CHAPTER 3.E

WATER SUPPLY

A. INTRODUCTION

The term "water supply" comprises the physical systems that support the City's population and one million upstate consumers with water. Most of the City's water supply is provided by three upstate watersheds, which collect rainwater via streams and pipes from large land coverage areas, and divert such rainwater to upstate reservoirs. Only a very small portion of the City in southeastern Queens is supplied with water from groundwater. This chapter examines the potential impacts on New York City's water supply from the proposed adulticide applications under the *Mosquito-Borne Disease Control Program.*

This chapter provides:

- A discussion of the Existing Conditions (i.e., an overview of the water-supply sources for the City of New York and pertinent regulations for such water-supply sources);
- A brief overview of expected Future Conditions Without the Proposed Action;
- A detailed discussion of the Methods of Analysis used in this chapter; and
- Results of the analyses of the potential impacts on the water supply from the application of adulticides under the *Mosquito-Borne Disease Control Program.* This section is called Probable Impacts of the Proposed Action.

In addition, this chapter also addresses the potential cumulative impacts on the surface-water supply should Westchester County perform similar concurrent adulticiding operations at the time such actions are undertaken in New York City. The representative study areas included in this assessment are the Jerome Park/Van Cortlandt Park South section of the Bronx (i.e., Jerome Park Reservoir) and the Edgemere/Far Rockaway and Jamaica Bay and Environs for the assessment of potential groundwater issues.

B. EXISTING CONDITIONS

OVERVIEW

The New York City water supply system provides approximately 1.4 billion gallons per day (gpd) of safe drinking water daily to 8 million City residents, as well as visitors, commuters, and approximately 1 million people living in Westchester, Putnam, Ulster, and Orange counties. While this water is used for the drinking water supply, it is also used for sanitary (e.g., showers, toilets, sinks), safety (e.g., fire hydrants) and commercial (e.g., cleaning, manufacturing) purposes. 99 percent of the City's drinking water is from surface-water supplies located in upstate watersheds, while over 350,000 residents of southeastern Queens receive groundwater or a blend of groundwater and surface water.

Surface water from three primary watersheds in upstate New York is impounded in the Croton, Catskill, and Delaware Systems, which include eighteen reservoirs and three controlled lakes. Water from all three of the surface-supply systems flows to the City by gravity through three aqueducts (Catskill Aqueduct, Delaware Aqueduct, and the New Croton Aqueduct), two balancing reservoirs in Westchester County (New Croton Reservoir in the Town of Yorktown and Kensico Reservoir in the Village of Valhalla), two distribution reservoirs (Hillview Reservoir in the City of Yonkers and Jerome Park Reservoir in the Bronx), and three tunnels (City Tunnels 1, 2, and 3). (The function of balancing and distribution reservoirs will be explained later in this chapter.) The three water systems were designed and built with various interconnections to increase flexibility by permitting the exchange of water from one system to another. Within the City, a grid of water mains distributes water to consumers from City Tunnels 1, 2 and 3. Orthophosphate is added to the City's water supply to create a protective film on pipes that reduces the release of metals, such as lead, from household plumbing.

Approximately 90 percent of the surface water comes from the Catskill and Delaware Systems, located in Delaware, Greene, Schoharie, Sullivan and Ulster counties, west of the Hudson River. For the Catskill and Delaware Systems, sodium hydroxide is added to reduce pH and control corrosivity. The Croton System, the City's original upstate supply, provides about 10 percent of the City's daily water from 12 reservoir basins and three controlled lakes in Putnam, Westchester, and Dutchess counties. Figure 3.E-1 depicts New York's City surface-water supply. In 2000, the City's groundwater system in southeastern Queens supplied an average of 12 million gallons per day (mgd) of drinking water, or less than 2 percent of the City's total use.

SURFACE-WATER SUPPLY WATERSHEDS

This section describes the City's three watersheds. In addition, it briefly discusses balancing reservoirs (where time is allowed for the settling out of impurities), and the distribution reservoir, both located in Westchester County, through which all water from the Catskill and Delaware systems flows.

Croton System

The Croton System is the oldest of the three water supply systems. Although it was once the only reservoir system supplying water from outside the City, the Croton System is now the smallest of the three systems. The Croton System consists of twelve reservoirs and three controlled lakes on the Croton River, with tributaries and branches extending into Westchester, Putnam, and Dutchess Counties in New York State and into Fairfield County in Connecticut. The Croton Watershed, located north of the New Croton Reservoir in Westchester County, encompasses a total of 375 square miles.

Water from the Croton System flows by gravity from the New Croton Reservoir to the Jerome Park Reservoir in the Bronx via the 33-mile New Croton Aqueduct. The Jerome Park Reservoir, a distribution reservoir, is located in the Bronx, at the downstream end of the Croton Aqueduct, and is the point at which water from the Croton system enters the New York City water distribution system. With a total storage capacity of 94.6 billion gallons and a safe yield of 240 mgd, the Croton System on the average provides approximately 10 percent of the City's average-day demand for drinking water. However, during droughts, the Croton System has served up to 29 percent of in-City demand (in sections of the Bronx and Manhattan). Water from the Croton System will be filtered upon completion of construction of the Croton Water Treatment Plant in 2007.

Catskill System

The Catskill System includes the Ashokan and Schoharie Reservoirs (in Ulster and Schoharie Counties), the Shandaken Tunnel (in Greene and Ulster Counties), the Catskill Aqueduct (connecting the Ashokan Reservoir to the Kensico Reservoirs, and the Kensico Reservoir to the Hillview Reservoir), the Kensico and Hillview Reservoirs (both in Westchester County), and City Tunnel 1. Situated approximately 100 to 125 miles north of lower Manhattan, the 571-square-mile Catskill Watershed consists of relatively sparsely populated areas in the central and eastern portions of the Catskill Mountains. Water from the Catskill System flows from the Schoharie Reservoir, reaching the Ashokan Reservoir, where the Catskill Aqueduct begins. From there, the water is conveyed 92 miles by the Catskill Aqueduct to the Kensico Reservoir, which is located east of the Hudson River in Westchester County. The current capacity of the Catskill Aqueduct from the Ashokan Reservoir to the Kensico Reservoir is 580 mgd, and the aqueduct's capacity from the Kensico Reservoir to the Hillview Reservoir is 800 mgd. With a total storage capacity of 178 billion gallons and a safe yield of 470 mgd, the Catskill System on average provides 35 percent of the City's average-day demand for drinking water.

Delaware System

The Delaware System extends between 85 and 125 miles northwest of lower Manhattan. The 1,010-square-mile Delaware Watershed is located just west of the Catskill Watershed. Three of the system's reservoirs (Cannonsville, Pepacton, and the Neversink) collect water from the region surrounding the branches of the Delaware River. These reservoirs then feed the water eastward to the West Delaware, East Delaware, and Neversink Tunnels. The water then flows through these tunnels to the Rondout Reservoir, where the Delaware Aqueduct begins. From the Rondout Reservoir, the water flows 70 miles by the Delaware Aqueduct to the West Branch Reservoir, located east of the Hudson River in Putnam County. From the West Branch Reservoir, the Delaware Aqueduct proceeds south to the Kensico Reservoir and finally to the Hillview Reservoir and into City Tunnel No. 2 which traverses through the Bronx, Queens, Brooklyn and into the Richmond Tunnel and the Silver Lake Tanks in Staten Island. With a total storage capacity of 326 billion gallons and a safe yield of about 580 mgd, the Delaware System on average provides approximately 55 percent of the City's average day demand for drinking water. During drought emergencies, the flow in the Delaware Aqueduct can be supplemented by up to 100 mgd of water from the Hudson River at the Chelsea Pumping Station located in Dutchess County.

