

TASK ORDER 0001

SPECIAL INVESTIGATIVE AUDIT #14 (SIA#14)

**Environmental Data Trend Report
World Trade Center Disaster
2nd Draft**

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ENVIRONMENTAL DATA TREND REPORT WORLD TRADE CENTER DISASTER (2nd DRAFT)

INTRODUCTION

The IT Corporation Quality Assurance Technical Support (IT QATS) Program was tasked by the US Environmental Protection Agency (USEPA) on October 18, 2001 to evaluate environmental data collected in the aftermath of the World Trade Center (WTC) disaster. The task involved accessing environmental data compiled in the New York City (NYC) Response Monitoring Data Retrieval database, and evaluating those data for trends by analyte, location, and collection dates. IT QATS evaluated all results present in the database as of November 14, 2001. As of this date, approximately 66,000 results for samples collected between September 11, 2001 to November 13, 2001, have been entered. This report provides a summary of the trends observed for select analytes with elevated concentrations or of those with particular concern to the USEPA. Also presented are trend correlations between select analytes in representative chemical classes or correlations between sampling sites.

As conditions change at the WTC and other monitored sites, and additional monitoring results are entered, some of the trends reported here will likely change. To the extent possible, the most current results recorded in the NYC Response database have been used. This report is designed so that trend updates may be provided periodically (as needed and requested by the USEPA) to address changes in WTC site conditions, provide more detail on specific analytes of interest, provide additional focus on contamination from a particular location, or to provide additional detail for analytes not highlighted in this report.

This work was performed by IT QATS under Technical Direction 26, Task 07, Task Order 0001 of USEPA Contract 68-W-01-010.

BACKGROUND

The terrorist attacks on the World Trade Center on September 11, 2001 completely destroyed the twin towers and several surrounding buildings. The initial collapse of the buildings released a dust cloud that hovered over the area and penetrated into broken windows of buildings in the surrounding area. The dust cloud was comprised primarily of materials inherent to the construction of the collapsed buildings. In addition to the dust, fires, first ignited by jet fuel from the crashed planes, continue to burn deep in the rubble pile of what remains of the WTC Towers. These fires, fueled by combustible materials present in the destroyed buildings, are releasing a variety of gases and products of incomplete combustion. The concern is that some of the materials associated with the dust, including asbestos, airborne metals in dust, and particulate matter, and some of the components of the gases, including benzene and other potentially carcinogenic compounds, may cause health problems to workers and residents if they are present in sufficiently high concentrations.

To address this concern, the USEPA and other federal, state, and local agencies have each

day since the attack been collecting environmental monitoring data from the WTC destruction zone and surrounding area. Samples from a variety of media, including air, bulk dust, water, river sediments, and drinking water have been taken and analyzed for the presence of contaminants that could pose a health risk to those working or living in the surrounding vicinity. As of November 14, 2001, approximately 66,000 sample results have been collected from monitoring stations all over Manhattan, Staten Island, New Jersey, and Brooklyn for asbestos, volatile organic compounds (VOCs), inorganic analytes, heavy metals, particulate matter, and other parameters. The agencies have been entering these data into the NYC Monitoring Data Retrieval database as they have become available. EPA has provided a great deal of information to the public via the Internet on the results of these analyses, the standards used to evaluate potential health risks, and the areas associated with the monitoring activities. Links to some of the web sites containing this information are as follows:

EPA WTC data summary reports: http://www.epa.gov/epahome/wtc/data_summary.htm
 EPA benchmarks and standards <http://www.epa.gov/epahome/wtc/activities.htm>
 Fixed Air Monitoring Station Map <http://www.epa.gov/epahome/wtc/monstations.htm>
 Asbestos Monitoring Site Map <http://www.epa.gov/enviro/nyc/asbestos/>
 Bulk Dust Monitoring Site Map <http://www.epa.gov/enviro/nyc/bulkdust/>
 PM 2.5 Monitoring Site Map <http://www.epa.gov/enviro/nyc/pm25/>

While significant amounts of environmental information have been collected thus far and the results for individual analytes have been routinely reported to the public by EPA, a collective assessment of all of the data for trends has not to our understanding yet been performed. The purpose of this report is an attempt to address this need.

