United States Environmental Protection Agency | Region 2 902 | EPA/902/R-93-001a January 1993

EPA

Staten Island/New Jersey Urban Air Toxics Assessment Project Report

Volume I

Summary

ACKNOWLEDGEMENTS

This report is a collaborative effort of the staffs of the Region II Office of the U.S. Environmental Protection Agency (EPA), the New Jersey Department of Environmental Protection and Energy, the New York State Department of Environmental Conservation, the New York State Department of Health, the University of Medicine and Dentistry of New Jersey and the College of Staten Island. The project was undertaken at the request of elected officials and other representatives of Staten Island concerned that emissions from neighboring industrial sources might be responsible for suspected excess cancer incidences in the area.

Other EPA offices that provided assistance included the Office of Air Quality Planning and Standards, which provided contract support and advice; and particularly the Atmospheric Research and Exposure Assessment Laboratory, which provided contract support, quality assurance materials, and sampling and analysis guidance, and participated in the quality assurance testing that provided a common basis of comparison for the volatile organic compound analyses. The Region II Office of Policy and Management and its counterparts in the States of New York and New Jersey processed the many grants and procurements, and assisted in routing funding to the project where it was needed.

The project was conceived and directed by Conrad Simon, Director of the Air and Waste Management Division, who organized and obtained the necessary federal funding.

Oversight of the overall project was provided by a Management Steering Committee and oversight of specific activities, by a Project Work Group. The members of these groups are listed in Volume II of the report. The Project Coordinators for EPA, Robert Kelly, Rudolph K. Kapichak, and Carol Bellizzi, were responsible for the final preparation of this document and for editing the materials provided by the project subcommittee chairs. William Baker facilitated the coordinators' work.

Drs. Edward Ferrand and, later, Dr. Theo. J. Kneip, working under contract for EPA, wrote several sections, coordinated others, and provided a technical review of the work.

The project was made possible by the strong commitment it received from its inception by Christopher Daggett as Regional Administrator (RA) for EPA Region II, and by the continuing support it received from William Muszynski as Acting RA and as Deputy RA, and from Constantine Sidamon-Eristoff, the current RA. The project has received considerable support from the other

project organizations via the Management Steering Committee, whose members are listed in Volume II.

PREFACE - DESCRIPTION OF THE STATEN ISLAND/NEW JERSEY URBAN AIR TOXICS ASSESSMENT PROJECT REPORT

This report describes a project undertaken by the States of New York and New Jersey and the United States Environmental Protection Agency with the assistance of the College of Staten Island, the University of Medicine and Dentistry of New Jersey and, as a contractor, the New Jersey Institute of Technology.

Volume I contains the historical basis for the project and a summary of Volumes II, III, IV, and V of the project report.

Volume II of the report lists the objectives necessary for achieving the overall purpose of the project, the organizational structure of the project, and the tasks and responsibilities assigned to the participants.

Volume III of the report presents the results and discussion of each portion of the project for ambient air. It includes monitoring data, the emission inventory, the results of the source identification analyses, and comparisons of the monitoring results with the results of other studies. Volume III is divided into Part A for volatile organic compounds, and Part B for metals, benzo[α]pyrene (BaP), and formaldehyde. Part B includes the quality assurance (QA) reports for the metals, BaP, and formaldehyde.

Volume IV presents the results and discussion for the indoor air study performed in this project. It contains the QA reports for the indoor air study, and a paper on the method for sampling formaldehyde.

Volume V presents the results of the detailed statistical analysis of the VOCs data, and the exposure and health risk analyses for the project.

Volume VI, in two parts, consists of information on air quality in the project area prior to the SI/NJ UATAP; quality assurance (QA) reports that supplement the QA information in Volume III, Parts A and B; the detailed workplans and QA plans of each of the technical subcommittees; the QA reports prepared by the organizations that analyzed the VOC samples; descriptions of the sampling sites; assessment of the meteorological sites; and a paper on emissions inventory development for publicly-owned treatment works.

The AIRS database is the resource for recovery of the daily data for the project. The quarterly summary reports from the sampling organizations are available on a computer diskette from the National Technical Information Service.

STATEN ISLAND/NEW JERSEY
URBAN AIR TOXICS ASSESSMENT PROJECT

VOLUME I. SUMMARY EPA/902/R-93-001a

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1. EXECUTIVE SUMMARY

The Staten Island/New Jersey Urban Air Toxics Assessment Project (SI/NJ UATAP) was a program of ambient air monitoring and meteorological data collection conducted from October 1987 through September 1989, and indoor air sampling conducted from July 1990 to March 1991. An emission inventory was developed in support of risk assessment and source identification for the study area, which consisted of Staten Island and nearby New Jersey, directly across the Arthur Kill from Staten Island. (See Map I-1.)

The project was a cooperative undertaking by the U.S. Environmental Protection Agency Region II, the States of New York and New Jersey, the College of Staten Island, and the University of Medicine and Dentistry of New Jersey.

Quantitation of 40 pollutants--22 volatile organic compounds (VOCs), 16 metals, benzo[α]pyrene (BaP), and formaldehyde--was pursued using sorbent samplers for VOCs at 13 sites, hi-vol samplers for particulates at 5 sites, and aldehyde-specific samplers for formaldehyde at 5 sites.

At the outset of the project in 1986, it was known that the sampling and analytical procedures available for determination of VOCs in ambient air were complex, difficult to perform, essentially research techniques rather than standardized monitoring methods.

The project was highly successful in collecting air quality data over a period of 24 months. These data have been used to characterize the distribution of air toxics spatially and temporally over the area and to perform risk assessments for the ambient air pathway.

Most of the annual averages for individual VOCs at the study monitoring sites fall within a range of a factor of two. Some of the intersite differences are almost ten-fold, but such large differences occur for only a few compounds at a few sites. The concentrations of the VOCs measured at the sites in the SI/NJ UATAP were quite uniform. No single monitoring site was consistently associated with the highest concentrations.

For the year October 1988 through September 1989, tetrachloroethylene and toluene were the compounds consistently found at the highest concentrations for the chlorinated and aromatic groups respectively. The concentrations of the aromatic compounds toluene, benzene, and the xylenes were higher in the period from January to March, and lower in the period from April

to June. The chlorinated compounds did not exhibit readily apparent seasonal trends.

The annual average concentrations for the SI/NJ UATAP sites were in the same range as those for other urban areas nationwide, a conclusion based on comparison to the results of the EPA Urban Air Toxics Monitoring Program (U.S. EPA, 1989; U.S. EPA, 1990).

The SI/NJ UATAP inventory showed for the VOCs monitored in this project that the emission rate for toluene (primarily from point sources) was the highest. Among the pollutants with high cancer unit risk factors, emission rates were highest for benzene (from mobile sources) and dichloromethane (methylene chloride) (from point sources).

Although several sites showed significant variations in concentrations with wind direction, there were few cases in which individual point sources could be associated with air quality at the site. In several cases, it was clear that total loading of upwind point sources had a strong impact on ambient air quality. The most important finding, however, was that localized sources, both mobile and area sources, had the greatest impact on air quality monitored at a site.