The Kensico and Hillview Reservoirs

All water from the Catskill and Delaware systems flows through the Kensico and Hillview Reservoirs. These reservoirs are both located in Westchester County, and function as balancing and distribution reservoirs, respectively, for the water-supply system. Water from both the Catskill and Delaware aqueducts enters the Kensico Reservoir before proceeding to the Hillview Reservoir via both aqueducts. Therefore, from the Kensico Reservoir southward to New York City, the system is referred to jointly as the "Catskill/Delaware System."

Kensico Reservoir

The Kensico Reservoir is situated approximately 30 miles north of Manhattan in the Village of Valhalla, which is part of the Town of Mount Pleasant in Westchester County. The reservoir has a maximum storage capacity of about 31 billion gallons.

Its major function during normal operations is to receive water from all six Catskill and Delaware System reservoirs, and to make those water supplies available for the fluctuating daily demands of

New York City consumers. Catskill and Delaware water supplies are typically held in the Kensico Reservoir for approximately 15 to 25 days before proceeding to the City's distribution system, allowing additional time for settling out of impurities, including solids and microorganisms.

Hillview Reservoir

The Hillview Reservoir is situated approximately 15 miles north of Manhattan in the City of Yonkers. It has a storage capacity of about 929 million gallons (mg). As discussed above, the Hillview Reservoir receives water from the Kensico Reservoir through the Catskill and Delaware Aqueducts, and supplies water to the City distribution system through tunnels and water mains.

The Hillview Reservoir serves to balance the water demand hour by hour.

In addition to Tunnels 1 and 2, the City is in the process of completing the construction of Tunnel 3. The first stage of Tunnel 3 is in operation and helps supply water to Manhattan and western Queens.

GROUNDWATER SUPPLY SYSTEM

Overview

Some residents of southeastern Queens receive groundwater or a mix of surface and groundwater. Figure 3.E-2 depicts the distribution of groundwater (from wells), surface water (from upstate reservoirs), and mixed (both surface and well) water supplies to parts of southeast Queens. The groundwater comes from underground water-bearing strata of permeable rock, sand or gravel, known as aquifers, primarily the Upper Glacial, Post Jameco, and Magothy Aquifers. Locations that receive groundwater include sections of Cambria Heights, Hollis, Holliswood, Jamaica, Jamaica Estates, Kew Gardens, Laurelton, Queens Village, Richmond Hill, Rosedale, St. Albans, South Ozone Park, and Springfield Gardens.

The Upper Glacial and Post Jameco Aquifers are shallower than the Magothy Aquifer. Wells in service from the Upper Glacial and Post Jameco Aquifers are at depths ranging from to 102 to 158 feet. The shallowest well in service from the Magothy Aquifer is at a depth of 275 feet. Water supplied from wells is chlorinated and fluoridated.

Unlike the surface-water supplies from upstate reservoirs, the raw groundwater supplies may contain volatile organic compounds (VOCs), which have been entrained (drawn) into the water supply by spills or discharges of industrial products, including oil-based products that contain VOCs. Air-stripper facilities operate at several wells to remove VOCs found in those sources. Air strippers operate by blowing ambient air through aerators where water flows. The forced air dissolves in water and removes most of the VOC contaminants, by converting them to the gaseous phase. As a result, the air strippers discharge the VOCs into the surrounding ambient air. With treatment, the well-water supply is of a high quality and meets all Federal and State drinking-water standards.

Since the air strippers function by blowing a large volume of ambient air as the primary means to displace VOCs from the groundwater supply, the potential exists for airborne adulticides to become entrained in the air strippers. This is addressed later in this chapter, in the section called Probable Impacts of the Proposed Action.

Wells and Air Strippers

The actual number of wells and air strippers in service in southeast Queens can vary from year to year. During the summer of 2000, nineteen wells were in use. Seven of these wells used air strippers to remove VOCs from the groundwater supply. Figure 3.E-3 depicts the locations of the wells with air

strippers that operated in 2000. The maximum capacity of the wells in service is approximately 30 mgd, but the existing use is about 12 mgd. While wells with air strippers on the average provide about 0.3 percent of New York City consumption, some City residents' water supply is provided solely from groundwater that has passed through air strippers.

At the wells with air strippers, water pumped from the aquifer passes through air strippers and then flows by gravity into clear wells. The average capacity of the clear wells is about 3,000 gallons. Water is pumped from the clear wells and pressurized into the distribution system. In the distribution system, water that passed through the air strippers may mix with water from other wells or from surface water. During periods of low consumption (e.g., nighttime) water that passed through air strippers recharges water tanks where it is mixed with water that did not pass through air strippers. Mixing will vary according to local consumption, the location of wells and storage tanks, and the capacity of storage tanks. The capacity of storage tanks varies from 250,000 gallons to 4 million gallons (17 of the 23 storage tanks have capacity of 1 million gallons or less).

Pumps from the wells can be regulated by remote control from the New York City Department of Environmental Protection (NYCDEP) Groundwater Control Center, where wells with air strippers could be turned off for short periods of time. However, the wells on 199th Street, which have air strippers, cannot be turned off because the distribution system in that area is not connected to the surface-water distribution system.

SAFE DRINKING WATER ACT AND NEW YORK DRINKING WATER STANDARDS

Federal Standards and Guidance

Under the Safe Drinking Water Act (SDWA), maximum contaminant levels (MCLs) for 83 contaminants, including 24 active ingredients in pesticides, have been established by the United States Environmental Protection Agency (USEPA) for drinking-water supplies for community and non-community systems. Of the 24 pesticides for which the USEPA has established MCLs, 14 active ingredients are still registered for use by USEPA (USEPA, October 2000.) The MCL is established to be as close as possible to the maximum contaminant level goal (MCLG), where, pursuant to the 1996 amendments to the SDWA, the MCLGs are based on the assessed risks for lifetime exposure for adults who drink 2 liters of water (i.e., a little more than 2 quarts) per day. The MCLGs developed by USEPA also account for potential risks to children, the elderly and other sensitive groups, and these sensitive population groups are included in the analysis completed for purposes of determining the regulatory MCL.

The MCL for each contaminant is based on a consideration of the best available technology (BAT), as well as frequency and duration of exposure, health effects and toxicity, and economics. Once the MCL is established for a contaminant, the contaminant is included on the list of regulated contaminants. Under the current SDWA, the allowable levels of some pesticides should not exceed their MCLs. These MCLs have been established to be protective of human health and must be "feasible." The feasibility is determined by BAT removal efficiency, levels of contaminants in raw water, water quality parameters, and the contaminant concentrations that can be accurately quantified analytically. None of the active ingredients for which MCLs that have been under the SDWA are planned for use as part of the Proposed Action. There are USEPA MCLs set for products that are considered to fall under the general category of petroleum distillates, and may be used as inert ingredients in the formulation of adulticides. These products include xylene and toluene, which have MCLs of 10 and 1 milligrams per liter (mg/L), respectively. They may be inert constituents proposed for use against adult mosquitoes.

