- Dyeing	X			
	- Tanning	X		Chem. - Strong acids and alkalies, solvents, metals and hydrocarbons.	
	- Textile/Apparel Coating	X			
	- Fabric/Apparel Printing	X			
	All Other Apparel Production		R		Site plan review and management plan for critical chemicals.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
24xx	Lumber and Wood Production - Hardwood Veneer and Plywood - Softwood Veneer and Plywood - Wood Preserving - Reconstituted Wood Products *All Other Activities*	 X X X X	 R	Act. - Chemical treatment of wood, chemical storage. Chem. - Creosotes, tars, trichlorophenol, pentachlophenol, metals, solvents, oils.	Prohibit banned uses. Site plan review.
	Wood Household Furniture		R	Act. - Painting and finishing of wood, cleaning and maintenance of equipment. Chem. - Solvents, preservatives, paint wastes.	Site plan review hazardous material and waste material management plan.
26xx	Paper and Allied Products - Pulp and Paper Manufacturing *All Other Activities*	 X 	 R	Act. - Storage and use of hazardous and non-hazardous materials, large quantities of waste generation. Chem. - Toxic organic and inorganic chemicals metals, chlorinated hydrocarbons.	Prohibit listed activities. Site plan review hazardous material and waste material management plan.
27xx	Printing and Publishing - Including plate making, commercial lithographic, photoengraving, commercial printing, gravure.	X		Act. - Storage and use of organic chemicals, equipment cleaning, engraving. Chem. - Chlorinated solvents, phenols, hydrocarbon compounds.	Prohibit banned uses. Site plan review, hazardous materials, fuels, and waste management plan.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
28xx	Chemicals and Allied Products	X		Act. - Storage, use and production of chemicals, equipment cleaning and maintenance, hazardous waste generation. Chem. - Organic and inorganic chemicals.	Prohibit.
29xx	Petroleum and Coal Products	X		Act. - Storage and use of fossil fuels, machine shops, equipment cleaning and maintenance. Chem. - Hydrocarbons, solvents.	Prohibit.
30xx	Rubber and Miscellaneous Plastic Products - Rubber Manufacturing, e.g., Fabric Coating, Elastomer and Resin Cements, Tires and Tubes *All Other Activities*	X R		Act. - Raw material storage, process hazardous waste generation, machine shops. Chem. - Waste oils, solvents, phenols, strong organic and inorganic wastes.	Prohibit banned uses. Site plan review hazardous material and waste material management plan.
31xx	Leather and Leather Products - Leather Tanning and Finishing *All Other Activities*	X R		Act. - Storage and use of toxic chemicals. Chem. - Strong acids and alkalies.	Prohibit.
32xx	Stone, Clay and Glass Products - Glass Mirrors, Coating *All Other Activities*	X R		Act. - Machine shops, chemical processes for mirror and coating manufacturing. Chem. - Strong acids and alkalies.	Prohibit banned uses. Site plan approval.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
33xx	Primary Metal Industries	X		Act. - Foundries, metal forming, machine shops, equipment cleaning and maintenance use and storage of fuels, hazardous and non-hazardous waste generation. Chem. - Strong acids and alkalies, metals, chlorinated solvents, cyanides, waste oils.	Prohibit.
34xx	Fabricated Metal Products - Metal Plating or Cleaning, Etching and Degreasing *All Other Activities*	X R		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops. Chem. - Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, waste oils, paint and thinner wastes, cyanides.	Prohibit banned uses. Site plan review, hazardous materials, fuels, and waste management plan.
35xx	Industrial Machinery and Equipment - Metal Plating or Cleaning, Etching, Degreasing, and Contract Machine Shops *All Other Activities*	X R		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops. Chem. - Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, paint and thinner wastes, waste oils.	Prohibit banned uses. Site plan review, hazardous materials, fuels, and waste management plan.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
36xx	Electronic and Other Electronic Equipment - Metal Plating or Cleaning, Etching, and Degreasing	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops.	Prohibit banned uses. Site plan review, hazardous materials, fuels, and waste management plan.
	All Other Fabrication Activities		R	Chem. - Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, waste oils, paint and thinner wastes.	
37xx	Transportation and Other Electric Equipment - Metal Plating or Cleaning, Etching and Degreasing	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops.	Prohibit banned uses. Site plan review, hazardous materials, fuels, and waste management plan.
	All Other Activities		R	Chem. - Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, waste oils, phenols, PCBs, cyanides.	
38xx	Instruments and Related Products - Metal Plating or Cleaning, Etching and Degreasing	X		Act. - Storage and use of hazardous materials, hazardous waste generation, equipment cleaning and maintenance, machine shops.	Prohibit banned uses. Site plan review, hazardous materials, fuels, and waste management plan.
	All Other Activities		R	Chem. - Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, oils.	