The relatively high annual average concentration for tetrachloroethene (tetrachloroethylene) found at one site appears to be attributable to releases from two nearby dry cleaners. Relatively high concentrations of tetrachloroethylene at the Staten Island Mall site (also called the Pump Station) may be attributable to the pumping station of a publicly-owned treatment works (POTW). Mobile sources (autos and trucks), refineries, and, to some extent, gasoline stations were found to be the major contributors to the highest concentrations of benzene at the project monitors. The case for toluene was similar, but with some input from other industrial sources and from POTWs. POTWs, industrial sources, and area sources (dry cleaners) were the primary sources of the highest concentrations of chlorinated hydrocarbons at the project monitors.

The annual average concentrations for the metals, BaP, and formaldehyde in the SI/NJ UATAP were generally in the same concentration ranges as those for a number of sites in the EPA UATMP program during the same time period. In some cases for which the SI/NJ UATAP concentrations appear to be high, as for cadmium, vanadium (New York sites only, no valid data for New Jersey sites), and nickel, there is uncertainty regarding accuracy of the reported SI/NJ UATAP results. Chromium concentrations were generally higher at the New Jersey sites than at most of the UATMP sites; no valid data were available for the New York sites.

A limited study of indoor air showed that concentrations of 13 VOCs in several homes in the study area were generally similar to concentrations found in several other data bases for indoor air. 1,1,1-trichloroethane was frequently detected in NJ homes only. Tetrachloromethane was never detected indoors. Toluene, benzene, m- and p-xylenes, o-xylene, ethylbenzene, hexane, trichloromethane, and tetrachloroethylene were usually or always found at higher concentrations indoors than outdoors. The highest concentrations of benzene and toluene in ambient air were associated with mobile sources and petroleum refineries; yet indoor concentrations of these chemicals were higher than outdoor concentrations.

Quantitative estimates of increased lifetime cancer risks for individual pollutants were in the range of 0.4 to 80 per million. The Hazard Quotients, which are a measure of the likelihood of adverse noncancer health effects, were below one for all pollutants except benzene, chromium, and nickel. The estimated risks for chromium and nickel are believed to be conservative, i.e., err in the direction of overestimating risk; since the chemical species of chromium and nickel in the ambient air samples were not determined, uncertainty remains regarding how conservative the estimates are.

The additive risk assessment for noncancer toxicity by target organ, and for cancer for all pollutants combined assumed continuous lifetime exposure to the median annual average ambient air concentrations of nine VOCs, nine metals, BaP and formaldehyde for the year October 1988 through September 1989. It yielded a maximum Hazard Index (the sum of the Hazard Quotients for a given target organ) of 2 (blood formation effects and respiratory tract irritation) for noncancer toxicity. The cumulative cancer risk estimate was 96 or 123 per million, depending on the assumptions about ambient air concentrations of chromium VI used in the estimates.

The estimated cancer and noncancer toxicity risks associated with benzene were consistently higher than those estimated for the other pollutants addressed in the risk assessments. The next highest estimated risks for ambient air exposure were associated with nickel, chromium, arsenic, and tetrachloromethane.

Statistically significant site-to-site differences were found in mean ambient air concentrations for several VOCs. The risk estimates were not sensitive to the differences, however.

The results of this project are being used by the U.S. EPA towards fulfilling the mandates of the Urban Area Source Program, §112(k) of Title III of the Clean Air Act Amendments of 1990: to list not less than 30 hazardous air pollutants (HAPS)--pollutants that are or will be listed pursuant to §112(b) of Title III--presenting the greatest threat to public health in the largest

number of urban areas; to identify and regulate subject to standards pursuant to §112(d) of Title III the area source categories accounting for 90% or more of the aggregate emissions of each of the 30 identified HAPS; and to take specific action to reduce the risks posed by the identified HAPS, including achieving a reduction of not less than 75% in the incidence of cancer attributable to HAPs emitted by stationary sources.

Because the project did not show a dominant role for any specific major point source in creating an air quality problem in the study area, no basis was found for abatement actions directed at any specific major source.

2. INTRODUCTION

2.1 ORGANIZATION OF THE STATEN ISLAND/NEW JERSEY URBAN AIR TOXICS ASSESSMENT PROJECT REPORT

The report for the SI/NJ UATAP has been organized into six volumes. Volume I, this volume, provides a summary of the overall program and a description of the contents of the remaining volumes.

Volume II provides the organization and functioning of the project, brief descriptions of the methods of sampling and analysis, and the formats of the data reports. The organizational structure consisted of a Management/Steering Committee, a Working Group, Technical Subcommittees and an Advisory Group. The detailed workplans of the technical subcommittees are provided in the appendices in Volume VI.

Volume III, divided into Part A for the volatile organic compounds (VOCs) and Part B for the particulates and formaldehyde, reports the results obtained from the analysis of two years of ambient air samples. The data are presented in tabular and graphical forms. The findings are discussed in terms of their significance with regard to the objectives of the program.

The results of the eight-month indoor air study, initiated near the end of the two-year ambient air sampling program, are presented in Volume IV.

The ambient air VOC concentrations were analyzed for statistical significance of apparent intersite differences. A health risk assessment was prepared using the results of the ambient air monitoring and indoor air monitoring, and statistical analysis inputs. The results are presented in Volume V.

Volume VI is a compilation of the detailed workplans and Quality Assurance (QA) plans of the subcommittees, the QA reports of the sampling and analytical organizations and the QA Subcommittee, descriptions of the sampling sites, and a reference paper on air emissions from publicly-owned treatment works (POTWs). While this material is not required for an understanding of the data analyses and interpretations, it provides the basis for a more thorough understanding of the project.

2.2 HISTORICAL BACKGROUND

The SI/NJ UATAP is a study of the ambient levels of selected volatile organic compounds and particulate matter species in the county of Richmond (Staten Island), New York, and in neighboring counties (Middlesex, Union, and Essex) of New Jersey to determine the exposures (and associated risk) of residents of the area to a variety of toxic air pollutants. (See Map I-1.) The study was undertaken in response to concerns of these residents that their health may be at serious risk due to exposure to toxic air pollutants emitted routinely by industrial sources in the area, as well as by episodic releases often characterized by disagreeable odors. Furthermore, a number of studies had concluded that residents of Staten Island had experienced a higher incidence of cancers than other communities of similar socioeconomic status.[1] Reflecting the concerns of their constituents, elected officials and other representatives of Staten Island asked state and federal officials to investigate the causes of recurrent odor episodes, and to determine whether or not emissions from neighboring industrial sources might be responsible for suspected excess cancer incidences in the area.

Because of Staten Island's low population density relative to other parts of New York City, it has generally experienced lower concentrations of the criteria air pollutants than those other areas of New York City. However, the Island is bordered on the west by a complex of major industries including pharmaceutical plants, oil refineries, and chemical storage facilities. Other potential sources of toxic and/or odorous organic compounds include sewage treatment plants and the 1400-acre Fresh Kills Landfill, the world's largest landfill. Therefore, many of the residents have developed a high level of concern about the toxicity of the ambient air.

According to a 1985 series of articles in a local newspaper, the Staten Island Advance, Staten Island residents had been concerned about pollution from New Jersey for over 100 years. An 1882 report of the New York State Board of Health stated, "Most of the buildings on the North Shore of Staten Island are private residences, occupied by families long residing on the Island, and from the causes here named, and for the first time, their homes have been made uncomfortable and in the case of many of their inmates, unhealthy, from causes beyond their reach, but wholly under the control of a neighboring state and people."

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[1] Section 2.3 of this volume describes ATSDR (Agency for Toxics Substances and Disease Registry) reviews of three of these studies, and the findings that the studies were flawed and not supportive of the asserted association between cancer incidence and air pollution.