USEPA also provides Health Advisory Levels (HALs). HALs for a drinking water supply contaminant are short- and long-term estimates of the acceptable drinking water level for that chemical substance, and are based on health-effects information. HALs are not legally enforceable Federal standards. Instead, they are intended to serve as technical guidance to assist Federal, State and local officials (USEPA, Summer 2000). HALs are established by the USEPA under the SDWA when adequate scientific information is available, but an MCL has not yet been officially set. Of the active ingredients being considered for use in this EIS, malathion is the only one that has HALs suggested by USEPA. For a small child, the HAL is 0.2 mg/L for the short-term (i.e., 1 to 10 days of water consumption at that concentration). For lifetime exposure (i.e., the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure), the HAL for malathion is 0.1 mg/L.

For petroleum distillates, such as toluene and xylene, the HALs are much higher than the suggested malathion levels. For example, the HAL for toluene is 20 mg/L for 1 day and 2 mg/L for a 10-day water consumption value (for a small child), and 1 mg/L for lifetime exposure.

New York State Standards

New York State MCLs are established under the New York State Department of Health Public Water Systems Regulations (New York State, 1998). State MCLs are similar to Federal MCLs but include general standards that apply to any organic chemical contaminant that does not have a specific MCL listed in regulation. These include (1) a standard of 0.005 mg/L for Principal Organic Contaminants (POCs), (2) a standard of 0.050 mg/L for any other organic contaminants (Unspecified Organic Contaminants, [UOCs]), and (3) a standard of 0.100 mg/L for the total of POCs and UOCs. By definition, POCs are the classes of organic chemicals which include (i) halogenated alkanes, (ii) halogenated ethers, (iii) halobenzenes and substituted halobenzenes, (iv) benzene and alkyl- or nitrogen-substituted benzenes, (v) substituted, unsaturated hydrocarbons, or (vi) halogenated non-aromatic cyclic hydrocarbons. The adulticides include active ingredients that would fall under the category of UOCs, while the inerts in many adulticide products could likely be considered to be POCs.

New York State surface-water-supply standards have been established by the New York State Department of Environmental Conservation (NYSDEC) for (1) the protection of aquatic species, humans, and wildlife using the resource, and (2) preservation of the quality of water for use as a potential drinking-water source or for fishing. These standards are designed to protect these waters from health and aesthetic impacts.

Under Title 6 of the Official Compilation of Codes, Rules, and Regulations of the State of New York (6 NYCRR), Chapter X, Article 2, Part 703, surface and groundwater quality standards have been promulgated by NYSDEC. For water sources located within New York City, the Jerome Park Reservoir is classified as Class AA fresh surface waters, and the Magothy and Jameco Aquifers are classified as Class GA fresh groundwaters. These classifications are used to establish discharge levels.

For malathion, the only active ingredient in the adulticides under consideration that has compound specific New York water-supply standards, New York State has a current groundwater drinking water supply standard of 0.007 mg/L, which is based on former groundwater standards; and a surface-water supply standard of 0.0001 mg/L, which is based on protecting aquatic sources from chronic or long-term effects. The New York State surface-water supply standard for potential inerts in petroleum

distillates, such as toluene and xylene, is 0.005 mg/L; and for groundwater supply levels, a principal organic contaminant standard of 0.005 mg/L would be applicable for toluene and xylene.

EXISTING LEVELS OF PESTICIDES IN WATER SUPPLIES

In 1997, the U.S. Geological Survey (USGS), in cooperation with NYSDEC, began a statewide monitoring program to assess the occurrence of pesticides in groundwater and surface waters of New York State, including Long Island (USGS, 1999). A part of the monitoring program investigates the occurrence of pesticides and their metabolites, which are breakdown products formed by degradation of the pesticides' active ingredients, in public-water-supply reservoirs. As part of this program, water samples were collected at the ten New York City water-supply reservoirs that comprise the New York City reservoirs network. This program also collected samples at three Finger Lakes, Lake Erie, and Lake Ontario, and three small reservoirs in western New York that supply small cities or towns.

Of the 60 active ingredients and active ingredient-metabolites for which samples were analyzed, 16 (27 percent) were detected, 8 of which were herbicides, and 8 of which were herbicide metabolites. No insecticides were detected. The concentrations of the compounds detected in the samples generally were low. Only a few of the compounds detected had a concentration exceeding 0.001 mg/L, and no compounds detected in the New York City reservoirs network had concentrations exceeding 0.05 mg/L. None of the compounds detected exceeded any Federal or State water-quality standard. Median total pesticide and metabolite concentration for the New York City reservoirs network was less than 0.00002 mg/L.

NYCDEP also continuously monitors the quality of the water supply as it enters the distribution system, and conducts regular tests at sampling points throughout the entire City. NYCDEP conducts analyses for a broad spectrum of microbiological, chemical, and physical measures of quality. In 1999, NYCDEP collected more than 41,500 in-City samples and performed approximately 594,300 analyses. POCs are tested as part of this program, and approximately 50 POCs which are included in the monitoring program were below detections limits. This includes POCs that could be included in the inerts, such as toluene and xylene.

C. FUTURE WITHOUT THE PROPOSED ACTION

In the future without the proposed *Mosquito-Borne Disease Control Program*, real-estate development is expected to be ongoing within the City and representative study areas. The *Routine Program* elements of the *Comprehensive Arthropod Surveillance and Control Plan* would also continue. While growth is expected in the City's population and employment throughout the City, this growth is not expected to overburden the City's water supply.

The City remains committed to protecting its water supply sources and distribution. In the future without the proposed *Mosquito-Borne Disease Control Program*, the City expects the water supply to remain of high quality. Pursuant to the adopted Watershed Regulations, NYCDEP reviews all permits submitted to NYSDEC for pesticide applications within the watershed. Should upstate counties apply adulticides to control mosquito-borne pathogens, such actions will have to be limited to label restrictions, and NYCDEP may require additional restrictions. Furthermore, NYCDEP could add monitoring for the presence of adulticides in upstate reservoirs, if warranted in the future.

D. METHODS OF ANALYSIS

SURFACE WATER

Overview

An analysis of the potential infiltration of adulticides into the surface-water supply was performed. This analysis considered both an exposed, open-water-supply source in New York City and sources outside the physical boundaries of New York City. As part of the restrictions on the products and the methods of application that will be employed as part of the Proposed Action, there will be no direct application of adulticides into surface-water supplies within either New York City or counties north of the City. Since the estimates of the concentrations of adulticides serve as an input to the public health risk assessment, a series of conservative assumptions on the fate of the products were made. The net effect of these assumptions may overestimate the likely concentrations in the water supply by an order of magnitude (i.e., a factor of 10 times) or more.