TECHNICAL APPROACH

The data used by IT QATS in developing this trend report only include those environmental results available in the NYC Response Monitoring Data Retrieval database. Data from other sources (i.e., those collected by OSHA) were not evaluated.

The NYC database is a secure archive containing environmental data collected by agencies including the New York City Department of Environmental Protection (NYCDEP), New York State Department of Environmental Conservation (NYSDEC), New Jersey Department of Environmental Protection (NJDEP), New York State Department of Health (NYSDOH), and the USEPA. As of November 14, 2001, it contained approximately 66,000 results for four hundred ninety-seven (497) analytes including VOCs (i.e., benzene, chloromethane, 2-butanone, vinyl chloride, etc.), polynuclear aromatic hydrocarbons (PAHs) (i.e., benzo(a)pyrene), chlorinated dibenzodioxins/furans, pesticides (i.e., DDT, endrin), polychlorinated biphenyls (PCBs), inorganic metals (i.e., arsenic, lead, cadmium, etc.), asbestos, particulate matter (i.e., PM 2.5, PM 10), and others. For each sample in the database, there are up to 75 associated fields, including 26 station information fields, 24 sample information fields, and 25 result information fields. A complete listing of analytes in the database (as of November 14, 2001) is provided in Attachment 1.

The approach used by IT QATS in evaluating the NYC data involves a systematic series of steps.

- Each analyte in the NYC Response Data Monitoring database is accessed for all 75 sample information fields, allowing all available data to be downloaded into spreadsheet files. The Predefined HTML Output and 'Hot Map' results for select analytes are also printed for review and data entry in customized spreadsheets.
- The data in each spreadsheet are first sorted by media, detected results, and result concentrations to determine the number of detects and whether they are present in significant concentrations.
- If there are a large number of detects by media type, the data are sorted by address and sample collection date to establish concentration versus time.
- Summaries of analyte characteristics including the numbers of samples collected by media type, number of detects, concentration range of detected analytes, method detection limits (MDLs), unusually high concentrations, etc., are recorded.
- For analytes of interest to EPA, or those with elevated concentrations, graphs are created illustrating trends of concentration versus time by location, and linear trend lines are plotted.
- Analytes of a particular class are evaluated for correlation, and graphs are plotted. Correlation statistics for multiple analytes are calculated and trend plots are prepared. Regression analysis for benzene at the two WTC Tower sites has also been performed.

Other factors, such as weather conditions or potential quality issues, are evaluated and discussed if they appear to be relevant to the observed results.

RESULTS

The results for individual analytes and analyte classes are presented below. Three (3) attachments have also been provided at the end of this document. Attachment 1 briefly summarizes the results reported to-date for all 497 analytes currently in the database to enable users of this report to obtain a quick reference of significant characteristics of any specific analyte. The dates of sample collection, number of samples, numbers of detects, high concentrations with dates and locations, and MDLs are information included in these summary descriptions. Attachment 2 contains EPA EnviroMapper maps identifying monitoring locations, and Attachment 3 contains trend charts for specific analytes.

Benzene and Other Volatile Organic Compounds (VOCs)

The VOC results in the NYC Response database are updated every 2-3 days. The results for twelve (12) select VOCs in air, including benzene, toluene, styrene, ethylbenzene, chlorobenzene, tetrahydrofuran (THF), 2-butanone, propylene, chloromethane, trichlorofluoromethane (Freon 11), dichlorodifluoromethane (Freon 12), and chlorodifluoromethane (Freon 22), from the WTC North and South Towers are presented in the following section and listed in Tables 1 and 2. Note that on several days and for several analytes, more than one (1) sample result has been recorded. All of the VOC data recorded in the NYC Response database as of November 17th has been included. In the case of the VOCs, sample results through November 13th are recorded in the database and reported here.

In the NYC Response database, the majority of VOCs detected in air from the WTC North and South Tower sites are hydrocarbons, including aromatics, ketones, alkenes, and others. With the exception of chloromethane and chlorobenzene, we have not found halogenated VOC results in the NYC Response database at levels which compare to the hydrocarbon concentrations. In all of the Lower Manhattan sites examined, the concentrations of benzene and toluene in air appear to maximize at the WTC North Tower Center where the highest concentrations reported were on October 5th, October 11th, and more recently on November 7th, 8th, and 9th. The highest benzene in air value was 180,000 ppb on November 8th. For styrene, a high value of 180,000 ppb was reported on October 11th.

