



A Study to Characterize Air Concentrations of Methyl Tertiary Butyl Ether (MTBE) at Service Stations in the Northeast

Health and Environmental Sciences Department
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API PUBLICATION NUMBER 4619

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PREFACE

Preliminary findings from a presentation on MTBE made by Ted Johnson to the U. S Environmental Protection Agency (EPA) are included as an attachment to this report. The presentation was made at the EPA Conference, **MTBE and Other Oxygenates: A Research Update**, July 26-28, 1993 in Falls Church, VA. The attachment contains additional information – a presentation summary and copies of projection transparencies for inclusion in the conference proceedings. It has been included solely for the convenience of the reader.

ABSTRACT

The compound methyl tertiary butyl ether (MTBE) is routinely added to gasoline during the winter driving season to reduce carbon monoxide (CO) emissions from motor vehicles in CO nonattainment areas. In 1992, the U.S. Environmental Protection Agency (EPA) began receiving anecdotal complaints of headaches, nausea, and other symptoms following alleged wintertime exposures to MTBE in fuels. EPA solicited estimates of typical air concentrations of MTBE that motorists and attendants might experience during refueling at service stations that dispense gasoline containing MTBE. In response, the American Petroleum Institute (API) funded breathing zone, pump island and station perimeter measurements of ambient MTBE concentrations at 10 service stations in the New York metropolitan area in April 1993. Air samples were also analyzed for BTEX (benzene, toluene, ethylbenzene, xylene), THC (total hydrocarbons), CO and formaldehyde. Field personnel monitored meteorological parameters, gasoline composition (oxygenate content, Reid vapor pressure, BTEX), and gasoline sales and deliveries during each sampling period. Personnel also noted the time each vehicle was refueled and conducted regular counts of traffic on nearby roadways. The principal findings of the study are summarized below:

1. Mean and maximum four-hour average MTBE concentrations generally decrease from breathing zone to pump island to perimeter, suggesting that refueling activities are the principal source of MTBE measured at service stations, and MTBE concentrations are generally lower at stations with Stage II vapor controls.
2. Median four-hour average MTBE concentrations for all stations are below 2 ppm at breathing zone and pump island locations and below 0.02 ppm at the station perimeters.
3. Maximum four-hour average MTBE concentrations are below 2.6 ppm at breathing zone and pump island locations and below 0.2 ppm at station perimeters.
4. Because the canisters also sampled nonrefueling periods, breathing zone measurements may underestimate actual breathing zone concentrations during fuel dispensing by station-specific factors ranging from 1 to 3. Most factors fall between 1.0 and 1.4.

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EXECUTIVE SUMMARY

In 1992, the U.S. Environmental Protection Agency (EPA) began receiving anecdotal complaints of headaches, nausea, and other symptoms following alleged wintertime exposures to methyl tertiary butyl ether (MTBE) in fuels. In early 1993, EPA began a series of clinical research studies to investigate the validity of these claims. To properly design these studies, EPA solicited estimates of typical air concentrations of MTBE that motorists and attendants may experience during refueling at service stations that dispense gasoline containing MTBE. EPA also expressed interest in determining typical MTBE concentrations at the property boundaries of these service stations.

In response to these needs, the American Petroleum Institute (API) funded a field study in which IT Air Quality Services (ITAQS) measured ambient MTBE concentrations at ten service stations in the New York metropolitan area. The stations included:

1. Two full-service stations with Stage II vapor recovery on a commuting route near East Brunswick, New Jersey;
2. Three self-service stations with Stage II vapor recovery in Westchester County, New York; and
3. Five self-service stations without Stage II vapor recovery in Fairfield County, Connecticut.

The selection of full-service stations in New Jersey was unavoidable, as self-service stations are not permitted in that state.

Each station was sampled on a separate day between April 7, 1993 and April 23, 1993. The monitoring activities at each station were conducted during two four-hour periods, nominally 9 a.m. to 12 a.m. and 2 p.m. to 6 p.m. Four-hour canister and impinger samples were collected at four perimeter locations (north, east, south, and west) and one pump location at each station, in customer breathing zones at the New

York and Connecticut stations, and in attendant breathing zones at the New Jersey stations. In addition, four-hour charcoal tube samples were collected in the breathing zones of all stations. These samples were analyzed to determine air concentrations of MTBE, BTEX (benzene, toluene, ethyl benzene, xylene), total hydrocarbon (THC) concentration, and formaldehyde.

Continuous carbon monoxide measurements were made in the pump area of each station using a Metrosonics® pm-7700 monitor. Organic vapor analyzers (OVA) were used to continuously monitor THC concentrations in the pump areas and breathing zones. These measurements were made as a means of identifying individual refueling events which could not be distinguished in the four-hour samples collected by the canister samplers.

Field personnel monitored meteorological parameters, gasoline composition (oxygenate content, Reid vapor pressure, BTEX), and gasoline sales as well as deliveries during each sampling period. Personnel also noted the time each vehicle was refueled and conducted regular counts of traffic on nearby roadways. Gasoline pumping activities were continuously recorded by a stationary video camera.

Statistical analyses of the data obtained from the field monitoring activities support the following general findings.

1. Mean and maximum four-hour average MTBE concentrations generally decrease from breathing zone to pump island to perimeter, suggesting that refueling activities are the principal source of MTBE measured at service stations.
2. MTBE concentrations are generally lower at stations with Stage II vapor controls.
3. Median four-hour MTBE concentrations for all stations are below 2 ppm at breathing zone and pump island locations and below 0.02 ppm at the station perimeters.

4. Maximum four-hour MTBE concentrations for all stations are below 2.6 ppm at breathing zone and pump island locations and below 0.2 ppm at station perimeters.
5. For all stations, because the canisters also sampled nonrefueling periods, breathing zone measurements of MTBE concentration may underestimate actual breathing zone concentrations during fuel dispensing by station-specific factors ranging from 1 to 3. Most factors fall between 1.0 and 1.4.

A series of special statistical analyses were performed to identify patterns in the individual component data and to compare sampling methodologies. An analysis of concentration ratios (the ratio of MTBE to a second component) found that ratios were generally larger for pump and breathing zone canister samples than for perimeter canister samples. This pattern suggests that refueling operations were the principal source of MTBE at each station, whereas other sources (e.g., local traffic) contributed significantly to the levels of BTEX and THC.