In 1928, J. Meyers, writing in "The New York State Journal of Medicine," said that in the period from 1911 to 1920, Staten Island was ranked first in New York City in terms of cancer deaths with a rate of 92.5 in 100,000 people. The identified cause was that "much of [Staten Island's] northern shore had suffered for many years from smoke, fumes and vapors from the great oil refineries, and chemical, metal and other works situated on Constable Hook, Bayonne and adjacent territory."

In 1967, a study published in "Archives of Environment and Health" concluded that respiratory cancer rates for Staten Islanders exposed to the highest amount of air pollution from New Jersey were higher than for Islanders in low pollution areas.

In 1983, the New York City Department of Health (NYCDOH) found in a study on the trends in New York City's respiratory cancer deaths that Staten Island's death rate was the highest of the boroughs of the City between 1960 and 1980. The rate had risen from 27 out of every 100,000 people to 42.3 out of every 100,000 people, an increase of more than 57 percent in the 20-year period compared to a citywide death rate increase of 35 percent.

In May 1985, Staten Island Congressman Guy Molinari called a special town meeting featuring a panel of scientists including a toxicologist from the University of Medicine and Dentistry of New Jersey, a pulmonary specialist from the VA Medical Center in Brooklyn, an industrial hygienist from Mt. Sinai Hospital, a pulmonary specialist (physician) in private practice on Staten Island, and a health effects researcher from the College of Staten Island. The meeting was convened because many people in the community had expressed increasing concern that toxic contaminants in the Staten Island air were the cause of unusually high respiratory cancer rates on Staten Island. The panelists shared a common position that the residents were at considerable risk due to emissions from the petrochemical complex in the nearby New Jersey area. One of the panelists also asserted that children raised on Staten Island and in New York City's other boroughs exhibit disproportionately high incidences of pediatric asthma.

In the same year (1985), a study entitled "Ill Winds," conducted by the staff of Congressman Molinari, used published census data, cancer statistics, and prevailing wind pattern data to demonstrate that in the United States, counties such as Staten Island, located downwind from petrochemical plants, have a higher incidence of respiratory cancer than those upwind.

In an effort to be responsive to these concerns, federal, state, and local officials met from time to time during the early 1980's to determine what appropriate actions they might take to

address the concerns that had been expressed about the frequent odor episodes, as well as the unscheduled or accidental release of chemicals by industries bordering the Arthur Kill (the river separating Staten Island from New Jersey). When, in a period of months from October 1984 to January 1985, fifteen major chemical release incidents occurred, officials again called for special federal investigations. Among the officials who pressed for these investigations, were the Borough President of Staten Island and the Congressional representative for the area. Both made personal appeals to the EPA Administrator to undertake the necessary studies. These meetings and consultations led to the undertaking of a number of specific initiatives.

In March of 1984, the EPA Region II Administrator sent the EPA National Emergency Response Team (ERT) based in Edison, New Jersey, into the field in an attempt to document the presence of toxic substances in the ambient atmosphere on Staten Island and neighboring New Jersey. The ERT performed a one-week investigation of ambient air concentrations in areas using state-of-the-art measurement techniques. It identified the presence of about 30 toxic chemicals near many of the sources suspected of causing odor and toxics problems. However, it could not quantify the contaminant concentrations nor conclusively link the identified chemicals with emissions or odors from any specific source. Gusty wind conditions prevailed during the monitoring period and no serious odor events occurred during the time.

In a related investigation later that year (September 1984), the EPA's National Enforcement Investigations Center (NEIC) agents visited locations identified as possible sources of odors. They identified liquid effluent from a sewage treatment plant as the possible source of the so-described cat-urine odor that had often been the basis for complaints. From this effluent, it was possible to trace the origin of the offending substance to a nearby pharmaceutical plant. The discharge of the offending liquid into the sewage system was discontinued as a result of this investigation.

In the same year (1984), the EPA released a report referred to as the Six-Month Study, which documented that significant amounts of toxic substances existed in the air over large, densely-populated urban areas. This provided further incentive for the EPA Regional Office to design and conduct an ambient air quality monitoring and assessment project. Lacking sufficient funding and resources to conduct an independent study, the Regional Office set out to undertake a cooperative effort with other units of government, with industry, and with environmental and academic institutions.

Through its inquiries, the Regional Office discovered that a number of agencies and organizations had themselves independently planned to undertake some form of ambient air

monitoring activity in the Staten Island/Northern New Jersey Area.

- The New York State Department of Environmental Conservation (NYSDEC) had decided to undertake a $5 million statewide enhancement of its ongoing sampling program with approximately $1 million of the total to be used for airborne toxics throughout the state. NYSDEC planned to set up monitoring sites for air toxics at four locations in Staten Island.

- The New Jersey Department of Environmental Protection (NJDEP, now NJDEPE) was about to undertake an ambient air monitoring program for a variety of volatile organic compounds at two sites in northern New Jersey with technical support from the New Jersey Institute of Technology (NJIT).

- The College of Staten Island (CSI) was about to undertake an Island-wide ambient air monitoring program for volatile organic compounds using funds provided by the Governor of New York State. CSI also planned to undertake a health effects study of the area.

- The New York City Department of Environmental Protection (NYCDEP) was planning to conduct ambient air monitoring activities in the Staten Island area, but had not yet formulated specific plans.

- The Interstate Sanitation Commission (ISC) which had over the years received and responded to citizens' complaints concerning interstate odors and pollution transport, was interested in participating in the study.

- The Arthur Kill Industrial Business Association (AKIBA), a consortium of businesses, expressed an interest in joining a cooperative effort provided that a major emphasis was placed on odor tracking.

At the request of the EPA Region II Administrator Christopher Daggett, representatives of these organizations and agencies met on several occasions in 1984 to determine what kind of cooperative project could be put together using the pooled resources of these organizations. It was agreed that an AKIBA-

developed odor tracking project[2] should proceed on its own with whatever assistance might be provided by the ISC because of the common interest of both organizations in odor problems and because of their experiences in addressing both odor episodes and episode response. It was decided, as well, that those agencies in a position to contribute resources and expertise for performing air quality sampling and analysis using advanced techniques would join together under the leadership of the EPA Region II Office to develop an ambient air monitoring project. The group decided to invite the University of Medicine and Dentistry of New Jersey (UMDNJ) and the New York State Department of Health (NYSDOH) to participate in order to provide needed expertise in risk assessment. The NYCDEP and the ISC failed to obtain the necessary resources to join in the project.

2.3 THE STATEN ISLAND/NEW JERSEY URBAN AIR TOXICS ASSESSMENT PROJECT, THE STATEN ISLAND CITIZEN'S ODOR NETWORK, AND THE ROLE OF ATSDR

During 1985 and 1986, the effort that became known as the Staten Island/New Jersey Urban Air Toxics Assessment Project (SI/NJ UATAP) organized a series of committees and began to develop plans for conducting monitoring, collecting other information, and interpreting the results. In October 1986, the project's Steering Committee formulated the objectives for the project, listing nine specific objectives. Ambient air monitoring would be the most expensive and extensive project activity, and would be used to address most of the objectives. In addition, the Committee agreed to pursue indoor monitoring, emission inventories, various levels of data assessment and

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[2] The AKIBA study was conducted by The Research Corporation of New England (TRC) using meteorological data and odor reports to develop a methodology for tracking the sources of odors during odor incidents. Its final report (released in 1989) concluded that municipal facilities (sewage treatment plants and landfills) were the most frequent and the most intense sources of odors in the Arthur Kill region, often responsible for adverse impacts on nearby communities. The report specifically pointed to the Linden-Roselle sewage treatment plant at Tremley Point and the Fresh Kills Landfill as making major contributions to the regions's odor problems. As a follow-up to the study, AKIBA installed an odor hotline for use during odor episodes to alert industries to check their facilities for malfunctions and potential unauthorized releases.

interpretation, and exposure and health risk assessment, along with quality assurance and data handling for all of the other phases of the project.