Our initial calculations indicate that the benzene results from the WTC North and South Tower sites appear largely unrelated with a correlation coefficient of 0.1779 over the thirty-two (32) days with reported values for both sites. This calculation is subject to revision based on more in-depth evaluation of sampling times.

The highest concentration of 1,3-butadiene, an indicator of aliphatic fuel combustion, was 9,200 ppb on November 8th from the North Tower Center. Most (192 of 204) of the results for this compound through November 8th were 'not detected' at less than 20 ppb.

Chloromethane was found at concentrations as high as 47,000 ppb on October 20th at the WTC North Tower Center. The results for the three (3) Freons are more intermittent and variable. Chlorodifluoromethane (Freon 22) results are available starting on October 26th. A high value of 960 ppb was reported for chlorodifluoromethane (Freon 22) on November 1st at the

WTC North Tower Center site.

Correlation coefficients between benzene and toluene, benzene and 2-butanone, and benzene and chloromethane at the WTC North and South Towers were calculated to describe the similarity or difference in the air concentrations with time using data from September 19th through November 12th.

**Benzene Correlation Coefficients with
Toluene, 2-Butanone, and Chloromethane at WTC North and South Towers**

Site	Toluene	2-Butanone	Chloromethane
WTC North Tower Center	0.9424	0.8418	0.2069
WTC South Tower (Location 1)	0.9493	0.9373	0.9263

Correlation coefficients near one (1.0) indicate that the compounds are changing at the same time and in proportion to benzene. Compounds of similar chemical classes might be expected to change at the same rates. At the WTC North Tower Center, the correlation between benzene and 2-butanone (0.8418), compounds of different chemical classes, is less than the correlation between benzene and toluene (0.9424). Benzene and chloromethane are poorly correlated at the WTC North Tower. Low correlation coefficients indicate different trends for each compound. The correlation between benzene and all three compounds is nearly equivalent at the WTC South Tower site which suggests similar sources of these compounds or a sampling site where the concentration of the four compounds is increasing and decreasing at the same time.

Regression analysis has also been performed for benzene at the WTC sites to describe any increasing or decreasing trend in concentrations. The results of the regression analysis is listed below.

**Benzene vs Time Regression Analysis for WTC North and South Tower Sites
Units: ppb/day**

Site	x coefficient (slope)	std error in x coefficient
WTC North Tower Center	236	442
WTC South Tower (Location 1)	58.2	183

For both WTC Tower sites, the positive x coefficient indicates an apparent increase in benzene concentration. The large standard error in the calculation from both sites, however, indicates high variability and considerable uncertainty. At this time, the high error in the calculation indicates that any trend is very uncertain.

The x coefficient (slope) regression calculations are consistent with the linear fit lines in Figure 3. Both fitted lines indicate an increase in benzene concentration at the WTC North and South Tower sites. The recent high value for benzene of 180,000 ppb on November 8th for the

WTC North Tower Center reversed the line from a decreasing trend seen through November 7th. The regression slope listed in above was also negative before the November 8th result was entered in the calculation. Fitted lines to describe trends should be used with caution, especially when highly variable data like the WTC VOCs are evaluated.

Outside the WTC sites and immediate vicinity, VOC concentrations are much lower or undetected (<20 ppb). The benzene concentrations at the WTC sites and surrounding Lower Manhattan sites are listed in Table 3. The highest benzene in air concentration at sites other than the WTC sites reported to date was 11,000 ppb on September 26th at the Liberty and Trinity site. Compared to the WTC North and South Tower sites, however, relatively few VOC results are available for other Lower Manhattan sites. On November 8th when the benzene concentration at the WTC North Tower site was 180,000 ppb, the highest air concentration of benzene reported to date, the concentration of benzene at the WTC South Tower (Location 1) was 1100 ppb, the WTC-Austin Tobin Plaza-Work Zone Location 2 concentration was 85 ppb, and the concentration of benzene at Murray St, between West St & North End Ave, was <20 ppb.