The results of stepwise regression analyses performed on the four-hour canister data indicate that MTBE concentration can be predicted well ($R^2 = 0.886$) as a linear function of simultaneously-measured concentrations of benzene, toluene, ethyl benzene, and THC. Of these four predictors, benzene provides the best single means of predicting MTBE concentration. Benzene also provides the best prediction of toluene and THC concentration. Toluene is the best predictor of ethyl benzene concentration.

Other stepwise regression analyses were performed on the four-hour canister measurements to identify factors that potentially affect component concentration values. The analyses suggest that following conditions are associated with an increase in MTBE concentration:

- Measurements are made at pump island or breathing zone locations rather than perimeter locations;

- Measurements are made at a Connecticut station (i.e., a station with no Stage II vapor recovery) rather than a New York or New Jersey station;
- Low wind speed;
- High traffic on nearby roads.

Analysts also attempted to identify possible conditions that could explain fourteen high MTBE values. Seven of the 14 values were found to be associated with the combination of two unusual conditions: (1) average wind speed less than 3 mph and (2) number of serviced vehicles exceeded 115. Four of the high values were associated with spills or overflows, two were associated with cumulative street traffic exceeding 10,000 vehicles, and three were associated with average gasoline dispensing rates exceeding 325 gallons/hour. Active use of garage bays may have contributed to two of the high values. Other potential events that may be relevant include a gasoline delivery and a vehicle running during refueling.

Although the field study was conducted primarily to obtain representative air concentrations of MTBE at service stations, the collected data also provide a means for comparing canisters and charcoal tubes. These sampling methodologies are routinely used in chemical exposure studies. The data base contains 20 cases in which canister and charcoal tube samples were collected at the same location for the same time period. An analysis of the 14 cases in which MTBE concentrations exceeded the limit of detection for both sampling methodologies found that the ratio of canister MTBE to tube MTBE ranged from 0.52 to 9.74. Fifty percent of the canister-to-tube ratios were between 0.62 and 1.17; the median ratio was 1.00.

Ten pairs of duplicate samples were collected using canister samplers, and ten pairs were collected using impinger samples. The median percent difference in concentration between the duplicate measurements was 21.8 percent for MTBE, 12.2 percent for benzene, 19.4 percent for toluene, 30.5 percent for ethyl benzene, 11.8 percent for xylene, and 19.0 percent for formaldehyde. Note that duplicate pairs

containing values below the detection limit were not considered in calculating these values.

During the ITAQS service station study, an independent research team headed by Dr. Paul Lioy of the Environmental and Occupational Health Sciences Institute (EOHSI) collected air samples in the passenger compartments of automobiles during typical home-to-work commutes (manuscript in preparation). Selected automobiles in the Lioy study were refueled at stations included in the service station study. Breathing zone MTBE concentrations measured by the EOHSI team during these refueling events were comparable to breathing zone measurements made by the ITAQS team.

Section 1

INTRODUCTION

The compound methyl tertiary butyl ether (MTBE) is routinely added to gasoline during the winter driving season to reduce carbon monoxide (CO) emissions from motor vehicles. In 1992, the U. S. Environmental Protection Agency (EPA) began receiving anecdotal complaints about headaches, nausea, and other symptoms following alleged exposure to MTBE. In early 1993, EPA began planning a series of clinical research studies to investigate the validity of these claims. To properly design these studies, EPA solicited data which could be used to estimate the MTBE exposures of motorists during refueling at service stations that dispense gasoline containing MTBE. EPA also expressed interest in determining typical "fenceline" concentrations of MTBE at service stations. In response to these needs, the American Petroleum Institute (API) supported two related studies in the New York Metro area: a service station study conducted by IT Air Quality Services (ITAQS) and a commuter study conducted by the Environmental and Occupational Health Sciences Institute (EOHSI). In addition to MTBE, both studies measured air concentrations of the four BTEX compounds (benzene, toluene, ethyl benzene, and xylene), formaldehyde, and carbon monoxide (CO).

During the service station study, ITAQS collected air samples at stations located in East Brunswick, NJ (two stations); Mamaroneck, NY (two stations); Port Chester, NY (one station); Greenwich, CT (four stations); and Stamford, CT (one station). The samples represented four general locations: the breathing zone of customers, the breathing zone of attendants, the general vicinity of the pumps, and the property boundary. Field personnel also monitored meteorological parameters, gasoline composition, gasoline sales as well as deliveries during each sampling period. Gasoline pumping activities were recorded by a stationary video camera.

In the commuter study, an EOHSI research team directed by Dr. Paul Lioy collected air samples in the passenger compartments of automobiles during typical home-to-work commutes. These automobiles were fueled with gasoline containing MTBE and were driven through areas in which MTBE use was mandatory. Selected automobiles in the commuter study were refueled at stations included in the service station study. The refueling operations were timed to coincide with the collection of air samples at the stations. Further information concerning the commuter study can be obtained from the Lioy research team.

This report provides a description of the service station study and summarizes the results of statistical analyses performed on data collected during the study. Section 2 of the report briefly discusses the procedures used in selecting service stations for the study, lists the sampling dates and times associated with each station, and presents the general characteristics of each station. Section 3 provides a detailed description of the monitoring activities performed at each station. Section 4 provides summary statistics for the data collected during the field portion of the study. The results of a series of special statistical analyses are presented in Section 5. Section 6 provides a summary of the major findings of the study. Section 7 provides references for the sampling and analytical techniques employed in the study. Appendix A contains a schematic of each station showing sampling locations. Appendix B contains a record of the notable events that occurred during the study.

Section 2

SELECTION OF SERVICE STATIONS AND MONITORING PERIODS

In March of 1993, API issued a request to member petroleum companies for the names and locations of potential service station participants for the study. The resulting list of stations was combined with a list of service stations identified by the EOHSI research team as being located along roadways selected for the commuting study. After completing an evaluation of all candidate stations, API identified ten stations that were suitably located and willing to participate in the study. The stations fall into three general categories:

1. Two full-service stations with Stage II vapor recovery on a commuting route near East Brunswick, New Jersey;
2. Three self-service stations with Stage II vapor recovery in Westchester County, New York;
3. Five self-service stations without Stage II vapor recovery in Fairfield County, Connecticut.