In 1987, the ambient air monitoring phase of the project was initiated. Monitoring activities and other field work continued until 1989. The ambient monitoring phase of the project included 15 sites (see Map I-1) at which the following parameters were measured:

volatile organic compounds at 13 sites,
metals at 5 sites,
formaldehyde at 5 sites, and
meteorological data at 4 sites.

The indoor air monitoring phase of the project began in July 1990 and concluded in March 1991, encompassing four indoor sites and two associated outdoor sites. The emission inventory portion of the project spanned the period from October 1987 to December 1991. Once the monitoring and inventory data began to appear, the data handling, data interpretation, and exposure and health risk assessment phases were initiated.

In 1990, EPA also undertook an ancillary study, called the Staten Island Citizen's Odor Network, to further address the concerns of the Staten Islanders about air quality during odor events. EPA supplied canister devices similar to those utilized in the ambient monitoring phase of the project to six Staten Island homeowners and asked them to activate the devices when they detected odors of concern. There were few occasions in which odor episodes triggered the use of these samplers. On no occasions were unusually high concentrations of air toxics found to correlate with odor episodes.

In an effort to address the health effects issues, EPA asked the Agency for Toxic Substances and Disease Registry (ATSDR) to review the 1979 NYCDOH and the 1984 CSI cancer incidence studies, and the 1985 Ill Winds study developed by the staff of Congressman Molinari. ATSDR determined that all three studies were flawed in design, in the handling of statistical information, and in the conclusions reached.[3] Based on this, the conclusions that there were links between reported cancer incidence and air pollution could not be supported. CSI expressed an interest in conducting further health-based studies.

It is important to realize that the incidence of cancer and other diseases in a population is determined by the combined effects of many genetic, socioeconomic and environmental factors in addition to air contaminant exposure. Studies of other

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[3] ATSDR, 1988a; ATSDR, 1988b;, ATSDR 1988c.

communities with a concentration of petroleum refineries and other industries, and cancer rates higher than in other nearby communities, have failed to show statistically significant correlations of cancer incidence and air contaminant levels. In a study in Contra Costa County, California,[4] for example, the only variable identified as a significant factor in lung cancer was smoking. Thus, the assignment of possible sources of cancer may be difficult without a carefully planned epidemiological study.

In studies of air pollution directed toward an understanding of population exposures, risks, and health effects, it is important to recognize (a) limitations in approaches to and, hence, in results associated with estimation of lifetime exposure; (b) the relative contributions of indoor air and ambient air to total inhalation exposure; and (c) the relative contribution of inhalation exposure to total exposure via all routes. Studies (Wallace et al., 1987) have shown that personal exposures to VOCs--that is, integrated, measured concentrations for 24-hour personal air samples--are usually more closely related to indoor air concentrations than to ambient air concentrations. Nevertheless, the sources of concern in this study were industrial and non-point sources whose impact would be assessed by evaluating ambient air quality.

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[4] Personal communication of J. Wesolowski of the California State Department of Health to T.J. Kneip in 1991 concerning the results of an unpublished report on a study in Contra Costa County.

3. SUMMARY DESCRIPTION OF THE STATEN ISLAND/NEW JERSEY URBAN AIR TOXICS ASSESSMENT PROJECT

The project was organized in a committee/subcommittee style along lines suggested by the U.S. EPA Region II Air and Waste Management Division. A Management/Steering Committee was established to determine the objectives of the program and to provide ongoing guidance on the operation as it evolved. Subcommittees were set up and a Project Work Group organized. Each subcommittee established a workplan and QA plan; the organizations responsible for the actual work were designated by agreement (such as a commitment by a state laboratory) or by contract to the EPA or a state agency. The Working Group was responsible for the technical details of the work in conformance to the objectives and the workplans of the subcommittees. The membership of these groups and many other details of the organization of the program are reported in Volume II.

3.1 PROJECT OBJECTIVES

The objectives established for the program were as follows:

1. Characterize air quality for selected volatile organic compound (VOCs) for the purpose of doing an exposure assessment for various population, commercial and industrial interfaces.

2. Characterize air quality for the parameters identified by EPA as high-risk urban toxics for the purpose of using exposure assessment for comparison with other studies.

3. Characterize indoor air quality for selected VOCs for the purpose of doing exposure assessment for various types of commercial facilities and residences.

4. Evaluate indoor/outdoor concentration relationships for selected VOCs.

5. Perform emission source inventory (including point, area and mobile sources), so as to formulate hypotheses linking major contaminants to potential sources.

6. Obtain air quality data for the purpose of identifying potential sources using meteorological modeling.

7. Evaluate indoor air quality data to identify possible sources.

8. Evaluate episodic odor occurrences and relate such episodes to air quality data.

9. Evaluate some general abatement strategies.

3.2 SUBCOMMITTEE CONTRIBUTIONS

3.2.1 Quality Assurance Subcommittee

This subcommittee provided guidance on the development of the QA plans of the other subcommittees and reviewed the overall sampling plans including site selections. It reviewed the QA operations of the sampling and analytical organizations, examined quarterly data reports and QA reports, field-audited the operations, and examined the final data sets submitted in order to establish the validity of the data sets reported in these volumes and used to meet the objectives of the program. The subcommittee implemented a quality assurance program establishing a basis for interorganization comparisons, so that any differences in reported concentrations of a compound at different sites could be assessed for statistical significance.

The subcommittee prepared periodic memoranda pointing out problems as they arose and proposed corrective actions. It certified the satisfactory performance of the QA plans and formally accepted the data sets that met the QA objectives.

The QA was not so extensive for the particulates as for the VOCs due to the perspective that, unlike VOCs sampling, sampling and analytical methods for particulates were well-established and capable of delivering results of acceptable quality.

3.2.2 Ambient Monitoring Subcommittee

This subcommittee was organized to define the sampling and analysis strategies for the substances that were chosen for monitoring. In conjunction with the Working Group and the Management/Steering Committee, the subcommittee developed the list of substances likely to fit the project objectives. The final list of compounds was defined by estimating the likelihood that each substance would be present at concentrations measurable with the sampling and analytical methods available at the time. The overall process of selecting the compounds was designed to assure the maximum likelihood of obtaining data with good accuracy and precision. Sampling was conducted with the goal of quantitating 40 chemicals in ambient air. VOCs were sampled

using sorbents; particulates, using hi-vol samplers; and formaldehyde, using aldehyde-specific samplers. The subcommittee also took primary responsibility for selection of the sampling sites. Subsequent to collection of the concentrations data, this subcommittee prepared the initial data analysis for the report.

3.2.3 Data Management Subcommittee

This subcommittee was initially established to develop a uniform format for data submissions, to collect the data from the analytical laboratories, to circulate the assembled results on a periodic basis for use in the project, and to establish the project data base. During these operations, it became clear that this subcommittee needed to review the submitted results for discrepancies and other problems prior to circulation of the assembled results. The subcommittee compiled data tables for calculation and presentation of quarterly and annual averages, prepared summary graphs of selected data, and provided a basis for the initial site-to-site and interlaboratory comparisons.