The relatively low concentrations detected outside the WTC North Tower site may be the result of quick dispersion of the gas, ground level sampling sites below the dispersing gases, or other wind factors. On October 6th, the benzene detected outside the WTC sites was 44 ppb at the North Park South of Pier 25-Rockefeller Park site which is approximately 700 times lower than the WTC North Tower value of 31,000 ppb on October 6th. The styrene concentration on October 6th at the Pier 25-Rockefeller Park site was 78 ppb which is approximately eighty-five (85) times lower than the WTC North Tower concentration of 6,700 ppb observed on that date. On October 11th when the styrene concentration was at its maximum of 180,000 ppb at the WTC North Tower site, styrene was not detected at the Pier 25-Rockefeller Park site (<20 ppb).

As one example of the sample results and information available in the NYC Response database concerning VOCs, a summary of the information for benzene is as follows:

- A total of 259 samples were collected between September 15th and November 13th and analyzed for benzene. The media collected include 238 air samples, 14 drinking waters, 4 minican samples, and 3 Personal Air Monitoring (PAM) samples.
- The benzene air samples were collected between September 16th and November 13th from various WTC sites and Lower Manhattan locations (the Lower Manhattan monitoring sites for benzene are shown in Attachment 2, Figure 2). Many of the air samples were collected at "Ground Zero" sites including the WTC North Tower, WTC South Tower (Location 1), and WTC Austin Tobin Plaza (Location 2). Others were collected away from WTC, including at North Park South of Pier 25 (Rockefeller Park).
- The methods of analysis for air samples were predominantly identified as by gas chromatography/mass spectrometry (GC/MS). Also identified were EPA Methods TO-14 and TO-15. Nearly all of the air samples were analyzed in a mobile laboratory, the EPA Trace Atmospheric Gas Analyzer (TAGA) bus.
- Of the 238 air samples, 207 were reported in units of ppb, ranging from an MDL of 0.66 ppb

to 180,000 ppb; 10 were reported in units of ppbv, ranging from an MDL of 20 ppbv to 83,000 ppbv; and 21 were reported in units of $\mu\text{g}/\text{m}^3$, ranging from an MDL of 2 $\mu\text{g}/\text{m}^3$ to 280 $\mu\text{g}/\text{m}^3$. Of the 238 air samples, 142 were positively detected for benzene, with results ranging from 0.81 ppb to 180,000 ppb.

- The air samples included 5 Quality Assurance (QA) blanks, all of which showed results of non-detect, below the MDL of 20 ppb.
- The 4 minican and 3 PAM benzene samples were collected between September 22th and September 27th by OENHP inside the cabs of heavy equipment operators operating directly on the rubble pile. There was one positive detect for these samples at 7 ppbv on September 23rd. The other results were non-detect below the MDLs (minican MDL 5 ppbv, PAM MDL 0.2 mg/m^3). There were no other data from personal monitoring samples in the database to compare with the TAGA results.
- The 14 drinking water samples were collected on September 15th from various locations surrounding the WTC. All results were non-detect for benzene, below the MDL of 1 $\mu\text{g}/\text{L}$.

Benzene is still being sporadically detected at significant levels from the WTC North Tower and South Tower sites, with high spikes observed within the first two weeks of November. All evidence indicates the burning rubble pile is the source, although the specific materials that are leading to its release are unknown. Benzene and other VOCs are also present in fuel and engine emissions which may be a contributing factor.