Within New York City Boundaries

As discussed above, three different surface-water supply sources were selected for analysis. Within the boundaries of New York City, the potential introduction of adulticides into the Jerome Park Reservoir was simulated. Since the surface of the Jerome Park Reservoir is at the highest local grade elevation in the immediate area and there is no runoff from the surrounding region into the reservoir, the primary method for adulticide contact with this waterbody would be deposition of airborne adulticides onto the surface of the reservoir.

Cumulative Impacts from Outside New York City Boundaries

While not within the areas affected by the City's proposed *Mosquito-Borne Disease Control Program,* the Croton Watershed system and the Hillview Reservoir were analyzed to determine the maximum potential adulticide concentrations in these sources from independent actions undertaken by agencies outside the City. Like the Jerome Park Reservoir, the Hillview Reservoir is at the highest local grade elevation in the immediate area and there is no significant runoff into the reservoir. However, the reservoirs that feed or supply the Croton Watershed System are supplied with water primarily from rainfall runoff and, therefore, the potential maximum concentrations in the watershed from adulticide applications over the drainage basin for the watershed were analyzed.

Within New York City Boundaries

Jerome Park Reservoir

As discussed above, there would be no direct application of adulticides onto waterbodies, including the Jerome Park Reservoir in the Bronx, within 100 feet of such waterbodies by truck applications, or within 300 feet by aerial application. As discussed in Chapter 3.A, "Framework of the Analysis," the results of the air-drift modeling indicated that there is significantly less deposition of products from trucks beyond 300 feet from point of application; and deposition concentrations from aerial applications would be less than those from truck applications. The resultant deposition of the airborne adulticides onto the ground at distances greater than 300 feet from point of application comprises a relatively small percentage of the product applied, because deposition concentration decreases as distance increases from the point of application.

Initial Screening-Level Analysis

In order to provide an initial screening worst-case estimate for the input to the risk assessment analyses presented in Chapter 3.C, "Public Health," upper-end worst-case estimates of the potential maximum concentration of active ingredients in the Jerome Park Reservoir were performed. The initial screening analysis assumed that one percent of all active ingredients sprayed within an approximate 1/3-mile radius of the Jerome Park Reservoir perimeter would deposit into the Jerome Park Reservoir. Ten spray events in the year were assumed to occur near the Jerome Park Reservoir, and this material was assumed to mix in the approximately 800 million gallons of water in the reservoir. For this initial screening analysis, no net flow (i.e., new freshwater from the Croton system or release of water to the City's distribution system south of the Jerome Park Reservoir) of water through the reservoir during the complete time period for the 10 spray events was assumed. In addition, no credits for the degradation of the active ingredients over time were applied in the analysis. The public health risk analyses utilized these initial worst-case estimates as part of the input to the risk assessment analyses presented in Chapter 3.C, "Public Health."

Second-Level Screening Analysis

Since the initial screening analysis was performed to yield upper-end worst-case estimates of the potential maximum concentration of active ingredients in the Jerome Park Reservoir, such unrealistic overly conservative estimates would not be prudent for comparisons to drinking water standards. Therefore, a second-level screening analysis was performed to yield conservative estimates of adulticide concentrations in the water supply for comparison to drinking water standards. For the second-level screening analysis, the net flow through the Jerome Park Reservoir and estimates of the potential deposition of adulticides based on the air quality modeling results were used in the analysis. These modeling results are discussed in Chapter 3.A, "Framework of the Analysis."

The Jerome Park Reservoir has a net daily average flow of 110 mgd when in operation, and with a capacity of 800 million gallons, the water in the Jerome Park Reservoir has a complete turnover in about a week. Therefore, the second-level screening analysis assumed two spray events would occur during the seven days before the water is completely replenished at the reservoir. The analysis also assumed that the deposition of adulticides into the Jerome Park Reservoir would be from trucks 300 feet from one side of the reservoir, and that the wind would blow perpendicular to the trucks towards the reservoir.

Cumulative Impacts from Outside New York City Boundaries

Croton Watershed

As discussed above, the Croton Watershed includes the region in Westchester and Putnam Counties where rainfall helps supply the reservoir systems that comprise the Croton surface-water supply system. While there would be no direct application of adulticides onto waterbodies, this screening analysis assumed that all of the product applied in the watershed would eventually drain into the reservoir systems. Ten spray events in the year were assumed to occur over 50 percent of the total Croton Watershed basins.

The Croton Watershed includes a land area of approximately 375 square miles including areas covered by waterbodies, and has a storage capacity of 94.6 billion gallons of water. For every inch of water runoff from rainfall, 6.52 billion gallons of water are supplied to the system. Given the large vegetation and permeable soil coverage of the watershed area (typically about 70 percent of rainfall in rural areas does not run off, but goes into the ground), and given that approximately 10 percent of the watershed is covered by waterbodies, and that there are large land coverages over the complete

watershed that are not accessible by truck, and that the active ingredients would tend to adhere to organics, it was estimated that 5 percent of the active ingredients would become entrained into the reservoir. The analysis also assumed that seven inches of water would run off in rainfall over the time period that the ten spray events occur. No credits for the breakdown of the adulticides in the water over time were applied in the analyses.

Since the Croton Watershed system supplies the Jerome Park Reservoir, the potential cumulative impacts from adulticide spraying within the City and outside the City boundaries were determined. The largest calculated adulticide concentration in any of the water supply components (i.e., the initial screening values from the potential deposition into the Jerome Park Reservoir) was employed as the worst-case cumulative impact for the public health risk assessment.

Hillview Reservoir

While there would be no direct application of adulticides onto water bodies including the Hillview reservoir in Yonkers because of the label restrictions for the products, an analysis similar to that employed for the second-level screening analysis for Jerome Park Reservoir was performed. For this analysis, the net flow through the Hillview Reservoir and estimates of the potential deposition of adulticides based on the air quality modeling results which are discussed in Chapter 3.A, "Framework of the Analysis," were used.

Given that the Hillview Reservoir has a net daily average flow of 1.2 billion gallons per day (and with a capacity of 900 million gallons, the water in the Hillview Reservoir has a complete turnover in about one day), the second-level screening analysis assumed one spray event would occur before the water is completely replenished at the reservoir. No credits for the breakdown of the adulticides in the water over time were applied in the analysis. The analysis assumed that the deposition of adulticides into the Hillview Reservoir would be from trucks 300 feet from one side of the reservoir, and that the wind would blow perpendicular to the trucks towards the reservoir.

GROUNDWATER

Similar to the approach employed in the surface-water analyses, a series of conservative assumptions on the fate of the products were assumed, so that upper limits of adulticide concentrations in the groundwater supply were calculated. For the groundwater analyses, two scenarios were assessed:

- Infiltration into the aquifers; and
- Transfer of airborne adulticides into the water supply via air strippers.

The maximum application rates of the products along with the assumption of up to ten spray events per year were assumed in these analyses. As discussed below, a series of assumptions on the fate and transport of these adulticides (e.g., no breakdown of products due to sunlight or hydrolysis in water) were applied in these screening analyses in order to calculate upper-end estimates of the concentration of adulticides into the City's groundwater supply.