The stations differ with respect to geographic location, service type (full versus self), and the use of vapor recovery. Note that the selection of full-service stations for New Jersey was mandatory, as self-service stations are not permitted in this state. Both New Jersey stations were located on a commuting route used by the Lioy group. The remaining eight stations were located in a 20-mile-long commuting corridor between Mamaroneck, NY, and Stamford, CT. Table 2-1 provides a general description of each station. The names and street addresses of the stations have been omitted to comply with confidentiality agreements.

Each station was monitored on a separate calendar day between April 7, 1993 and April 23, 1993. The monitoring activities at each station were conducted during two four-hour periods, nominally 8 a.m. to 12 a.m. and 2 p.m. to 6 p.m. Table 2-1 lists the sampling date for each station and the actual start/stop times for each four-hour sampling period.

Table 2-1. Service station characteristics.

Station Identification Code	Nearest City	Date Sampled	Four-hour Sampling Periods		Service Type ^a	Number of Service Bays	Stage II Vapor Recovery?	Major Adjoining Roadways
			Morning	Afternoon				
1NJ	East Brunswick, NJ	4/7/93	10:00-14:00	16:30-20:30	Full	2	Yes	West - 6 lanes
2NJ	East Brunswick, NJ	4/8/93	8:30-12:30	15:00-19:00	Full	3	Yes	West - 6 lanes
3C	Greenwich, CT	4/12/93	8:00-12:00	14:17-18:17	Full and self	4	No	East - 4 lanes, South - 2 lanes
4NY	Mamaroneck, NY	4/13/93	8:00-12:00	14:25-18:31	Full and self	0	Yes	West - 4 lanes, South - 2 lanes
5C	Stamford, CT	4/15/93	7:47-12:48	14:17-18:16	Full and self	3	No	West - 2 lanes, South - 2 lanes
6C	Greenwich, CT	4/16/93	7:51-11:53	14:04-18:00	Self	0	No	East - 2 lanes, West - 2 lanes
7C	Greenwich, CT	4/19/93	7:37-11:37	14:33-18:36	Full and self	3	No	West - 4 lanes, North - 2 lanes
8C	Greenwich, CT	4/20/93	7:47-11:50	13:59-18:03	Full and self	5	No	East - 4 lanes, North - 2 lanes
9NY	Mamaroneck, NY	4/22/93	^b	14:00-18:02	Full and self	3	Yes	South - 4 lanes, West - 2 lanes
10NY	Port Chester, NY	4/23/93	7:40-11:56	14:00-17:52	Self	0	Yes	South - 4 lanes, East - 2 lanes

^aApplies to service in area where pumps and customers were monitored.

^bSplit sampling period: 7:30-8:00 and 8:43-10:47.

Section 3

MONITORING ACTIVITIES

Table 3-1 provides an overview of the field monitoring activities. Four-hour canister and impinger samples were obtained at four perimeter locations (north, east, south, and west) and one pump island location at each station. Four-hour canister and impinger samples were also obtained for customer breathing zones at the New York and Connecticut stations and for attendant breathing zones at the New Jersey stations. Four-hour charcoal tube samples were obtained for customer breathing zones at the New York and Connecticut stations. Attendant breathing zones were sampled at the New Jersey stations because customers are not permitted to refuel motor vehicles in New Jersey.

To assist the EOHSI commuting study, field personnel collected special one-hour canister and charcoal tube samples at both of the New Jersey stations and at Station 10NY in New York for comparison to EOHSI adsorbent tube values. The samples were collected at the west perimeter location of each New Jersey station. The sampling periods were 13:00 to 14:00 for Station 1NJ and 8:27 to 9:30 for Station 2NJ. Two sets of special samples were also obtained near the pumps at Station 10NY in New York. The sampling periods were 16:05 to 17:05 and 17:13 to 18:15.

In addition, eight-hour charcoal tube samplers were attached to attendants at Connecticut stations 3C and 8C. The sampling periods were 6:58 to 15:00 (8 h, 2 min) for Station 3C and 7:07 to 14:29 (7 h, 22 min) for Station 8C. Field personnel were not able to monitor the Station 8C attendant for a full eight-hour period, as his work shift ended at 14:30.

Table 3-2 lists the number of individual air samples collected using canisters, impingers, and charcoal tubes. The listings are organized by station and location within station.

Table 3-1. Summary of principal monitoring activities.

Property perimeter (all stations) Canisters (4-hour samples): MTBE, BTEX, and THC Impingers (4-hour samples): formaldehyde Vicinity of pumps (all stations) Canisters (4-hour samples): MTBE, BTEX, and THC Impinger samplers (4-hour samples): formaldehyde Metrosonics® pm-7700 (continuous): carbon monoxide Organic vapor analyzer (continuous): THC Breathing zone (attendant: NJ stations, customer: NY and CT stations) Canisters (4-hour samples): MTBE, BTEX, and THC Impinger samplers (4-hour samples): formaldehyde Organic vapor analyzer (continuous): THC Charcoal tube (4-hour samples): MTBE and BTEX Attendant breathing zone (two Connecticut stations) Charcoal tube (8-hour sample): MTBE and BTEX One-hour samples (see Table 3-2) Meteorological station (all stations) Wind speed - 15 minute intervals Wind direction - 15 minute intervals Temperature - 30 minute intervals Relative humidity - 30 minute intervals Gasoline samples (all stations)

Table 3-2. Number of individual air samples collected using canisters, impingers, and charcoal tubes.