Table 1. Select VOCs in Air at WTC North Tower Center
Units: ppb

Date	Benzene	Toluene	Styrene	Ethyl- benzene	Chloro- benzene	Tetrahydro- furan (THF)	2-Butanone (MEK)	Propylene	Chloro- methane	TCFM Freon 11	DCDFM Freon 12	CDFM Freon 22
19-Sept	<4 4600	<4 1400	<4 1700	<4 920	na	na	na	na	<4 4800	<4 48	na	na
3-Oct	<20 28000 39000	<20 13000 18000	<20 9500 14000	<20 15000 18000	<20 370 540	<20 2600 5100	<20 5400 10000	21 20000 30000	<20 8600 18000	<20 120 260	<20 34	na
5-Oct	38000 86000	18000 40000	2200 15000	20000 48000	680 1200	4300 7500	8800 16000	27000 56000	15000 26000	170 280	21 40	na
6-Oct	31000	14000	6700	17000	290	2800	5600	na	<20	230	<20	na
11-Oct	58000	23000	180000	23000	960	58000	13000	36500	27000	<20	98	na
12-Oct	21000	9600	4900	11000	190	1600	3100	12000	5500	54	<20	na
13-Oct	18000	11000	6700	13000	100	3500	6700	17000	16000	<50	<50	na
14-Oct	1800	900	500	960	<20	140	360	1500	760	<20	<20	na
15-Oct	16000	10000	6700	13000	50	2900	6000	15000	11000	49	27	na
16-Oct	9200	6200	3800	8500	<50	1600	3400	7900	7700	<50	<50	na
18-Oct	4500	470	110	200	<20	<20	120	540	72	<20	<20	na
19-Oct	720	290	78	280	<20	33	87	280	170	<20	<20	na
20-Oct	15000	7400	4800	6000	210	700	1100	1300	47000	<40	<40	na
21-Oct	2700	570	43	240	<40	<40	430	670	110	<40	<40	na
22-Oct	8700 13000 15000	2300 3700 4800	1600 3100 6800	1800 3100 4900	<1000 630	<1000 740	810 1100 1700	<50 <1000	6100 9600 12000	<50 <1000	<50 <1000	na
23-Oct	20000 24000	7000 7500	2200	5000 5100	<20 430	1200 1400	1600 1700	<20	12000 18000	<20 88	<20 <1000	na

Table 1. Select VOCs in Air at WTC North Tower Center
Units: ppb

Date	Benzene	Toluene	Styrene	Ethyl- benzene	Chloro- benzene	Tetrahydro- furan (THF)	2-Butanone (MEK)	Propylene	Chloro- methane	TCFM Freon 11	DCDFM Freon 12	CDFM Freon 22
24-Oct	20000 24000	1100 11000	<1000 6500	<1000 12000	<1000 260	1700	2100 2200	18000 20000	11000 14000	<1000 130	<1000 290	na
25-Oct	2500	1200	760	1300	58	410	550	1700	1000	21	<20	530
26-Oct	27000	11000	12000	16000	790	930	2800	16000	13000	<50	<50	<50
27-Oct	33000	8500	3900	7500	640	1100	3300	19000	8900	<50	66	na
28-Oct	2900	1000	500	800	<50	210	370	1700	<50	<50	<50	360
29-Oct	2000	790	490	690	<40	170	320	1500	920	<40	<40	210
30-Oct	4900	1400	<50	1200	97	410	590	3000	2200	<50	<50	na
31-Oct	64 620	23 410	<20 350	<20 560	<20	<20 120	<20 350	37 460	<20 530	<20	<20	<20 39
01-Nov	210	110	73	130	<50	<50	50	120	89	<50	<50	960
02-Nov	7300	2800	1200	3000	98	280	760	4100	1700	<50	<50	<50
03-Nov	61000 83000	45000 67000	46000 56000	4100 95000	1600 1700	2700 2800	7600 7800	43000 49000	6300 6800	<50 <1000	<50 <1000	<50 <1000
05-Nov	440	220	56	210	<20	61	110	340	310	<20	<20	<20
06-Nov	990	370	130	380	27	51	150	680	220	<20	<20	<20
07-Nov	83000	41000	7400	41000	<200	3500	20000	55000	1500	<200	<200	<200
08-Nov	180000	74000	40000	67000	660	6200	21000	92000	2200	<200	<200	<200
09-Nov	85000	31000	6900	23000	1900	1800	880	42000	7300	<200	<200	<20
11-Nov	44	<20	<20	<20	<20	<20	30	<20	<20	<20	<20	<20
12-Nov	1400	125	23	84	43	<20	310	<20	200	<20	<20	<20
13-Nov	4900	3300	1600	6900	150	1000	1600	4700	3500	<20	<20	<20

Table 2. Select VOCs in Air at WTC South Tower (Location 1)