3.2.4 Emission Inventory Subcommittee

This subcommittee was established to develop a description of the major point, area, and mobile sources near each sampling site. The vast amount of information developed was a product of new approaches to the integration of a number of data resources, as well as field work at each site.

3.2.5 Modeling and Source Identification Subcommittee

This subcommittee took on the tasks of producing pollution roses for the many sites and pollutants, and back- trajectories for selected pollutants on particular dates at several sites. Identification of the sources of distinctly high concentrations of VOCs at the monitoring sites was the goal of this work. Results of the data management and emissions inventory efforts served as inputs for the source identification.

3.2.6 Indoor Air Subcommittee

This subcommittee undertook the design and execution of a limited indoor air sampling and analysis program focusing on 12 VOCs. Canister samplers were used for VOCs, and an aldehyde-specific samplers was used, albeit unsuccessfully, for

formaldehyde. The eight-month period of the study, July 1990 to March 1991, followed the ambient air program. Ambient air samples from sites near the houses selected for the indoor air sampling were taken simultaneously with the indoor air sampling.

3.2.7 Exposure and Health Risk Assessment Subcommittee

This subcommittee was established to select the substances that represented potential health threats at the concentrations measured, and produce estimates of population exposures and health risks. The inhalation exposure and associated health risk assessments were generated using ambient air and indoor air average concentration data, toxicological information, and the results of the statistical analyses of the VOCs data.

4. CONCLUSIONS

4.1 DATA SETS

At the outset of the project in 1986, it was known that the sampling and analytical procedures available for determination of VOCs in ambient air were complex, difficult to perform, and essentially research techniques rather than standardized monitoring methods. It was anticipated that the precision of an individual measurement might be no better than a factor of two, and that site-to-site differences might be difficult to demonstrate.

The VOC data were evaluated using the considerable quantity of intralaboratory and interlaboratory comparison data generated for the study. Almost all of the VOCs data met the stringent conditions stated in the quality assurance plans at the outset of the project. These conditions were embodied in a two-level approach. The first level was the obligation of each laboratory and included the establishment of good laboratory practices by each organization, including the following:

proper calibration,
use of analytical standards,
sampling and analytical blanks,
duplicate analyses,
participation in inter-laboratory sampling and analytical comparisons, and
data review.

The second level of QA, project-level, consisted of the following:

verifying that the QA/QC procedures of each organization were appropriate and were implemented;
requiring written QA plans from each organization, reviewing the plans and performing QA audits to confirm performance of the work;
coordinating submission of Performance Evaluation samples reviewing the results;
coordinating the performance of collocation sampling experiments and reviewing the analytical results; and
reviewing periodically the monitoring data and quarterly QA reports of each organization, and recommending and requiring corrective action as appropriate.

The results of the QA analysis provided comparisons of paired analyses for absorber and canister samples taken

simultaneously at the same sites by each of the participating organizations. The data for the canister samples were accepted as reference values for each sampling period. The number of sample pairs ranged from 4 to 130 depending on the organization and compound compared. The data are provided in tables in Section 2 of Volume III, Part A. A statistical evaluation of the results for absorption tube and canister sample comparisons and the results of the collocation sampling experiments was provided.

The accuracy of the results for the VOCs is represented by the difference between the canister reference result and the absorber analysis for each compound. For most of the compounds with measurable concentrations, the concentrations reported for the sorbents were within ±30 to 40% of those reported for the canister reference, with all cases falling within ±63% of the reference. There was no contamination problem, therefore the results for the project provide satisfactory accuracy. The precision for duplicate samples taken by all organizations is in the range of 10 to 30%, which is excellent for concentrations of the magnitudes measured in this program.

The single Tenax absorber was found to have excessive breakthrough for dichloromethane; however collection efficiencies for all other compounds analyzed were satisfactory . The trisorbent tubes used by the New York State Department of Environmental Conservation were found to have satisfactory collection efficiencies for all compounds.

The graphs in Section 3 of Volume III, Part A, show quite clearly that the sample-to-sample variations are actual changes in the measured concentrations. Work with the meteorological analyses demonstrated that patterns in the data in some cases are related to wind direction and air parcel trajectories.

The data sets for the VOCs are clearly of very high quality. Where problems were found during the QA reviews, data sets were withdrawn or caveated as supported by less than completely satisfactory precision or accuracy data. In the latter case caution is recommended in the use of the data.

For the metals, data were omitted from the project data base for numerous chemicals due to insufficient accuracy or insufficient data to establish data quality. Other data were caveated due to low recoveries or, in the case of formaldehyde, an interference with the method. For still other chemicals, standard reference materials were unavailable to gauge accuracy of the reported results. While measurement of the VOCs were the focus of the QA effort of this project, the particulates do figure importantly in the risk assessment. In fact, two of the clear risk-related recommendations from this project relate to the metals data.

The QA results for this project demonstrate the need for attention to interlaboratory differences in data quality, especially when comparing concentration data from different studies, e.g., when analyzing data from a national data base.

4.2 DATA ANALYSES

Most of the annual averages for individual VOCs at the study monitoring sites fall within a range of only a factor of two. Some of the intersite differences are almost ten-fold, but such large differences occur for only a few compounds at a few sites. When compared to the Urban Air Toxics Monitoring Program results for VOCs (U.S. EPA, 1989; U.S. EPA, 1990) for many sites in the United States, the annual averages for the SI/NJ UATAP sites are generally in the same range as those for other urban areas nationwide. The data for the SI/NJ UATAP sites fall in the middle to low end of the ranges for annual average comparisons with the exception of the tetrachloroethylene results for the Dongan Hills and Pump Station sites. These averages are on the high end of the range for the UATMP study.

The concentrations of the VOCs measured at the sites in the SI/NJ program are quite uniform. No single monitoring site consistently had the highest concentrations; however, some sites consistently had higher annual average concentrations for a number of compounds. For example, the annual average concentrations for the Dongan Hills, Elizabeth, Port Richmond and Eltingville sites were typically $\geq$1.4 ppb for benzene and $\geq$4 ppb for toluene. The Carteret and Bayley Seton sites exceeded these levels in one of the two years. Both the Dongan Hills and the Staten Island Mall sites had high average concentrations for some compounds.

The Dongan Hills site had the highest annual average concentration for tetrachloroethene (tetrachloroethylene). This appears to be attributable to releases from two dry cleaners identified in the microinventory within 100 meters of the monitor, and from two more about 250 and 400 meters away. Dry cleaners are known sources of this compound; other studies have shown a relationship between distance from a dry cleaner and exposure measurements (Upton et al., 1989). The 14 gas stations within 1,000 meters of the monitor, the fire house at the monitor, and the nearby streets were all possible sources of aromatic hydrocarbons at the Dongan Hills monitor; however, the statistical analysis did not find the apparently higher concentrations of benzene and toluene at this site significantly higher than at all other sites in the study.

Annual average concentrations of tetrachloroethylene and other chlorinated hydrocarbons were relatively high at the Staten Island Mall site (also called the Pump Station), which is located adjacent to a sewage pumping station. Publicly-owned treatment works (POTWs) are known sources of VOCs, particularly trichloroethylene; sewage collection systems are believed to be large sources as well. The possibility that the pumping station is a source of these compounds may be investigated should the detailed exposure-health risk analysis indicate the need.