Sampler type	Sampling period	Location	New Jersey			New York			Connecticut					Total
			1	2	4	9	10	3	5	6	7	8		
Canister	4h	Perimeter Pumps	9	9	9	9	9	9	9	9	9	9	90	
		Customer	2	2	2	2	2	2	2	2	2	2	20	
		Attendant	0	0	2	2	2	2	2	2	2	2	16	
		Subtotal	2	2	0	0	0	0	0	0	0	0	4	
		Subtotal	13	13	13	13	13	13	13	13	13	13	130	
Canister	1h	West Perimeter Pumps	1	1	0	0	0	0	0	0	0	0	2	
			0	0	0	0	2	0	0	0	0	0	2	
		Subtotal	1	1	0	0	2	0	0	0	0	0	4	
Impinger	4h	Perimeter Pumps	9	9	8	5	9	9	9	9	9	9	85	
		Customer	2	2	2	1	2	2	2	2	2	2	19	
		Attendant	0	0	2	1	2	2	2	2	2	2	15	
		Subtotal	2	2	0	0	0	0	0	0	0	0	4	
		Subtotal	13	13	12	7	13	13	13	13	13	13	123	
Charcoal tube	4h	Attendant Customer	2	2	0	0	0	0	0	0	0	0	4	
			0	0	2	2	2	1	2	2	2	2	15	
		Subtotal	2	2	2	2	2	1	2	2	2	2	19	
Charcoal tube	1h	West Perimeter Pumps	1	1	0	0	0	0	0	0	0	0	2	
			0	0	0	0	2	0	0	0	0	0	2	
		Subtotal	1	1	0	0	2	0	0	0	0	0	4	
Charcoal tube	8h	Attendant	0	0	0	0	0	1	0	0	0	1	2	
		Total	30	30	27	22	32	28	28	28	28	29	282	

Continuous carbon monoxide measurements were made in the pump island area of each station using a Metrosonics® pm-7700 monitor. Organic vapor analyzers employing flame ionization detectors were used to continuously monitor THC concentrations in the pump areas and breathing zones. Data obtained from these monitors are useful in identifying individual refueling events which cannot be distinguished in the four-hour samples collected by canister and charcoal tube samplers.

The approximate heights of the sample intake ports at each sampling location are listed in Table 3-3. Generalized station schematics, including sampling locations, are provided in Appendix A.

Section 7 provides references for the sampling methods used during the field monitoring activities. References are also provided for the procedures used in analyzing the collected samples. Table 3-4 provides a summary of this material.

Table 3-3. Approximate heights of sampling points.

Sample location	Approximate height of sample intake port above the ground (feet)
North	4.25
East	4.25
South	4.25
West	4.25
Pump	5.00
Breathing zone	4.75

Table 3-4. Sampling methods and analytical techniques.

Canister (MTBE, BTEX, and THC)

Sampling method	Six-liter SUMMA (tm) polished stainless steel canister
Analytical method	Gas chromatography (GC/MS) – Method TO14 ¹

Charcoal tube (MTBE and BTEX)

Sampling method	Two charcoal tubes in series (front 400 mg, back 200 mg) – NIOSH Method 1615
Analytical method	Gas chromatography (FID) – NIOSH Method 1615 ²

Impinger (formaldehyde)

Sampling method	Midget impinger containing 10 ml of DNPH reagent
Analytical method	High performance liquid chromatography – Method TO5 ³

Carbon monoxide monitor

Sampling method	Metrosonics® pm-7700 continuous analyzer ⁴
Calibration	Carbon monoxide gas cylinder (20 ppm, $\pm$ 5%) traceable to National Institute of Standards & Technology

Organic vapor analyzer (continuous THC)

Sampling method	Foxboro® Model 108 organic vapor analyzer
Calibration	U.S.E.P.A. Method 21 (40 CFR 60, Appendix A) ⁵

Gasoline samples

Sampling method	One gallon metal can
Analytical Method 1	Gas chromatography – ASTM 4815 (MTBE and BTEX) ⁶
Analytical Method 2	High resolution capillary gas chromatography (MTBE only) ⁷

¹⁻⁷ See References, Section 7-1.

Section 4

DESCRIPTIVE STATISTICS

Table 3-1 in Section 3 lists the principal monitoring activities performed during the field portion of this study. These activities can be grouped into the following general categories according to measurement methodology:

- Canister samples;
- Impinger samples;
- Charcoal tube samples;
- Continuous carbon monoxide measurements;
- Continuous THC measurements;
- Meteorological station measurements;
- Analysis of liquid gasoline samples.

This section provides descriptive statistics for the data provided by each methodology.

CANISTER SAMPLES

Two sets of canister samples were collected during the field study. The first set consisted of 130 samples collected over nominal four-hour periods; the second set included four, one-hour samples for comparison to EOHSI absorbent tubes.

The four-hour samples were collected at four locations (north, east, south, and west) on the perimeter of each station, at one location on a pump island, and in a location referred to as the "breathing zone." In monitoring the breathing zone, the technician placed the sample collection probe near the face of each customer or attendant during each refueling operation. During other time periods, the probe was placed on the top of the organic vapor analyzer at a height of approximately four feet. The organic vapor analyzer was typically located on the pump island. These are the combined measurements that constitute the breathing zone sample values in the tables that follow.

Two of the one-hour samples were collected at the west perimeter locations associated with the New Jersey stations (NJ1 and NJ2); the remaining two samples

were collected at the pump location of NY10. These canister samples were collocated with one-hour absorbent tube samples placed by the EOHSI research team. The one-hour canister samples provided a means for evaluating the accuracy of the concentrations obtained from the one-hour tube samples.

The canister samples were analyzed for six component species: total hydrocarbons (THC), MTBE, benzene, toluene, ethyl benzene, and xylene. Tables 4-1 through 4-6, respectively, list the concentrations for each of the six species according to station, time period, and monitoring location (e.g., north perimeter). The actual sampling period associated with each measurement is listed under "time period." Note that the morning sample for Station 9NY was collected during two time intervals: 7:30 to 8:00 and 8:43 to 10:47.

Tables 4-7 through 4-12 provide descriptive statistics for the four-hour canister data according to component species, station grouping (all stations, New Jersey stations, New York stations, or Connecticut stations), and monitoring location. The descriptive statistics include total number of concentration values, number of concentration values below the level of detection, minimum, maximum, median, geometric mean (GM), and geometric standard deviation (GSD). In calculating these statistics, each value below the detection limit was assigned a value equal to the detection limit. (Note that a majority of the ethyl benzene values were below the detection limit.) Whenever the collection of collocated samples produced two concentration values for a particular location, the average of the two values was used in calculating the descriptive statistics.

Arithmetic means have been purposely omitted from the tables of descriptive statistics. Because the data distributions are often highly skewed, the arithmetic mean may provide a misleading representation of the central tendency in the data. In such cases, the median and GM statistics will provide a better indication of "average" concentration.

Table 4-1. Concentrations of total hydrocarbon (THC) obtained from four-hour canister samples.