Units: ppb

Date	Benzene	Toluene	Styrene	Ethyl- benzene	Chloro- benzene	Tetrahydro- furan (THF)	2-Butanone (MEK)	Propylene	Chloro- methane	TCFPM Freon 11	DCDFM Freon 12	CDPM Freon 22
29-Sept	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	na
3-Oct	4300	1700	770	1700	74	320	690	2500	900	<20	<20	na
10-Oct	9800	2800	1400	3200	120	490	860	3900	1900	<20	<20	na
13-Oct	8600	2200	380	1200	110	160	130	3300	1600	<50	<50	na
14-Oct	12000	5200	1900	5000	130	1100	1900	7200	4300	67	<20	na
15-Oct	590	130	41	99	<20	35	94	400	180	<20	35	na
16-Oct	9700	2700	1200	1800	160	890	2400	7700	6900	260	240	na
18-Oct	120	31	<20	27	<20	<20	<20	50	28	<20	<20	na
19-Oct	6400	2000	550	1400	91	270	700	4100	3300	310	220	na
20-Oct	310	100	58	120	<40	47	85	190	130	<40	<40	na
21-Oct	200	55	<40	<40	<40	<40	<40	110	49	<40	<40	na
22-Oct	1000	360	140	401	<50	68	160	<50	570	<50	<50	na
23-Oct	2100	9900	2800	10000	160	2500	4400	<20	9900	<20	<20	na
24-Oct	19000	8900	2300	8500	160	2400	4000	12000	8600	<50	<50	na
25-Oct	18000	8100	2300	8200	170	2100	3600	1100	10000	28	<20	170
26-Oct	37000	19000	5000	21000	220	5000	8700	23000	27000	<50	<50	<50
28-Oct	7500	2100	450	950	<50	130	280	2100	860	<50	<50	<50
29-Oct	700	180	50	150	<40	<40	40	230	48	<40	<40	<40
30-Oct	<890	230	<50	180	<50	<50	<28	300	<31	<50	<50	na
31-Oct	3500	1900	320	1700	<50	430	700	2100	1600	<50	<50	na
01-Nov	9500	2600	580	1900	340	400	390	5000	530	<50	<50	<50

Table 2. Select VOCs in Air at WTC South Tower (Location 1)

Units: ppb

Date	Benzene	Toluene	Styrene	Ethyl- benzene	Chloro- benzene	Tetrahydro- furan (THF)	2-Butanone (MEK)	Propylene	Chloro- methane	TCFM Freon 11	DCDFM Freon 12	CDPM Freon 22
02-Nov	810	280	<50	210	<50	50	91	380	200	<50	<50	<50
03-Nov	4500	2000	56000	95000	1600	390	630	2300	1500	<50	<50	<50
05-Nov	530	160	39	92	<20	39	170	210	210	28	<20	<20
06-Nov	770	110	<20	71	57	36	110	340	190	<20	<20	<20
07-Nov	51000	28000	9800	28000	<200	5100	13000	26000	26000	<200	<200	<200
08-Nov	1100	170	100	200	<20	<20	30	<20	<20	<20	<20	<20
09-Nov	590	180	97	130	<20	27	110	310	340	<20	<20	<20
11-Nov	290	37	<20	<20	<20	<20	39	110	74	<20	<20	<20
12-Nov	7500	2300	1200	2300	75	210	950	2800	2000	<50	<50	<50
13-Nov	210	68	71	54	<20	<20	74	290	160	<20	<20	<20

'na' indicates that the results for this compounds are not available in the NYC Response database.

Table 3. Benzene at WTC and Surrounding Sites; Units: ppb; Grab Samples from EPA 'Hot Maps'

Date	WTC Sites				Surrounding Lower Manhattan Sites					
	North Tower Center	South Tower (Location 1)	Building 5 SW	Austin Tobin Plaza	North Park Pier 25 Rockefeller Park	Greenwich & Liberty St	Murray & West Broadway	Church & Day St	Liberty & Trinity	Liberty & West St
16-Sept	na	na	na	na	na	6	na	na	20	na
18-Sept	na	na	na	19	na	23	na	na	na	18
18-Sept	na	na	na	10	na	na	na	na	na	na
18-Sept	na	na	na	6.4	na	na	na	na	na	na
19-Sept	nd	na	na	na	na	na	na	na	na	na
19-Sept	4600	na	na	na	na	na	na	na	na	na
22-Sept	na	na	3200	33	na	8.3	na	na	na	9.2
22-Sept	na	na	2800	na	na	na	na	na	na	na
26-Sept	na	130	na	na	130	nd	na	na	11000	nd
26-Sept	na	na	na	na	nd	na	na	na	nd	na
29-Sept	na	nd	na	nd	na	na	na	na	na	na
29-Sept	na	na	na	2600	na	na	na	na	na	na
02-Oct	na	na	na	20	na	20	na	na	na	20
03-Oct	39000	4300	na	nd	na	nd	na	na	na	nd
03-Oct	nd	na	na	na	na	na	na	na	na	na
03-Oct	28000	na	na	na	na	na	na	na	na	na
05-Oct	86000	na	nd	9500	nd	na	na	na	na	nd
05-Oct	38000	na	na	nd	na	na	na	na	na	na
06-Oct	31000	na	na	na	44	na	na	na	na	na
07-Oct	9300	5100	na	na	nd	na	na	na	na	na