The data analyses demonstrate the influence of local sources in determining concentrations that may be used subsequently as typical and representative of an area. So when comparing concentrations reported for different areas, examination of siting is important. When attributing observed high concentrations to sources, field work was important in this study for supplementing available data bases. Area sources (e.g., small dry cleaners and gas stations) and non-industrial sources (e.g., POTWs) were important in explaining concentrations measured at the monitoring sites.

The annual average concentrations for toxic metals, BaP, and formaldehyde in the SI/NJ UATAP were in the same concentration ranges as those for a number of sites in the EPA UATMP program during the same time period. Where the SI/NJ UATAP data appear to be high, as is the case for cadmium, vanadium (New York sites only, no valid data for New Jersey sites), and nickel, there is a lack of certainty regarding accuracy of the reported SI/NJ UATAP results. Chromium concentrations were generally higher at the New Jersey sites than at most of the UATMP sites; no valid data were available for the New York sites.

4.3 PATTERNS AND CORRELATIONS

For the year October 1988 through September 1989, tetrachloroethylene and toluene were the compounds consistently found at the highest concentrations for the chlorinated and aromatic groups respectively.

The concentrations of the aromatic compounds toluene, benzene, and the xylenes were higher in the period from January to March, and lower in the period from April to June. The chlorinated compounds did not exhibit readily-apparent seasonal trends.

Patterns appear to exist in the VOCs data for some of the individual compounds in time series plots (graphs of concentration versus sampling data for a given site and pollutant), or in comparisons of seasonal and annual averages.

Data for some of the monitoring sites indicate that some concentrations are site-related, and in some cases may be related to specific sources.

The aromatic compounds toluene, benzene, and the xylenes are known to be emitted by petroleum refineries, automobiles, and gas stations. Several of the chlorinated hydrocarbons are widely used industrial solvents; tetrachloroethylene is the most widely-used dry-cleaning solvent. Almost all of the compounds in these groups were found at levels exceeding background concentrations (i.e., concentrations at the background sites for the project), but concentrations of several of the chlorinated compounds were at or near background levels, indicating that local or regional sources had a minimal impact on the concentrations in air. A number of site-related concentration differences were further evaluated for identification of possible source or spatial relationships.

There are a number of interesting and potentially useful temporal and spatial patterns in the particulates data, with some substances showing differences between the sampling sites in the two states, but not between sites within the states.

Since an ozone interference negatively biased the formaldehyde results, little information is derived from the apparent site-to-site differences for this compound.

4.4 POTENTIAL SOURCES

The emission microinventory data for the thousand-meter circle around each monitoring site aided in the evaluation of the potential site-related concentration differences as noted for the high tetrachloroethylene concentrations at the Dongan Hills site. The point source inventories provide compound-by-compound estimates of annual emissions at specific source locations; they supported efforts to determine sources of the VOCs.

The data analyses using pollution rose calculations and back-trajectory modeling demonstrated the usefulness of these approaches in achieving a full understanding of the complex data sets. The data have been shown to have sufficient accuracy and precision for the requirements of the computer programs used in the pollution rose and back-trajectory analyses. The time resolution of the data sets is also compatible with the meteorological data used in these programs. These methods assist in defining spatial and temporal variations and in obtaining possible identities of sources through the back-trajectory method of tracing air parcel histories.

Mobile sources (autos and trucks) and refineries were found to be the major contributors to the highest concentrations of benzene and toluene at the project monitors. POTWs, industrial sources, and area sources (dry cleaners) were the primary sources of the highest concentrations of chlorinated hydrocarbons at the project monitors.

The results of the statistical analyses provided input regarding possible exposure and health risk differences due to the spatial variations in the concentrations.

4.5 INDOOR AIR

The New York State Department of Health performed a limited study of indoor air pollution as an extension of the SI/NJ UATAP. The study was carried out in the year following completion of the two-year ambient air sampling program. One ambient monitor was operated together with the sampling carried out in two homes in New York in the Travis neighborhood on Staten Island, and one ambient monitor was operated with sampling in two homes in Carteret, New Jersey. Samples were taken over a 24-hour interval (two sequential 12-hr samples) every twelve days over the period from July 10, 1990, to March 19, 1991. The spring period was not sampled; however this is not a critical problem since both spring and fall are transition periods between the summer and winter extremes of indoor ventilation characteristics.

The results were found to be in generally good agreement with the data from the ambient air study of the previous two years, as well as with several other data bases for indoor air concentrations.

The VOCs frequently detected (found in 75% or more of the samples) in indoor air in the homes of both New Jersey and New York include chloromethane, dichloromethane, hexane, benzene, toluene, ethylbenzene, m- and p-xylenes, and o-xylene. 1,1,1-trichloroethane was frequently detected in NJ homes only. Several other chlorinated hydrocarbons were less often detected indoors, and tetrachloromethane was never detected indoors.

Toluene, benzene, m- and p-xylenes, o-xylene, ethylbenzene, hexane, trichloromethane, and tetrachloroethylene were usually or always found at higher concentrations indoors than outdoors. It is noteworthy that source identification results associated the highest concentrations of benzene and toluene in ambient air with mobile sources and petroleum refineries; yet on the basis of average concentrations, indoor concentrations were higher than outdoor concentrations for these chemicals.

4.6 EXPOSURE AND HEALTH RISK ESTIMATES

Quantitative estimates of increased lifetime cancer risks for individual pollutants were in the range of 0.4 to 61 per million for the Level 1 analysis (ambient air), and 1 to 80 per million for the Level 2 analysis (ambient and indoor air, VOCs only). The Hazard Quotients for non-carcinogenic effects were below one for all pollutants except benzene, chromium, and nickel. The estimated risks for chromium and nickel are believed to be conservative, i.e., err in the direction of overestimating risk, since the specific chemical species of chromium and nickel in the ambient air samples were not measured.

The additive risk assessment for noncancer toxicity by target organ, and for cancer for all pollutants combined, yielded a maximum Hazard Index of 2 (hematopoietic effects and respiratory tract irritation), and a cumulative cancer risk of 96 or 123 per million, depending on the reference concentrations and chromium VI assumptions used in the estimates.

The estimated cancer and noncancer toxicity risks associated with benzene were consistently higher than those estimated for the other pollutants addressed in the Level 1 and Level 2 analyses. The next highest estimated risks in the Level 1 analysis were associated with nickel, chromium, tetrachloromethane, and arsenic; while the next highest estimated risks in the Level 2 analysis (VOCs only) were from trichloromethane and tetrachloroethene.

Using the 1988 and 1989 Urban Air Toxics Monitoring Program (UATMP) studies as the basis for comparison, the risk estimates for tetrachloroethene, nickel, and chromium were higher for the study area than for other urban areas nationwide. An assessment of the significance of the magnitudes of the differences is not offered; some of the differences might be attributable to differences in sampling and chemical analysis for the studies.

5. ADDRESSING THE PROJECT OBJECTIVES

This section presents the project results in terms of the goals established for the project.

5.1 OBJECTIVE 1

Characterize air quality for selected volatile organic compounds (VOCs) for the purpose of doing an exposure assessment for various population, commercial, and industrial interfaces.

This project was successful in characterizing air quality for selected VOCs at 13 sites across the project area over a two-year period. Yearly average concentrations of the target compounds at each monitoring site were produced by the various monitoring organizations, and validated according to the quality assurance (QA) program for the project.