Station	Sample type	TTime period	Total hydrocarbon concentration, ppm as hexane					Pump island sampler	Breathing zone sampler ^a
			Perimeter monitors						
			North	East	South	West			
1NJ	Morning 4h Afternoon 4h	10:00-14:00 16:30-20:30	0.540 2.200	(0.005) ^b 0.150	(0.005) 0.160	0.170 0.130	0.730 2.300	0.390 1.300	
2NJ	Morning 4h Afternoon 4h	8:30-12:30 15:00-19:00	0.400 0.680	0.260 0.150	0.180 (0.005)	0.440 0.200	5.500 2.100	13.000 4.300	
3C	Morning 4h Afternoon 4h	8:00-12:00 14:17-18:17	(0.005) (0.005)	0.140 (0.005)	0.800 0.700	(0.005) (0.005)	(0.005) 0.940	1.300 7.600	
4NY	Morning 4h Afternoon 4h	8:00-12:00 14:25-18:31	(0.005) (0.005)	0.091 0.170	0.120 (0.005)	(0.005) (0.005)	0.100 0.095	0.430 0.380	
5C	Morning 4h Afternoon 4h	7:47-12:48 14:17-18:16	0.140 0.074	0.170 0.088	0.037 0.039	0.200 0.230	0.500 0.900	5.300 7.900	
6C	Morning 4h Afternoon 4h	7:51-11:53 14:04-18:00	0.170 0.790	3.300 3.200	0.480 0.270	27.000 11.000	5.900 1.100	1.100 6.400	
7C	Morning 4h Afternoon 4h	7:37-11:37 14:33-18:36	0.450 0.210	0.120 0.160	3.800 1.900	0.890 0.400	2.900 1.500	7.600 3.800	
8C	Morning 4h Afternoon 4h	7:37-11:50 13:59-18:03	0.380 0.210	0.360 0.067	0.520 0.190	0.270 0.280	0.540 0.220	7.800 4.100	
9NY	Morning 4h Afternoon 4h	7:30-8:00 8:43-10:47 14:00-18:02	0.210 0.350	0.260 0.120	0.110 1.100	M ^c 0.120	0.810 0.490	1.300 1.700	
10NY	Morning 4h Afternoon 4h	7:40-11:56 14:00-17:52	0.400 0.510	0.180 M	0.190 0.110	0.310 0.280	0.240 M	1.000 2.200	

^aBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

^bNumbers in parentheses are detection limits

^cM = Missing (sample not available for analysis).

Table 4-2. Concentrations of methyl tertiary butyl ether (MTBE) obtained from four-hour canister samples.

Station	Sample type	Time period	MTBE concentration, ppm						Breathing zone sampler ^a
			Perimeter monitors				Pump island sampler		
			North	East	South	West			
1NJ	Morning 4h Afternoon 4h	10:00-14:00 16:30-20:30	0.002 0.001	0.001 (0.0011) ^b	0.002 0.002	0.012 0.009	0.120 0.220	0.084 0.520	
2NJ	Morning 4h Afternoon 4h	8:30-12:30 15:00-19:00	0.016 0.003	0.021 0.004	0.015 0.002	0.036 0.025	1.600 0.660	0.200 0.290	
3C	Morning 4h Afternoon 4h	8:00-12:00 14:17-18:17	0.008 0.013	0.008 0.008	0.019 0.027	(0.0011) (0.0012)	(0.0005) 0.300	0.196 1.500	
4NY	Morning 4h Afternoon 4h	8:00-12:00 14:25-18:31	0.002 0.002	0.003 0.007	0.014 0.010	0.002 0.007	0.014 0.019	0.100 0.077	
5C	Morning 4h Afternoon 4h	7:47-12:48 14:17-18:16	0.009 0.010	0.016 0.007	0.003 0.002	0.028 0.044	0.160 0.330	1.200 2.100	
6C	Morning 4h Afternoon 4h	7:51-11:53 14:04-18:00	0.017 0.016	0.005 0.005	0.120 0.025	0.120 0.060	1.500 0.180	0.170 2.200	
7C	Morning 4h Afternoon 4h	7:37-11:37 14:33-18:36	0.059 0.068	0.010 0.011	0.032 0.004	0.140 0.043	0.230 0.083	1.500 1.600	
8C	Morning 4h Afternoon 4h	7:37-11:50 13:59-18:03	0.033 0.029	0.012 0.030	0.004 0.002	0.071 0.038	0.034 0.009	2.600 0.460	
9NY	Morning 4h Afternoon 4h	7:30-8:00 8:43-10:47 14:00-18:02	0.029 0.006	0.022 0.004	0.006 0.019	0.008 0.003	0.068 0.080	0.250 0.300	
10NY	Morning 4h Afternoon 4h	7:40-11:56 14:00-17:52	0.081 0.083	0.014 0.004	0.008 0.014	0.002 0.004	0.027 0.080	0.160 0.780	

^aBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

^bNumbers in parentheses are detection limits.

Table 4-3. Concentrations of benzene obtained from four-hour canister samples.

Benzene concentration, ppm									
Station	Sample type	Time period	Perimeter monitors				Pump island sampler	Breathing zone sampler ^a	
			North	East	South	West			
1NJ	Morning 4h Afternoon 4h	10:00-14:00 16:30-20:30	0.001 <0.001 ^b	0.001 (0.0005) ^c	0.001 (0.0004)	0.001 0.002	0.010 0.022	0.005 0.032	
2NJ	Morning 4h Afternoon 4h	8:30-12:30 15:00-19:00	0.003 0.001	0.002 0.001	0.002 0.001	0.003 0.004	0.079 0.049	0.014 0.029	
3C	Morning 4h Afternoon 4h	8:00-12:00 14:17-18:17	0.001 0.001	0.001 0.001	0.002 0.002	(0.0004) (0.0005)	0.017 0.018	0.014 0.082	
4NY	Morning 4h Afternoon 4h	8:00-12:00 14:25-18:31	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.002 0.002	0.003 0.003	
5C	Morning 4h Afternoon 4h	7:47-12:48 14:17-18:16	0.001 0.001	0.001 0.001	0.001 0.001	0.002 0.002	0.008 0.012	0.039 0.085	
6C	Morning 4h Afternoon 4h	7:51-11:53 14:04-18:00	0.001 0.001	0.001 0.001	0.004 0.003	0.005 0.003	0.054 0.011	0.012 0.050	
7C	Morning 4h Afternoon 4h	7:37-11:37 14:33-18:36	0.006 0.003	(0.0004) 0.001	0.004 0.001	0.008 0.003	0.040 0.005	0.110 0.059	
8C	Morning 4h Afternoon 4h	7:37-11:50 13:59-18:03	0.004 0.002	0.002 0.001	0.001 0.001	0.005 0.004	0.002 0.001	0.072 0.018	
9NY	Morning 4h Afternoon 4h	7:30-8:00 8:43-10:47 14:00-18:02	0.002 0.001	0.002 0.001	0.002 0.003	0.002 0.001	0.005 0.006	0.010 0.009	
10NY	Morning 4h Afternoon 4h	7:40-11:56 14:00-17:52	0.003 0.005	0.002 0.001	0.001 0.002	ND 0.001	0.001 0.004	0.005 0.017	

^aBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

^bThe value is less than the specified value, but above the detected limit.

^cNumbers in parentheses are detection limits.

Table 4-4. Concentrations of toluene obtained from four-hour canister samples.

Toluene concentration, ppm									
Station	Sample type	Time period	Perimeter monitors				Pump island sampler	Breathing zone sampler ^a	
			North	East	South	West			
1NJ	Morning 4h	10:00-14:00	0.002	0.001	0.001	0.004	0.039	0.011	
	Afternoon 4h	16:30-20:30	0.001	0.001	0.001	0.004	0.071	0.061	
2NJ	Morning 4h	8:30-12:30	0.005	0.004	0.004	0.005	0.070	0.019	
	Afternoon 4h	15:00-19:00	0.001	0.002	0.002	0.007	0.055	0.046	
3C	Morning 4h	8:00-12:00	0.001	0.002	0.003	(0.0004) ^b	0.016	0.010	
	Afternoon 4h	14:17-18:17	0.003	0.003	0.004	0.001	0.029	0.065	
4NY	Morning 4h	8:00-12:00	0.002	0.002	0.002	0.001	0.004	0.005	
	Afternoon 4h	14:25-18:31	0.002	0.003	0.002	0.002	0.004	0.005	
5C	Morning 4h	7:47-12:48	0.002	0.004	0.002	0.003	0.016	0.046	
	Afternoon 4h	14:17-18:16	0.002	0.002	0.001	0.007	0.020	0.099	
6C	Morning 4h	7:51-11:53	0.004	0.003	0.007	0.017	0.074	0.037	
	Afternoon 4h	14:04-18:00	0.003	0.002	0.008	0.009	0.035	0.130	
7C	Morning 4h	7:37-11:37	0.011	0.006	0.009	0.015	0.076	0.120	
	Afternoon 4h	14:33-18:36	0.006	0.003	0.004	0.025	0.011	0.070	
8C	Morning 4h	7:37-11:50	0.007	0.004	0.004	0.010	0.005	0.088	
	Afternoon 4h	13:59-18:03	0.071	0.002	0.002	0.008	0.003	0.024	
9NY	Morning 4h	7:30-8:00	0.007	0.005	0.006	0.003	0.014	0.020	
	Afternoon 4h	8:43-10:47	0.003	0.003	0.005	0.002	0.012	0.013	
10NY	Morning 4h	7:40-11:56	0.010	0.003	0.002	0.001	0.003	0.008	
	Afternoon 4h	14:00-17:52	0.012	0.001	0.004	0.002	0.007	0.038	

^aBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

^bNumbers in parentheses are detection limits.

Table 4-5. Concentrations of ethyl benzene obtained from four-hour canister samples.

Station	Sample type	Time period	Ethyl benzene concentration, ppm						
			Perimeter monitors				Pump island sampler	Breathing zone sampler ^a	
			North	East	South	West			
1NJ	Morning 4h Afternoon 4h	10:00-14:00 16:30-20:30	(0.0003) ^b (0.0003)	(0.0004) (0.0005)	(0.0004) (0.0004)	(0.0005) 0.001	0.007 0.017	0.002 0.008	
2NJ	Morning 4h Afternoon 4h	8:30-12:30 15:00-19:00	0.001 (0.0005)	0.001 (0.0005)	(0.0006) (0.0004)	0.001 0.001	0.006 0.008	(0.0047) 0.009	
3C	Morning 4h Afternoon 4h	8:00-12:00 14:17-18:17	(0.0004) (0.0004)	(0.0004) (0.0004)	(0.0004) <0.001 ^c	(0.0004) (0.0005)	(0.0038) (0.0036)	(0.0052) (0.0036)	
4NY	Morning 4h Afternoon 4h	8:00-12:00 14:25-18:31	(0.0003) (0.0004)	(0.0004) 0.001	<0.001 ^c (0.0004)	(0.0004) (0.0005)	0.001 0.001	0.001 0.001	
5C	Morning 4h Afternoon 4h	7:47-12:48 14:17-18:16	(0.0004) (0.0004)	0.001 (0.0003)	(0.0004) (0.0004)	(0.0004) 0.001	(0.0004) (0.0040)	(0.0038) 0.006	
6C	Morning 4h Afternoon 4h	7:51-11:53 14:04-18:00	0.001 (0.0006)	<0.001 ^c (0.0003)	0.001 0.001	(0.0042) 0.001	0.007 (0.0055)	0.004 0.013	
7C	Morning 4h Afternoon 4h	7:37-11:37 14:33-18:36	0.002 0.001	0.001 (0.0005)	0.001 (0.0005)	0.002 0.002	0.011 0.002	0.012 0.005	
8C	Morning 4h Afternoon 4h	7:37-11:50 13:59-18:03	0.001 0.004	0.001 (0.0005)	(0.0005) (0.0005)	0.002 0.002	0.001 (0.0005)	0.007 (0.0043)	
9NY	Morning 4h Afternoon 4h	7:30-8:00 8:43-10:47 14:00-18:02	0.002 (0.0004)	0.001 (0.0003)	0.002 0.001	(0.0006) (0.0004)	0.002 0.002	0.003 (0.0029)	
10NY	Morning 4h Afternoon 4h	7:40-11:56 14:00-17:52	0.002 0.002	(0.0008) (0.0005)	(0.0004) 0.001	(0.0006) (0.0005)	(0.0004) 0.001	0.001 0.003	

^aBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

^bNumbers in parentheses are detection limits.