Infiltration into Aquifers

To address the potential impacts on groundwater supplies from the proposed project, the USEPA's PESTAN groundwater modeling software was used. PESTAN is a PESTicide ANalytical computer model developed to predict the rate of pesticide transport through the subsurface environment until it reaches the groundwater supply (USEPA, 1986). PESTAN was used in this EIS as a screening level model to determine whether there would be a need for further, more detailed investigations. The necessary input parameters include soil characteristics, some physical characteristics of the particular

pesticide, the recharge rate (the average annual amount of rainfall), the depth of interest (i.e., how far a depth to calculate the downward migration of the pesticide), and time of interest for the simulation. In order to project conservative estimates of the potential contamination to the groundwater supplies, model input values were selected to calculate upper-end estimates of the concentration of adulticides into the groundwater supplies. Where multiple references indicated disparate values for a parameter, the more conservative value (i.e., the value that would result in greater pesticide concentrations in the groundwater) was used. For example, the average annual amount of rainfall (recharge rate) was entered into the model with no adjustments to account for the fact that not all of this rainfall actually makes it into the subsurface environment. The assumption was made that the area modeled consisted of a completely permeable surface, with no paved areas. Adulticides that are deposited on paved areas would be carried with rainwater from the next rainfall event into City storm sewers, where they would be transported to a sewage-treatment facility or released into nearby waterways. These potential impacts are addressed in Chapter 4.D, "Natural Resources." Adulticides deposited on unpaved areas, such as lawns and parks, would be carried by the next rainfall event through the soil and eventually to the groundwater.

The two aquifers that are utilized as potable water sources for New York City are the Jameco Aquifer and the Magothy Aquifer. An aquifer is a subsurface layer consisting of a porous material such as sand and/or gravel that retains a significant amount of water in the pore spaces. The different aquifers in Queens and on Long Island are separated by a relatively impermeable layer of tightly packed clay or bedrock so that very little water passes between the aquifers and very little water is stored in the impermeable layer. Rainwater is the primary supply of water entering the upper aquifer, the Upper Glacial Aquifer, which can be encountered less than ten feet below the ground surface in some areas of Queens. The Post Jameco Aquifer is located below the Upper Glacial Aquifer and above the Magothy Aquifer. However, the impermeable layer between the Post Jameco and the Upper Glacial Aquifer is absent in some areas. Several groundwater supply wells are located in what is referred to as the "Upper Glacial/Post Jameco Aquifer." Since groundwater in the Upper Glacial Aquifer in Jamaica, Queens, can be encountered at depths as shallow as approximately ten feet below grade, this value was used as the depth to reach groundwater for simulation purposes. The effect on the simulation of a greater depth to groundwater would be a longer time for the pesticide to reach the groundwater and a lower concentration of pesticide in the groundwater. In addition, adulticides will degrade over time. Therefore, the longer it takes for the adulticide to reach the groundwater, the less adulticide there will be to reach the groundwater. An additional very important parameter for this model is soil characteristics. A soil consisting of small, tightly packed particles would result in much slower infiltration rates. The soil in this part of Queens, however, typically consists of larger grained materials such as sand and gravel. This would result in higher infiltration rates due to the soil's relative porosity.

Each of the active ingredients subjected to quantitative analysis was modeled as if ten applications took place. To accommodate the model restrictions, the simulation assumed that all applications occurred at the same time, even though such applications, should they actually occur, would happen over a much longer time in real life. Rainfall was estimated to occur immediately following the pesticide application, resulting in a minimal amount of time for pesticide degradation to take place at the surface. The simulation was run for a time period long enough for decreasing concentrations at the selected depth for the groundwater supply to be noted in the model output. For the time period immediately following the application, concentrations in the water reaching the groundwater supply are zero. Shortly after, the PESTAN model calculates how long it will take the adulticide to reach the groundwater, and computes the increase in concentrations for some period of time until a maximum

concentration is reached. Following this, as degradation takes place, concentrations would decrease and eventually reach zero again. The time until the maximum concentration is reached would differ for each adulticide modeled.

The output of the PESTAN model provides a concentration of the adulticide in a drop of downward-migrating water, as it reaches the groundwater supply.

Air Strippers

The potential for airborne pesticide to be pulled into the air strippers used to treat groundwater in southeast Queens, which may result in contamination of the water after contact with forced air, was also analyzed. The analysis consisted of using physical characteristics and empirical data on the adulticides, especially those characteristics and data involved in estimating the solubility (i.e., the maximum concentration of adulticides in water under steady-state conditions) of the adulticides. The analysis employed Henry's Law, which is a proven scientific method for estimating the partitioning (i.e., estimating the relative amount of a contaminant) between the gas (in this case, the airborne adulticides) and the liquid (in this case, the water passing through the air stripper) phases.

E. PROBABLE IMPACTS OF THE PROPOSED ACTION

Based on the discussion of the potential pathways of exposure in Chapter 3.A, "Framework of the Analysis," the surface water supply source that could be most affected by adulticide spraying at locations throughout the City is the Jerome Park Reservoir in the Bronx (which is included in the Jerome Park/Van Cortlandt Park South representative study area). The assessment of the impacts on groundwater supplies addresses the potential deposition of adulticides on the ground and, after rainfall, the migration of adulticides into the aquifers below southern Queens and Brooklyn, which supply the City's groundwater system; and the potential partitioning of airborne adulticides, which may enter air strippers and be transferred from the air into the water passed through the air strippers (i.e., from the gas to the liquid phase). The Edgemere/Far Rockaway and Jamaica Bay and Environs Representative Areas include locations where such groundwater supply issues may occur.

In addition, since Westchester and Putnam Counties may also decide to spray adulticides in those respective counties in the future as part of their control of mosquito-borne viruses, an assessment of the potential cumulative impacts on New York City surface water supplies was performed employing the analysis methods discussed above. This included an assessment of the potential runoff of adulticides into the Croton Watershed from actions potentially undertaken by Westchester and Putnam counties; and the potential deposition of adulticides into the Jerome Park Reservoir, which receives water from the Croton Watershed, by the New York City Department of Health (NYCDOH) sponsored actions. Analysis of the potential deposition of adulticides into the Hillview Reservoir, which is outside the City's boundaries and is supplied by the Catskill/Delaware Watersheds much further north of the City, from adulticiding actions undertaken by Westchester County, was also performed. Initial worst-case screening analyses were computed for the public health analyses presented in Chapter 3.C, "Public Health," while a second-level screening analysis was performed to estimate the potential deposition of adulticides into the Jerome Park and Hillview Reservoirs in order to make more appropriate comparisons of adulticide concentrations in the water supply for comparison to drinking water standards or published health effect levels for drinking water.

ANALYSIS RESULTS

The potential concentrations were calculated from (1) the application within the City's boundaries of adulticides that might reach the water-supply sources and (2) the potential maximum cumulative concentrations from adulticides entering the water system from applications outside New York City under the direction of non-New York City agencies. Presented below is a summary of the impacts from active ingredients, followed by an assessment of the potential impacts from the inerts in these products.