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
39xx	Miscellaneous Manufacturing Ind.			Act. - Storage and use of hazardous materials, hazardous waste generation, equipment	Prohibit banned uses.
	- Metal Plating or Cleaning, Etching and Degreasing	X		cleaning and maintenance, machine shops.	Site plan review, hazardous materials, fuels, and waste
	All Other Activities		R	Chem. - Heavy metals, chlorinated hydrocarbons, strong acids and alkalies, oils.	management plan.
N.A.	Machine or Maintenance Shops As A Support Activity (no contract work)		R	Act. - Accidental or illegal discharge of cleaning solvents and waste oils. Chem. - Solvents, waste oils.	Site Plan Review - Hazardous material storage and use, waste handling, records of waste material management, spill control plan.
40xx-49xx	Transport; Communications; Utility				Prohibit banned uses.
	- Transportation Systems Main.	X		Fuel storage/distribution, solvents, waste oil.	
	- Crude Petroleum Pipelines	X		Hydrocarbon contamination.	
	- Refined Petroleum Pipelines	X		Hydrocarbon contamination	
	- Fossil Fuel Power Plants	X		Risks associated with fuels storage/use, large	Prohibit.
	- Electric Services		R	quantities of waste generation, machine shops,	Site Plan Review, hazardous
	- Electric & Other Service		R	equipment maintenance.	materials, fuels and waste
	Comb.		R		management plan.
	- Combination Utilities, NEC		R	Leaky pipes - exfiltration of contaminants.	Require Watershed equivalent
	- Sewerage Systems				pipe specifications in AOC.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
50xx-51xx	Wholesale Trade			Large volumes of various materials and products	Prohibit banned uses.
	- Coal & Other Minerals & Ores	X		handled, stored, and distributed that might	
	- Metal & Auto Parts Salvage	X		contaminate ground water as a result of accidents,	
	- Chemicals & Allied Products, NEC	X		poor management practices, flooding or fires. Solvents, organic and inorganic chemicals, and	
	- Petroleum Bulk Stations/Terminals	X		hydrocarbon contamination threats.	
	- Petroleum Products, NEC	X			
	- Paints, Varnishes & Supplies	X			
	All Other Wholesale Trade		R		Site plan review.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
52xx-59xx	Retail Trade			Act. - Maintenance and repair of vehicles, use of	Prohibit banned uses (ideal),
	- New or Used Car Dealers	X		solvents, lubricants, paints, brake, and	or prohibit those activities
	- Gasoline Service Stations	X		transmission fluids, generation of waste oils,	and chemicals of concern.
	- Boat Dealers	X		hazardous and non-hazardous wastes.	
	- Recreational Vehicle Dealers	X			
	- Motorcycle Dealers	X		Chem. - Hydrocarbons, solvents, benzene, waste oil	Site plan review.
	- Other Automotive Dealers	X		and other organic chemicals.	Special storage provisions, no
	- Fuel Oil Dealers	X			dry wells or floor drains.
	- Lumber & Other Bldg. Mat.		R		
	- Paint, Glass & Wallpaper		R		
	Stores		R		
	- Hardware Stores		R		
	- Retail Nurseries and Gardens		R		
	- Mobile Home Dealers		R		
	- Department Stores		R		
	- Auto and Home Supply Stores		R		
	- Other Fuel Dealers				

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
70xx-89xx	Personal or Business Services			Act. - Fuel storage, use and storage of oils, paints,	Prohibit banned uses.
	- Dry Cleaning Plants Except	X		thinners, various solvents, brake and	
	Rug	X		transmission fluids.	
	- Industrial Launderers	X			
	- Lawn Care Business	X		Chem. - Hydrocarbons, solvents, benzene	Evaluate case by case.
	- Heavy Constr. Equip. Rental		R		Prohibit vehicle engine
	- Power Laundries (Fam/Comml)		R		servicing and repair, require
	- Coin-Operated				Site Plan review.
	Laundries/Cleaning		R		
	- Beauty Shops		R		
	- Funeral Service & Crematories		R		
	- Photofinishing Laboratories		R		
	- Pharmacies				
76xx	Miscellaneous Repair Services:			General use of cleaning solvents, hazardous materials,	Prohibit banned uses.
	- Furniture Stripping	X		methylene chloride.	
	- Armature Rewinding Shops	X			
	- Marine Service and Repair	X			
	- Radio and Television Repair		R	Cleaning, lubricating and regeneration of equipment	Site plan review, management
	- Refrigeration Service & Repair		R	and parts. Solvents, oils and other materials.	plan for storage and use of
	- Other Electrical Repair Shops		R		hazardous materials, waste oil
	- Reupholstery & Furniture		R		and hazardous waste
	Repair				management.

TABLE 7
(continued)

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Standard Industrial Classification (SIC) and Associated Activity and Chemical Concern

SIC Number	Land Uses of Concern	Ban	Reg	Activity/Chemical Concern	Recommendation
8xxx	Health/Misc. Services:			Miscellaneous spills, leaks, illegal discharges,	Site Plan review, regulate to
	- Health Services		R	hazardous material storage, use, container disposal, lawn care including use of fertilizers and pesticide use, hazardous and non-hazardous waste disposal.	provide for spill prevention, proper waste handling, storage and disposal.
	- Biological or Chemical Research	X		Laboratory chemicals and waste materials.	Prohibit.
	- Testing Laboratories		R	Laboratory chemicals and waste materials.	Spill prevention plans,
	- Golf Courses		R	Act. - Lawn care including storage/use of fertilizers and pesticides, equipment maintenance, and waste management.	connect to public sewers. Management plan for lawn care, fertilizer/pesticide storage, equipment maintenance, waste management.
				Chem. - Pesticides/nitrates, waste oils, hydrocarbons.	