^cThe value is less than the specified value, but above the detection limit.

Table 4-6. Concentrations of xylene obtained from four-hour canister samples.

Station	Sample type	Time period	Xylene concentration, ppm					Pump Island sampler	Breathing zone sampler ^a
			Perimeter monitors						
			North	East	South	West			
1NJ	Morning 4h Afternoon 4h	10:00-14:00 16:30-20:30	0.001 <0.001 ^b	0.001 (0.0005) ^c	0.001 (0.0004)	0.002 0.003	0.032 0.068	0.008 0.037	
2NJ	Morning 4h Afternoon 4h	8:30-12:30 15:00-19:00	0.004 0.001	0.002 0.001	0.003 0.001	0.003 0.004	0.027 0.038	0.008 0.040	
3C	Morning 4h Afternoon 4h	8:00-12:00 14:17-18:17	<0.001 0.001	0.001 0.001	0.001 0.002	(0.0004) (0.0005)	0.280 0.009	(0.0052) (0.0036)	
4NY	Morning 4h Afternoon 4h	8:00-12:00 14:25-18:31	0.001 0.001	0.001 0.006	0.002 0.001	0.001 0.002	0.003 0.004	0.003 0.004	
5C	Morning 4h Afternoon 4h	7:47-12:48 14:17-18:16	0.001 0.001	0.002 0.001	0.001 0.001	0.001 0.003	0.006 0.006	0.008 0.021	
6C	Morning 4h Afternoon 4h	7:51-11:53 14:04-18:00	0.002 0.001	0.002 0.001	0.003 0.004	0.008 0.005	0.028 0.011	0.016 0.047	
7C	Morning 4h Afternoon 4h	7:37-11:37 14:33-18:36	0.008 0.003	0.005 0.002	0.006 0.002	0.010 0.007	0.046 0.007	0.049 0.014	
8C	Morning 4h Afternoon 4h	7:37-11:50 13:59-18:03	0.006 0.007	0.003 0.001	0.002 0.001	0.008 0.011	0.003 0.002	0.024 0.006	
9NY	Morning 4h Afternoon 4h	7:30-8:00 8:43-10:47 14:00-18:02	0.006 0.002	0.004 0.003	0.008 0.004	0.003 0.002	0.010 0.011	0.012 0.004	
10NY	Morning 4h Afternoon 4h	7:40-11:56 14:00-17:52	0.010 0.010	0.002 0.001	0.002 0.004	0.001 0.001	0.002 0.005	0.004 0.014	

^aBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

^bThe value is less than the specified value, but above the detection limit.

^cNumbers in parentheses are detection limits.

Table 4-7. Descriptive statistics for concentrations of THC obtained from four-hour canister samples.

State	Station type	Location	Number of values		THC concentration, ppm as hexane					
			All	ND ^a	Minimum	Maximum	Median	GM ^b	GSD ^c	
New Jersey	Stage II full-serve	Perimeter Pumps BZ ^d	16	3	0.100	2.200	0.220	0.262	2.29	2.29
			4	0	0.730	5.500	2.200	2.099	2.29	2.29
			4	0	0.390	13.000	2.800	2.307	4.54	4.54
New York	Stage II self-serve	Perimeter Pumps BZ	24	9	0.077	1.245	0.145	0.196	2.12	2.12
			6	1	0.095	1.000	0.365	0.311	2.79	2.79
			6	0	0.380	2.200	1.150	0.962	2.06	2.06
Connecticut	Non-Stage II self-serve	Perimeter Pumps BZ	40	8	0.039	11.000	0.250	0.320	3.51	3.51
			10	3	0.220	5.900	0.970	1.058	2.51	2.51
			10	0	1.100	7.900	5.850	4.395	2.09	2.09

^aNumber of values below detection limit. ND values replaced by 1.0 x detection limit.^bGeometric mean (ppm).^cGeometric standard deviation (dimensionless).^dBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

Table 4-8. Descriptive statistics for concentrations of MTBE obtained from four-hour canister samples.

State	Station type	Location	Number of values		MTBE concentration, ppm				
			All	ND ^a	Minimum	Maximum	Median	GM ^b	GSD ^c
New Jersey	Stage II full-serve	Perimeter Pumps BZ ^d	16	1	0.001	0.036	0.003	0.005	3.48
			4	0	0.120	1.600	0.440	0.409	3.16
			4	0	0.084	0.520	0.245	0.224	2.15
New York	Stage II self-serve	Perimeter Pumps BZ	24	0	0.002	0.083	0.007	0.008	3.03
			6	0	0.014	0.080	0.048	0.038	2.18
			6	0	0.077	0.780	0.205	0.204	2.31
Connecticut	Non-Stage II self-serve	Perimeter Pumps BZ	40	2	0.001	0.140	0.014	0.014	3.61
			10	1	0.009	1.500	0.170	0.109	5.05
			10	0	0.170	2.600	1.500	0.978	2.73

^aNumber of values below detection limit. ND values replaced by 1.0 x detection limit.^bGeometric mean (ppm).^cGeometric standard deviation (dimensionless).^dBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

Table 4-9. Descriptive statistics for concentrations of benzene obtained from four-hour canister samples.

State	Station type	Location	Number of values		Benzene concentration, ppm				
			All	ND ^a	Minimum	Maximum	Median	GM ^b	GSD ^c
New Jersey	Stage II full-serve	Perimeter Pumps BZ ^d	16	2	<0.001	0.004	0.001	0.001	2.36
			4	0	0.010	0.079	0.036	0.030	2.52
			4	0	0.005	0.032	0.022	0.016	2.42
New York	Stage II self-serve	Perimeter Pumps BZ	24	1	0.001	0.005	0.001	0.001	1.82
			6	0	0.001	0.006	0.003	0.002	1.93
			6	0	0.003	0.017	0.007	0.006	2.04
Connecticut	Non-Stage II self-serve	Perimeter Pumps BZ	40	3	<0.001	0.008	0.001	0.002	2.21
			10	0	0.001	0.054	0.012	0.010	3.34
			10	0	0.012	0.110	0.055	0.042	2.23

^aNumber of values below detection limit. ND values replaced by 1.0 x detection limit.^bGeometric mean (ppm).^cGeometric standard deviation (dimensionless).^dBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

Table 4-10. Descriptive statistics for concentrations of toluene obtained from four-hour canister samples.