Within New York City Boundaries

Surface Water Supply

Organophosphates

Initial Screening Analysis

Based on the initial screening analyses discussed above, upper-end worst-case estimates of the maximum concentrations of active ingredients from organophosphates in the Jerome Park Reservoir water supply were calculated for use in the public health impact assessments. Table 3.E-1 presents the results of these initial screening level analyses. This analysis was based on the assumption that there would be no net flow through the reservoir, a cumulative 10 adulticide spraying events would occur, and 1 percent of the adulticides sprayed within an approximately 1/3-mile radius of the reservoir would deposit into the reservoir.

TABLE 3.E-1
Initial Screening Concentrations of Active Ingredients in Jerome Park Reservoir for Input to Public Health Analysis
(in mg/L)

Organophosphates		Pyrethroids			
Malathion	Naled	Permethrin	Resmethrin	Sumithrin	Piperonyl Butoxide (PBO)
0.001630	0.000603	0.000634	0.000211	0.000109	0.000634

As shown in Table 3.E-1, for the Jerome Park Reservoir within the City boundaries, the upper-end worst-case predicted organophosphate active ingredient concentrations for use in public health analyses were 0.00163 and 0.000603 mg/L for malathion and naled, respectively.

Second-Level Screening Analysis

Following the methodology discussed above, maximum predicted concentrations for comparisons to drinking water quality standards were estimated. These analyses accounted for the net flow through the reservoir and utilized the estimates of deposition from drift from the modeling described in Chapter 3.A, "Framework of the Analysis." Table 3.E-2 presents the maximum predicted concentrations from the second-level screening analysis for the organophospates' active ingredients malathion and naled. As shown in Table 3.E-2, the maximum predicted concentrations were 0.0000182 and 0.0000675 mg/L for malathion and naled, respectively.

Malathion is the only organophosphate active ingredient with corresponding HALs (from USEPA) and a compound specific New York State Drinking Water Supply Standard. The maximum predicted malathion concentrations in the Jerome Park Reservoir from the second-level screening analysis were

TABLE 3.E-2
Second-Level Screening Concentrations of Active Ingredients in Jerome Park Reservoir for Comparison to Drinking Water Supply Standards (in mg/L)

Organophosphates		Pyrethroids			
Malathion	Naled	Permethrin	Resmethrin	Sumithrin	Piperonyl Butoxide (PBO)
0.0000182	0.00000675	0.00000708	0.00000236	0.00000121	0.00000708

calculated to be less than the corresponding New York State Drinking Water Supply Standard (0.0001 mg/L for surface water) and the short- and long-term HALs recommended by USEPA. While a compound-specific drinking water standard has not been set for naled, this active ingredient can be considered to be a UOC with a standard of 0.050 mg/L, and maximum predicted naled concentrations in Jerome Park Reservoir were well below this standard. Based on these maximum predicted concentrations of malathion in the reservoir and the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of active ingredients from organophosphates in adulticides into the Jerome Park Reservoir would not result in any significant adverse human health impacts.

Pyrethroids

Active Ingredients

Initial Screening Analysis

Based on the initial screening analyses discussed above, upper-end worst-case estimates of the maximum concentrations of active ingredients from pyrethroids in the Jerome Park Reservoir water supply were calculated for use in the public health impact assessments. Table 3.E-1 presents the results of these initial screening level analyses. This analysis was based on the assumption that there would be no net flow through the reservoir, 10 adulticide spraying events would occur, and 1 percent of the adulticides sprayed within an approximately 1/3-mile radius of the reservoir would deposit into the reservoir.

As discussed earlier, in Chapter 2, "Pesticide Regulations and Usage," PBO was considered to be an active ingredient for these analyses. As shown in Table 3.E-1, for the Jerome Park Reservoir within the City boundaries, the upper-end worst-case predicted pyrethroid active ingredient concentrations for use in public health analyses ranged from 0.000634 (permithrin and PBO) to 0.000109 (sumithrin) mg/L.

Second-Level Screening Analysis

Following the methodology discussed above, maximum predicted concentrations for comparisons to drinking-water quality standards were estimated. These analyses accounted for the net flow through the reservoir and utilized the estimates of deposition from drift from the modeling described in Chapter 3.A, "Framework of the Analysis." Table 3.E-2 presents the maximum predicted concentrations from the second-level screening analysis for the pyrethroid active ingredients. As shown in Table 3.E-2, the maximum predicted concentrations ranged from 0.00000708 (permithrin and PBO) to 0.00000121 (sumithrin) mg/L.

There are no compound specific drinking water standards or HALs for the active ingredients in the pyrethroids under considerations. However, the active ingredients in pyrethroids can be considered as UOCs, and the maximum predicted active ingredient levels in the Jerome Park Reservoir were well

below the standard of 0.050 mg/L. Based on the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of active ingredients from pyrethroids (which were less than the corresponding values for organophosphates) in adulticides into the Jerome Park Reservoir would not result in any significant adverse human health impacts.

Inerts

As discussed in Chapter 2, "Pesticide Regulations and Usage," and Chapter 3.A, "Framework of the Analysis," inerts can make up a relatively large percentage of pyrethroid products. Biomist 1.5+7.5 ULV, which contains 1.5 percent of the active ingredient permethrin, and 91 percent inerts, contains the maximum amount of applied inerts in any of the pyrethroid products. This amount is approximately 118 times greater than the application rate of the active ingredient sumithrin (found in Anvil 2+2 and Anvil 10+10). The minimum amount of applied inerts in any of the pyrethroid products is found in Scourge 18+54, and is approximately three times the application rate of the active ingredient sumithrin. Based on the summary of results in Table 3.E-2, the maximum concentrations of inerts would range from 0.000143 to 0.00000364 mg/L.

While the complete identity of inerts for each product are not known, as discussed above, HALs for petroleum distillates such as toluene and xylene are on the order of 1 mg/L for short-term concentration (which would be the case for these scenarios). New York State standards for surface drinking water are 0.0005 mg/L POC. Maximum predicted inert organic concentrations in the Jerome Park Reservoir were calculated to be less than the corresponding POC standard, and less than typical short- and long-term HALs recommended by USEPA. Based on HALs and the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health impact assessment, the concentrations of inert ingredients from adulticides into the Jerome Park Reservoir would not result in any significant adverse human health impacts.

Conclusions of Impacts on Surface Water Supply

Based on the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment and comparison to standards and HALs for drinking water, the application of the adulticides which could deposit into the Jerome Park Reservoir would not result in any significant adverse human health impacts.