In addition to developing the desired air quality data, the project was able to investigate and demonstrate the relative merits of several techniques for measuring airborne VOCs. At the start of the project, the state of the art for measuring VOCs was as follows:

- sampling through sorbent tubes (particularly tubes filled with Tenax) with analysis by gas chromatograph/mass spectrometer (GC/MS) was the most accepted technique;
- sampling into specially polished stainless steel canisters, with analysis by GC/MS, was being promoted; and
- sampling directly into field-based analytical instruments (particularly gas chromatographs (GCs)) was in early development.

Some members of the project had experience in using the first two methods, and some were interested in developing expertise in all three. Some EPA offices (Region II, the Office of Air Quality Planning and Standards, and the Office of Research and Development) were interested in encouraging this development and in comparing the results of the various techniques in real-world settings.

In order to further all of these goals and to fall within the financial framework of the project, it was agreed that two-tube distributed-volume sorbent sampling would be the primary

monitoring technique, to be performed every six days at every site. Canisters would be used as a QA frame of reference, rotating from site to site, except that some sites would be sampled regularly by both methods. The real-time GCs would be fit in, as development warranted (although, in fact, this never came to pass). Special QA procedures would then be implemented to investigate method-to-method and organization-to-organization comparisons.

The various collocations, performance evaluation samples, and on-site audits indicated the following:

- Intermethod comparisons. Sorbent tube and canister sampling methods are able to produce comparable results in terms of both detection limits and variability. A given project or circumstance may be more amenable to one method or the other. For example, a project that will require long sample holding times would be more suited to canister sampling, while a project that requires ultra-low detection limits may benefit from sample-concentration capabilities of sorbent tubes.

- Interorganization comparisons. Differences between monitoring organizations are more important than differences between methods.

- Viability of a multi-organization, multi-method project. Extensive project-level QA activities, on top of the normal QA program within the various organizations, are able to account for and minimize variability. In this case, data quality was not compromised by the use of multiple methods, and the inter-organization variability was certainly less than it would have been if they had all used the same method but had not participated in extensive project-level QA activities.

- Usefulness of two-tube sorbent sampling. Two-tube sorbent sampling can be very effective when the concentrations for the target contaminants are only slightly above background and do not vary significantly, and long-term averages are desired. The more standard four-tube system may still be needed when individual sample values are critical, or when ambient concentrations may vary widely, as in the vicinity of a major source.

5.2 OBJECTIVE 2

Characterize air quality for the parameters identified by EPA as high-risk urban toxics for the purpose of using exposure assessment for comparison with other studies.

The project was highly successful in capturing air quality data for selected parameters at 13 sites in the project area over a period of 24 months. These data have been used to characterize the distribution of air toxics spatially and temporally over the area and to perform exposure assessments for the ambient air pathway. For most of the 10 VOCs compared, the 1989 data (the year of data most complete with respect to number of sites and number of samples) from this project show a striking similarity to the data obtained from the 14 sites in the 1989 Urban Toxics Monitoring Program (UATMP). One SI/NJ UATAP site experienced higher mean concentrations for tetrachloroethylene than any 1988 or 1989 UATMP site. Several UATMP sites (Pensacola, FL; Dallas, TX; Wichita, KS) often experienced lower concentrations than the SI/NJ UATAP sites. Several UATMP sites (Chicago, IL; Sauget, IL; Miami, FL) often experienced higher concentrations of the VOCs than the SI/NJ UATAP sites.

5.3 OBJECTIVE 3

Characterize indoor air quality for selected VOCs for the purpose of doing exposure assessment for various types of commercial facilities and residences.

Over an eight-month period in 1990, indoor sampling was conducted at four residences using sampling and analysis techniques consistent with those used in the ambient air sampling phase of the project. No sampling was done in commercial facilities. Concentrations of some of the 12 VOCs quantitated were found to be more variable indoors than outdoors. The results have been incorporated into the risk assessments.

5.4 OBJECTIVE 4

Evaluate indoor/outdoor concentration relationships for selected VOCs.

Studies found in the literature have shown that for some pollutants in some settings, indoor pollution levels are influenced or dictated by ambient air levels outside the buildings. These reports show that the relationships between concentrations in indoor air and outdoor air vary from site to site. At many sites the indoor levels of some toxic air pollutants far exceed outdoor levels. Comparing the concentrations found in the four selected residences with the concurrent outdoor measurements made near the residences, it was found that the indoor concentrations of the eight VOCs frequently detected indoors usually or always exceeded their outdoor concentrations. Indoor/outdoor concentration ratios were similar to those found in TEAM (Total Exposure Assessment Methodology) studies.

5.5 OBJECTIVE 5

Perform emission source inventory (including point, area, and mobile sources), so as to formulate hypotheses linking major contaminants to potential sources.

A primary purpose for this study was to determine whether or not large industrial sources in New Jersey were the origin of toxic air pollutants which might be adversely impacting the health of the residents of Staten Island and neighboring areas of New Jersey. Since the majority of pollutants selected for study are commonly derived from both point, area and mobile sources, it was important to document the location and distribution of sources around monitoring sites very carefully in order to identify source-receptor relationships.

An inventory was assembled for the various classes of sources (point, area, and mobile). Several innovations were necessary to derive emission estimates for some sources such as publicly-owned sewage treatment works. A microinventory was performed in the circle one kilometer in radius around each sampling site to supplement source information in the existing data bases.

For the VOCs monitored in this project, the inventory showed that estimated emissions for toluene (primarily from point sources) were the highest. Among the pollutants with high cancer unit risk factors, benzene (from mobile sources) and

dichloromethane (methylene chloride) (from point sources) were the VOCs with the highest emissions.

5.6 OBJECTIVE 6

Obtain air quality data for the purpose of identifying potential sources using meteorological modeling.

The air quality data for the target VOCs collected during this project were suitable for use in meteorological modeling for identifying potential sources.

Although several sites showed significant variations in concentrations with wind direction, there were few cases in which individual point sources could be associated with air quality at the site. In several cases, it was clear that total loading of upwind point sources had a strong impact on ambient air quality. The most important finding, however, was that localized sources, both mobile and area sources, had the greatest impact on air quality monitored at a site.

5.7 OBJECTIVE 7

Evaluate indoor air quality data to identify possible sources.

The variability in correlations between indoor and corresponding outdoor concentrations from day to day and from house to house often did not support indoor or outdoor sources as the clear cause for the observed differences in concentrations. There were some exceptions, however, where consistent indoor sources, short-duration activities, or local outdoor sources were implicated. The association of higher indoor concentrations with specific indoor sources was hampered by the lack of a complete, detailed inventory of potential sources within each residence--an asset planned but not realized.

5.8 OBJECTIVE 8

Evaluate episodic odor occurrences and relate such episodes to air quality data.

In an effort to determine whether or not concentrations of targeted organic compounds increase during odor episodes, EPA issued canisters to six residents of the area during the period October 1989 through August 1990. Participants were asked to collect ambient air samples over a 30-minute period during each

odor episode. They were also asked to record such available meteorological parameters as wind speed and direction, the time the sample was collected, the general type of odor which was present, the strength of the odor, and any activity in the neighborhood which might be associated with the chemical concentrations found in the sample. These activities could include fuel oil deliveries, use of gasoline lawn mowers, and vehicles idling for an extended period of time.