State	Station type	Location	Number of values		Toluene concentration, ppm				
			All	ND ^a	Minimum	Maximum	Median	GM ^b	GSD ^c
New Jersey	Stage II full-serve	Perimeter Pumps BZ ^d	16	0	0.001	0.007	0.002	0.002	2.20
			4	0	0.039	0.071	0.063	0.057	1.32
			4	0	0.011	0.061	0.033	0.028	2.20
New York	Stage II self-serve	Perimeter Pumps BZ	24	0	0.001	0.012	0.002	0.003	1.92
			6	0	0.003	0.014	0.006	0.006	1.98
			6	0	0.005	0.038	0.010	0.011	2.27
Connecticut	Non-Stage II self-serve	Perimeter Pumps BZ	40	1	<0.001	0.050	0.004	0.004	2.57
			10	0	0.003	0.076	0.018	0.018	2.93
			10	0	0.010	0.130	0.068	0.055	2.25

^aNumber of values below detection limit. ND values replaced by 1.0 x detection limit.^bGeometric mean (ppm).^cGeometric standard deviation (dimensionless).^dBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

Table 4-11. Descriptive statistics for concentrations of ethyl benzene obtained from four-hour canister samples.

State	Station type	Location	Number of values		Ethyl benzene concentration, ppm					
			All	ND ^a	Minimum	Maximum	Median	GM ^b	GSD ^c	
New Jersey	Stage II full-serve	Perimeter Pumps BZ ^d	16	12	<0.001	0.001	0.001	0.001	1.37	
			4	0	0.006	0.017	0.007	0.009	1.60	
			4	1	0.002	0.009	0.006	0.005	2.11	
New York	Stage II self-serve	Perimeter Pumps BZ	24	12	<0.001	0.002	0.001	0.001	1.73	
			6	1	<0.001	0.002	0.001	0.001	2.08	
			6	1	0.001	0.003	0.002	0.001	2.17	
Connecticut	non-Stage II self-serve	Perimeter Pumps BZ	40	19	<0.001	0.004	0.001	0.001	2.00	
			10	6	<0.001	0.011	0.004	0.002	3.16	
			10	4	0.004	0.013	0.005	0.006	1.57	

^aNumber of values below detection limit. ND values replaced by 1.0 x detection limit.^bGeometric mean (ppm).^cGeometric standard deviation (dimensionless).^dBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

Table 4-12. Descriptive statistics for concentrations of xylene obtained from four-hour canister samples.

State	Station type	Location	Number of values		Xylene concentration, ppm				
			All	ND ^a	Minimum	Maximum	Median	GM ^b	GSD ^c
New Jersey	Stage II full-serve	Perimeter Pumps BZ ^d	16	2	<0.001	0.004	0.001	0.001	2.52
			4	0	0.027	0.066	0.034	0.038	1.48
			4	0	0.008	0.040	0.023	0.018	2.46
New York	Stage II self-serve	Perimeter Pumps BZ	24	0	0.001	0.010	0.002	0.002	2.38
			6	0	0.002	0.011	0.004	0.005	2.01
			6	0	0.003	0.014	0.004	0.005	1.96
Connecticut	non-Stage II self-serve	Perimeter Pumps BZ	40	2	<0.001	0.011	0.002	0.002	2.66
			10	0	0.002	0.281	0.008	0.012	4.24
			10	2	0.004	0.049	0.015	0.014	2.47

^aNumber of values below detection limit. ND values replaced by 1.0 x detection limit.^bGeometric mean (ppm).^cGeometric standard deviation (dimensionless).^dBreathing zone sampler values are a station-specific composite of pump island and breathing zone concentrations (see discussion at pages 4-1 and 6-3).

The medians listed in Tables 4-7 through 4-12 exhibit a common pattern in that median concentrations are always larger for pump and breathing zone samples than for perimeter samples. Breathing zone medians for the New York and Connecticut stations are generally larger than the corresponding pump medians. The pattern is reversed for the New Jersey stations.

The descriptive statistics for MTBE (Table 4-8) suggest that MTBE concentrations are generally lower at stations with Stage II vapor controls than at stations without controls. Regardless of location, the measured four-hour MTBE concentrations are relatively low when compared to the proposed 40 ppm threshold limit value (TLV) for eight-hour occupational exposures currently under consideration by the American Conference of Governmental Industrial Hygienists (ACGIH). The median four-hour MTBE concentrations are below 2.00 ppm for breathing zone and pump island locations and below 0.02 ppm for the station perimeters.

Table 4-13 lists the concentration measurements for MTBE, benzene, toluene, ethyl benzene, and xylene obtained from the special one-hour canister samples. The samples were collected at the west perimeter locations of the two New Jersey stations and at the pump location at Station 10NY. The maximum toluene concentration was measured at Station 2NJ. The maximum concentration values for the other components occurred during the afternoon sampling period (17:13 - 18:15) at Station 10NY. With the single exception of the ethyl benzene concentration measured at Station 1NJ, all of the one-hour values exceeded the limit of detection.

IMPINGER SAMPLES (FORMALDEHYDE)

Impinger samples were collected at the same times and locations as the four-hour canister samples. Table 4-14 lists the formaldehyde concentrations determined from analyses of these samples. Table 4-15 presents descriptive statistics for these data by station grouping and monitor location. These statistics were calculated using the same procedures applied to the canister data.

Table 4-13. Concentration measurements obtained from one-hour canister samples.

Station	Time period	Sample location	Component concentration, ppm				
			MTBE	Benzene	Toluene	Ethyl benzene	Xylene
1NJ	13:00-14:00	West perimeter	0.008	0.001	0.003	(0.0006)*	0.002
2NJ	8:27-9:30	West perimeter	0.021	0.003	0.005	0.001	0.003
10NY	16:05-17:05 17:13-18:15	Pumps Pumps	0.057	0.003	0.001	0.008	0.006
			0.098	0.005	0.002	0.011	0.008

*Numbers in parentheses are detection limits.