Groundwater Supply

Infiltration to Aquifers

Organophosphates

Based on the results from the PESTAN model, the maximum concentration of the active ingredients in the adulticides with organophosphates under consideration are presented in Table 3.E-3. The concentrations presented in this table are conservative estimates, since they represent the maximum concentrations of a drop of water entering into the aquifer. In reality, once a drop of water reaches the groundwater interface, it would be mixed into and diluted by the existing water in the aquifer, which could result in organophospate concentrations in the groundwater supply from adulticides that are many orders of magnitude smaller than (hundreds if not thousands of times less than) than the conservative estimates reported in Table 3.E-3. In addition, if greater depths to groundwater were applied to the PESTAN modeling, the concentrations reported in Table 3.E-3 would be lower. Once the active ingredient reaches the groundwater, it would migrate in the direction of groundwater flow. A relatively impermeable layer separates the different aquifers. Therefore, the amount of water that

TABLE 3.E-3
Maximum Calculated Concentrations of Active Ingredients in Water Reaching the Aquifers below Brooklyn and Queens

	Organophosphates		Pyrethroids			
	Malathion	Naled	Permethrin	Resmethrin	Sumithrin	PBO
Concentration in Water Reaching Aquifer[1] in milligrams/liter	0.0057	0.0089	0.0020	0.00013	0.00061	0.0049
Time to reach Peak Value [2] in years	1	0.5	100	150	6	0.5 days

Notes: [1] 10 feet below surface
[2] Except for PBO which is in days

transfers between aquifers is extremely small and it is unlikely that infiltration of the active ingredients into the Magothy or Lloyd Aquifers would be of concern. Based on the results of the screening analysis, which are discussed below, additional analyses were not warranted and, therefore, no modeling of active ingredient transport to the deeper aquifers was performed.

Table 3.E-3 also shows the time calculated for the maximum peak concentration to occur. For both organophosphates, the time to reach the maximum concentration at a minimum water depth of 10 feet was approximately 1 year for malathion and ½ year for naled. The modeling indicated that the migration of the organophosphates would be relatively slow, even with the sandy soil above the aquifers.

As shown in Table 3.E-3, the maximum predicted organophosphate active ingredient concentrations of a drop of water infiltrating into the aquifers were 0.0057 and 0.0089 mg/L for malathion and naled, respectively, and the resultant concentrations in the aquifer supplied from these adulticiding actions would be expected to be at least 100 times less than the values shown in the table. As discussed above, malathion is the only organophosphate active ingredient with corresponding HALs (from USEPA) and a compound-specific New York State Drinking Water Supply Standard. The maximum predicted malathion concentrations dripping into the shallowest aquifer was calculated to be less than the corresponding drinking water standard (0.007 mg/L for groundwater), and the value was less than the short- and long-term HALs recommended by USEPA. While a compound-specific drinking water standard has not been set for naled, this active ingredient can be considered to be a UOC with a standard of 0.050 mg/L, and maximum predicted naled concentrations in Jerome Park Reservoir were well below this standard. Based on the HALs for malathion and the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of active ingredients from organophosphates in adulticides into groundwater acquifers would not result in any significant adverse human health impacts.

Pyrethroids

Active Ingredients. Table 3.E-3 also shows the maximum concentration of the active ingredients in the adulticides with pyrethroids under consideration from the PESTAN model, and the time calculated for the maximum peak concentration to occur. For pyrethroids, the time to reach the maximum concentration at a minimum water depth distance of 10 feet ranged from 1/2 day for piperonyl butoxide (which, as discussed above, was treated as an active ingredient) and 150 years for resmethrin.

As shown in Table 3.E-3, the maximum predicted pyrethroid active ingredient concentrations of a drop of water infiltrating into the aquifers ranged from 0.00013 to 0.0049 mg/L for resmethrin and PBO, respectively, although the resultant concentrations in the aquifer supplied from these adulticiding actions would be expected to be at least 100 times less than the values shown in the table. There are no compound-specific drinking water standards or HALs for the active ingredients in the pyrethroids under considerations. However, the active ingredients in pyrethroids can be considered as UOCs, and the maximum predicted active ingredient levels in the Jerome Park Reservoir were well below the standard of 0.050 mg/L. Based on the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of active ingredients from pyrethroids in adulticides into the groundwater supply would not result in any significant adverse human health impacts.

Inerts. As discussed above, inerts can make up a relatively large percentage of pyrethroid products. The maximum amount of applied inerts in any of the pyrethroid products is approximately 118 times greater than the application rate of the active ingredient sumithrin. The minimum amount of applied inerts in any of the pyrethroid products is approximately three times the application rate of the active ingredient sumithrin.

Inerts, such as petroleum distillates, may evaporate on the ground surface before rainfall recharges such materials into the groundwater. This evaporation would be further enhanced, because fine droplets are created by the spray of the adulticides, and the smaller the droplet size, the larger the surface area/volume of product, which increases the rate of evaporation of the inerts. Based on the summary of results in Table 3.E-3, the maximum concentrations of inerts in a drop of water infiltrating the aquifer would range from 0.000183 to 0.072 mg/L, and the resultant concentrations in the aquifer supplied from these adulticiding actions would be expected to be at least 100 times less than the values shown in the table.

While the complete identity of inerts for each product are not known, as discussed in Chapter 2, "Pesticide Regulations and Usage," HALs for petroleum distillates such as toluene and xylene are on the order of 1 mg/L for short term concentration (which would be the case for these scenarios). New York State drinking water standards for groundwater are 0.0005 mg/L for POCs. Maximum predicted inert organic concentrations in the drops of water reaching the aquifer were calculated to be greater than the corresponding POC standard. As discussed above, these values would be greatly diminished once these drops mix into the existing groundwater supply, and the values are less than typical short- and long-term HALs for inerts such as toluene and xylene. Based on HALs and the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health impact assessment, the concentrations of inert ingredients from adulticides infiltrating into the aquifers would not result in any significant adverse human health impacts.

Air Strippers

Based on the results of the analysis based on the amount of the adulticides airborne, the assumption that the air drawn through the stripper will reach a steady state to transfer adulticide ingredients from the gas to the liquid phase, and the Henry's Law constants for the active ingredients in the adulticides, the maximum potential concentrations of components of the adulticides into the groundwater supply were calculated.

Organophosphates

Based on Henry's Law, the maximum concentrations of the active ingredients in the adulticides with organophosphates under consideration are presented in Table 3.E-4. The concentrations calculated

TABLE 3.E-4
Maximum Calculated Concentrations of Active Ingredients in Water Passing Through Air Strippers (in mg/L)

Organophosphates		Pyrethroids			
Malathion	**Naled**	**Permethrin**	**Resmethrin**	**Sumithrin**	**PBO**
1.55E-13	2.86E-10	9.80 E-12	1.54 E-12	1.24 E-12	1.27 E-14

were extremely low, essentially zero. The resultant maximum concentrations in this analysis were so small that the results reported in Table 3.E-4 are presented in scientific notation. For example, the malathion concentration reported in Table 3.E-4 is 1.55E-13, which is equivalent to 12 zeroes after the decimal point (i.e., 0.000000000000155) mg/L. Naled also had insignificant levels computed for the groundwater passing through the air strippers.

As discussed above, malathion is the only organophosphate active ingredient with corresponding compound-specific HALs (from USEPA) and New York State Drinking Water Supply Standards. The maximum predicted malathion concentrations for groundwater passing through air strippers were calculated to be less than the corresponding water supply standard (0.007 mg/L for groundwater), and the values were less than the short- and long-term HALs recommended by USEPA. Maximum predicted naled concentrations would be less than the UOC standard of 0.050 mg/L. Based on the comparison to standards and HALs and the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of active ingredients from organophosphates in adulticides into groundwater aquifers would not result in any significant adverse human health impacts.

Pyrethroids

Active Ingredients. Table 3.E-4 also shows the maximum concentration of the active ingredients in the adulticides with pyrethroids under consideration from the Henry's Law analysis.