The Interstate Sanitation Commission's odor complaint log for the test period showed that in a majority of the 24 instances when samples were collected, odor complaints were received from several citizens in the area. This independently confirms that odors were present when the samplers were activated by the participating resident. The greatest number of responses by any one participant was five, the fewest was two. However, it was not possible to link any odor episodes to any specific event. The odors were most frequently described as smelling like garbage or burning garbage and cement mix. This effort was referred to as the Staten Island Citizen's Odor Network.

The samples were analyzed for 17 VOCs. The vast majority of concentrations obtained from the odor episode samples were <3.0 ppbv. The maximum concentration during any one odor episode was 19.0 ppbv (toluene). Five chemicals--toluene, o- and m/p-xylenes, benzene, and ethylbenzene--were found in all samples. Methylene chloride, tetrachloroethene, and 1,1,1-trichloroethane were frequently found. Table I-1 lists the maximum concentrations for the 17 chemicals detected in the odor episode samples. The mean concentrations of these chemicals during the odor episodes were similar to those observed during the non-episode periods of the SI/NJ UATAP project. However, concentrations of chloroform and chloromethane were about 10 times higher in the odor episode samples than in the non-episode period. Overall, those compounds with the highest measured concentrations in the non-episode periods tended to have the highest concentrations during the odor episode periods.

5.9 OBJECTIVE 9

Evaluate some general abatement strategies.

Because the project did not show a dominant role for any specific major point source in creating an air quality problem in the study area, no basis was found for abatement actions directed at any specific major source. Further, much of the potential problem in the study area appears to be related to area and mobile sources.

The importance of these sources of air toxics emissions in creating ambient air toxic problems was recognized by Congress when it passed the 1990 Amendments to the Clean Air Act, which contain strategies for addressing these emissions. Specifically, the Act's reformulated gasoline requirements in Title II require a 15 percent reduction in toxics by the year 1995; this reduction requirement increases to 20 to 25 percent in the year 2000. Specific reductions in air toxics emissions from both point and area sources are mandated by Title III of the Clean Air Act.

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MAP I-1

SI/NJ UATAP
Monitoring Locations

SITES:

1. Westerleigh
2. Travis
3. Annadale
4. Great Kills
5. Port Richmond
6. Dongan Hills
7. Pumping Station
8. Clifton
9. Tottenville
A. Elizabeth
B. Carteret
C. Sewaren
D. Piscataway
E. Highland Park

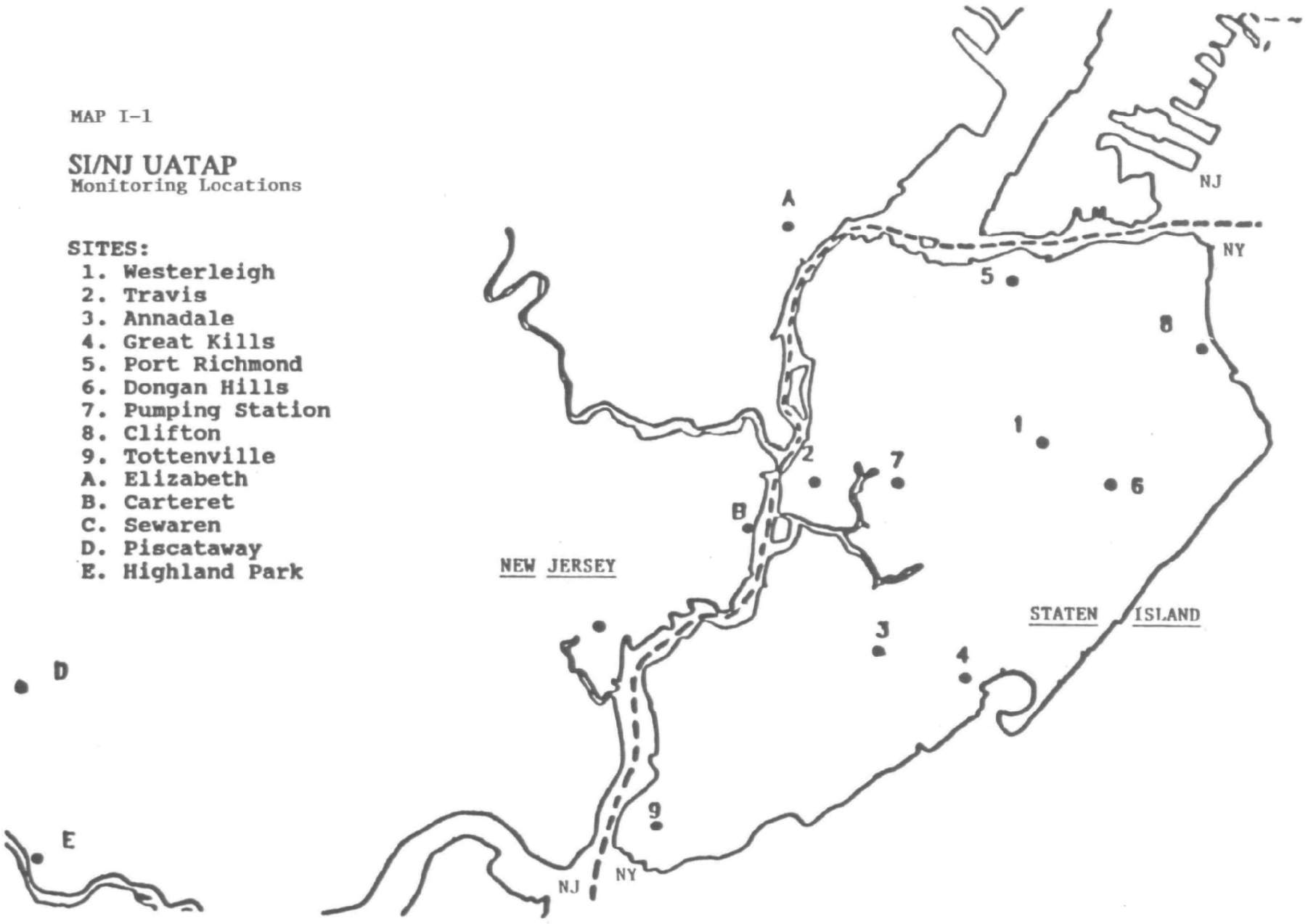

Table I-1: RESULTS OF THE STATEN ISLAND CITIZEN'S ODOR COMPLAINT NETWORK

Summary of analytical results for canister samples taken by a group of residents during the period from October 1989 through August 1990

Compound	# of Samples in which compound was detected*	Concentrations MAX	MIN	MEAN
BENZENE	24	5.60	0.65	2.2467
CHLOROFORM	2	21.10	0.09	0.5950
CHLOROMETHANE	7	1.35	0.53	0.9429
1,3-BUTADIENE	2	0.62	0.57	0.5950
P-DICHLOROBENZENE	13	0.60	0.07	0.2239
ETHYLBENZENE	24	2.50	0.24	0.7796
HEXANE	10	2.90	0.21	1.4130
METHYLENE CHLORIDE	20	12.71	0.58	2.4090
N-OCTANE	6	0.90	0.41	0.6467
STYRENE	14	1.20	0.02	0.3250
TETRACHLOROETHENE	22	4.16	0.29	0.7118
TOLUENE	24	19.00	0.64	6.6092
1,1,1-TRICHLOROETHANE	15	17.39	0.26	2.2307
TRICHLOROETHENE	9	1.40	0.03	0.3511
O-XYLENE	24	3.50	0.35	1.1392
M/P-XYLENE	24	15.00	0.53	4.0563
PROPYLENE	9	7.23	1.06	2.8289

*24 valid samples