Source: Report of the Aquifer Protection Task Force, State of Connecticut, February 15, 1989.

TABLE 8

TASK 16
MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Municipality	Type of well	Number of wells	Baseline delineation method*	Calculated fixed-radius	Analytical flow modeling	Hydrogeologic mapping
Town of Wallkill (Braeside, Crystal Run and Kosuga well fields)	Sand and gravel	10	X	X	X	X
Village of Harriman	Sand and gravel	1 to 2	X	X	X	X
	Bedrock	7	X			X
Town of Crawford (Pine Bush Water District)	Sand and gravel	2	X	X		X
	Bedrock	1	X			X
Village of Greenwood Lake	Sand and gravel	3	X	X		X
Town of Woodbury	Sand and gravel	3	X	X	X	X
	Bedrock	3	X			X
Village of Washingtonville	Sand and gravel	1 to 3	X	X	X	X
Village of Maybrook	Bedrock	3 to 5	X			X
Village of Walden	Sand and gravel	5	X	X	X	X
Town of Chester (Sugar Loaf Water District)	Bedrock	2	X			X
Village of Chester	Sand and gravel	2	X	X		X
Village of Montgomery	Sand and gravel	2	X	X	X	X
	Bedrock	3	X			X

TABLE 8
(continued)

TASK 16
MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Municipality	Type of well	Number of wells	Baseline delineation method*	Calculated fixed-radius	Analytical flow modeling	Hydrogeologic mapping
Town of Blooming Grove (Merriwald Water District)	Bedrock	3	X			X
Village of Otisville	Sand and gravel	1	X	X	X	X

* Baseline delineation methods outlined on table 1.

TABLE 9

TASK 17
MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Municipality	Type of well	Number of wells	Baseline delineation method*	Calculated fixed-radius	Analytical flow modeling	Hydrogeologic mapping
(T) Blooming Grove	bedrock	11	X			X
	sand and gravel	1	X	X		X
(T) Chester	bedrock	6	X			X
(V) Chester	sand and gravel	2	X		X	X
(V) Cornwall	sand and gravel	6	X	X	X	X
(T) Goshen	bedrock	12	X			X
(V) Goshen	bedrock	3	X			X
(T) Hamptonburgh	bedrock	4	X			X
(V) Unionville	bedrock	1	X			X
(V) Kiryas Joel	bedrock	12	X			X
(V) Monroe	bedrock	2	X			X
(T) Montgomery	bedrock	2	X			X
(V) Montgomery	bedrock	1	X			X
(V) Walden	sand and gravel	3	X		X	X
(T) Newburg	bedrock	1	X			X
(T) Wallkill	bedrock	3	X			X

TABLE 9
(continued)

TASK 17
MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Municipality	Type of well	Number of wells	Baseline delineation method*	Calculated fixed-radius	Analytical flow modeling	Hydrogeologic mapping
(T) Warwick	bedrock	6	X			X
	sand and gravel	5	X	X		X
(V) Greenwood Lake	sand and gravel	3	X		X	X
(V) Warwick	sand and gravel	1	X	X		X
(T) Woodbury	sand and gravel	3	X		X	X
	bedrock	6	X			X

* Baseline delineation methods outlined on table 1.

TABLE 10

MODEL GROUND-WATER PROTECTION PLAN
ORANGE COUNTY WATER AUTHORITY
GOSHEN, NEW YORK

Proposed Wellhead Protection Area Delineation
For Public Water-Supply Wells

BEDROCK WELLS	
Remedial Action Area - Zone I	Fixed 200-foot radius from a well, modified where appropriate.
Well Field Management Area	
Primary Recharge Area - Zone II	Fixed 1,500-foot radius from a well, modified where appropriate.
SAND AND GRAVEL WELLS	
Remedial Action Area - Zone I	Fixed 200-foot radius from a well, modified where appropriate.
Well Field Management Area	
Primary Recharge Area - Zone II	
Sand and gravel aquifer of limited areal extent	Mapped boundaries of the sand and gravel aquifer, modified where appropriate.
Sand and gravel aquifer of large areal extent	Mapped to include the portions of the zone of contribution (ZOC) within the unconsolidated sand and gravel aquifer contributing ground water to the RAA (Zone I) utilizing alternative delineation methods.
Secondary Recharge Area - Zone III	Delineated as the portions of the ZOC within the upland till or bedrock which contributes ground-water flow directly to the primary recharge area. Watershed areas drained by perennial streams in the upland areas are excluded from the secondary recharge area.