As shown in Table 3.E-4, the maximum predicted pyrethroid active ingredient concentrations in groundwater passing through air strippers were also calculated to be close to zero. There are no compound-specific drinking water standards or HALs for the active ingredients in the pyrethroids under considerations. However, maximum predicted pyrethroid active ingredient levels in water passing through air strippers would be less than the UOC standard. Based on the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of active ingredients from pyrethroids in adulticides into the groundwater supply would not result in any significant adverse human health impacts.

Inerts. As discussed above, inerts can make up a relatively large percentage of pyrethroid products. The maximum amount of applied inerts in any of the pyrethroid products is approximately 118 times greater than the application rate of the active ingredient sumithrin. The minimum amount of applied inerts in any of the pyrethroid products is approximately three times the application rate of the active ingredient sumithrin.

Based on the summary of results in Table 3.E-4, the maximum concentrations of inerts in groundwater passing through an air stripper would also be very small, and close to zero. While the complete identity of inerts for each product is not known, as discussed in Chapter 2, "Pesticide Regulations and Usage," HALs for petroleum distillates such as toluene and xylene are on the order

of 1 mg/L for short term concentration (which would be the case for these scenarios). New York State drinking water standards for groundwater are 0.0005 mg/L for POCs. Maximum predicted inert organic concentrations in the groundwater passing through air strippers would be much lower than the corresponding POC standards and lower than typical short- and long-term recommended by USEPA. Based on the comparisons to standards and HALs and the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of inert ingredients from adulticides infiltrating into the aquifers would not result in any significant adverse human health impacts.

Conclusions of Impacts on Ground Water Supply

Based on the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment and the comparisons to standards and HALs for drinking water, the application of the adulticides which could enter the groundwater supplies (either via infiltration to the aquifers or for water passing through air strippers) would not result in any significant adverse human health impacts.

Outside New York City Boundaries

Surface Water Supply

While not part of the Proposed Action, the potential concentrations of adulticides into the City's water supply were conservatively estimated, in order to determine the potential cumulative impacts (from both City and non-City actions undertaken) on the City's water supply.

Organophosphates

Based on the second-level screening analyses discussed above, the maximum concentrations of active ingredients from organophosphates in the Croton Watershed and the Hillview Reservoir were calculated. Table 3.E-5 presents the results of these analyses. As shown in the table, for the Croton Watershed and the Hillview Reservoir analyses, the maximum predicted organophosphate active ingredient concentrations (which were conservatively computed for the potential runoff into the Croton Watershed) were 0.00139 and 0.0005 mg/L for malathion and naled, respectively. Malathion is the only organophosphate active ingredient with corresponding HALs (from USEPA) and a compound-specific New York State Drinking Water Supply Standard. Maximum predicted naled concentrations would be less than the UOC standard of 0.050 mg/L. While maximum predicted malathion concentrations in the Croton Watershed (but not in the Hillview Reservoir) were calculated to be greater than the corresponding New York State Drinking water quality standard (0.0001 mg/L for surface water), the values were still less than the short- and long-term HALs recommended by USEPA.

TABLE 3.E-5
Maximum Predicted Concentrations of Active Ingredients in Water Supply Sources Outside New York City Boundaries (in mg/L)

	Organophosphates		Pyrethroids			
	Malathion	Naled	Permethrin	Resmethrin	Sumithrin	Piperonyl Butoxide
Croton Watershed	0.00139	0.000514	0.0000540	0.000180	0.0000925	0.000540
Hillview Reservoir	0.00000208	0.000000770	0.000000809	0.00000027	0.00000014	0.00000081

In addition, the maximum concentrations of organophosphates in the Croton Watershed were lower than those conservatively calculated in the initial screening analysis for the maximum concentrations in the Jerome Park Reservoir (shown in Table 3.E-1 and discussed above under "Within New York City Boundaries"), which were employed in the public health risk assessment. Therefore, the maximum calculated levels for Jerome Park Reservoir were considered to conservatively project the maximum potential cumulative concentration of organophosphates in the City's water supply.

Based on the comparison to standards and HALs for malathion and the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of active ingredients from organophosphates in adulticides into the Croton Watershed and the Hillview Reservoir would not result in any significant adverse human health impacts.

Pyrethroids

Active Ingredients

Based on the screening analyses discussed above, the maximum concentrations of active ingredients from pyrethroids in the Croton Watershed and the Hillview Reservoir water supply were calculated. As discussed earlier, PBO was considered to be an active ingredient for these analyses. These concentrations were less than those calculated for the "Within New York City Boundaries" Jerome Park Reservoir scenario. Therefore, the maximum calculated levels for Jerome Park Reservoir were considered to conservatively project the maximum cumulative concentration of organophosphates in the City's water supply.

There are no compound-specific drinking water standards or HALs for the active ingredients in the pyrethroids under considerations. The maximum predicted active ingredient levels of pyrethroids were well below the UOC standard of 0.050 mg/L. Based on the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of active ingredients from pyrethroids in adulticides in the Jerome Park Reservoir would not result in any significant adverse human health impacts.

Inerts

As discussed above, inerts can make up a relatively large percentage of pyrethroid products. The maximum amount of applied inerts in any of the pyrethroid products is approximately 118 times greater than the application rate of the active ingredient sumithrin. The minimum amount of applied inerts in any of the pyrethroid products is approximately three times the application rate of the active ingredient sumithrin.

As discussed in the "Within New York City Boundaries" groundwater analysis, inerts, such as petroleum distillates may evaporate on the ground surface, before rainfall recharges such materials into the groundwater. This evaporation would be further enhanced because fine droplets are created by the spray of the adulticides, and the smaller the droplet size, the larger the surface area/volume of product, which would increase the rate of evaporation of the inerts. Based on the summary of results in Table 3.E-5, the maximum concentrations of inerts in the Croton Watershed would range from 0.000278 to 0.0109 mg/L.

While the identity of all inerts for each product is not known, as discussed above, HALs for petroleum distillates such as toluene and xylene are on the order of 1 mg/L for short-term concentration (which would be the case for these scenarios). New York State standards for surface drinking water supplies are 0.0005 mg/L for POC. Maximum predicted inert organic concentrations in the

Croton Watershed were calculated to be greater than the corresponding POC standards, but the values were still less than typical short- and long-term HALs recommended by USEPA. These concentrations were less than those calculated for inerts for the "Within New York City Boundaries" Jerome Park Reservoir scenario. Therefore, the maximum calculated levels for Jerome Park Reservoir were considered to conservatively project the maximum cumulative concentration of organophosphates in the City's water supply. Based on the comparison to standards and HALs and the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health risk assessment, the concentrations of inert ingredients from adulticides potentially introduced into the "Outside New York City Boundaries" scenario would not result in any significant adverse human health impacts.

Conclusions of Potential Cumulative Impacts on Surface Water Supply

Based on the analyses presented in Chapter 3.C, "Public Health," which were used as part of the input to the public health impact assessment and the comparison to standards and HALs for drinking water, the application of the adulticides which could deposit into the "Outside New York City Boundaries" and "Within New York City Boundaries" scenarios would not result in any significant adverse human health impacts.

F. LITERATURE CITED

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