Table 3. Benzene at WTC and Surrounding Sites; Units: ppb; Grab Samples from EPA 'Hot Maps'

Date	WTC Sites				Surrounding Lower Manhattan Sites					
	North Tower Center	South Tower (Location 1)	Building 5 SW	Austin Tobin Plaza	North Park Pier 25 Rockefeller Park	Greenwich & Liberty St	Murray & West Broadway	Church & Dey St	Liberty & Trinity	Liberty & West St
07-Oct	na	110	na	na	na	na	na	na	na	na
08-Oct	44000	20000	na	na	nd	na	na	na	na	na
08-Oct	1400	na	na	na	na	na	na	na	na	na
09-Oct	23000	na	na	na	nd	na	na	na	na	na
09-Oct	17000	na	na	na	na	na	na	na	na	na
10-Oct	na	9800	na	8900	nd	na	na	37	na	na
10-Oct	na	na	na	2600	na	na	na	na	na	na
11-Oct	58000	na	na	1500	nd	na	na	na	na	na
11-Oct	na	na	na	40	na	na	na	na	na	na
12-Oct	21000	na	na	na	nd	na	nd	na	na	na
13-Oct	18000	8600	na	nd	na	na	nd	na	na	na
14-Oct	1800	12000	na	nd	nd	na	nd	na	na	na
15-Oct	16000	590	na	nd	nd	na	na	na	na	na
16-Oct	9200	9700	na	nd	nd	na	na	na	na	na
17-Oct	18000	9400	na	nd	nd	na	na	na	na	na
18-Oct	4500	120	na	nd	nd	na	na	na	na	na
19-Oct	720	6400	na	nd	nd	na	na	na	na	na
20-Oct	15000	310	na	27	nd	na	na	na	na	na
21-Oct	2700	200	na	nd	nd	na	na	na	na	na
22-Oct	15000	1000	na	nd	nd	na	na	na	na	na

Table 3. Benzene at WTC and Surrounding Sites; Units: ppb; Grab Samples from EPA 'Hot Maps'

Date	WTC Sites				Surrounding Lower Manhattan Sites					
	North Tower Center	South Tower (Location 1)	Building 5 SW	Austin Tobin Plaza	North Park Pier 25 Rockefeller Park	Greenwich & Liberty St	Murray & West Broadway	Church & Dey St	Liberty & Trinity	Liberty & West St
22-Oct	13000	na	na	na	na	na	na	na	na	na
22-Oct	8700	na	na	na	na	na	na	na	na	na
23-Oct	24000	2100	na	nd	nd	na	na	na	na	na
23-Oct	20000	na	na	na	na	na	na	na	na	na
24-Oct	20000	19000	na	29	nd	na	na	na	na	na
24-Oct	22000	na	na	na	na	na	na	na	na	na
25-Oct	2500	18000	na	75	nd	na	na	na	na	na
26-Oct	27000	37000	na	nd	nd	na	na	na	na	na
27-Oct	33000	na	na	na	na	na	na	na	na	na
28-Oct	2900	7500	na	nd	nd	na	na	na	na	na
29-Oct	2000	700	na	nd	nd	na	na	na	na	na
30-Oct	4900	nd	na	nd	nd	na	na	na	na	na
31-Oct	620	3500	na	nd	nd	na	na	na	na	na
31-Oct	64	na	na	na	na	na	na	na	na	na
01-Nov	210	9500	na	33	nd	na	na	na	na	na
02-Nov	7300	810	na	20	nd	na	na	na	na	na
03-Nov	83000	4500	na	46	nd	na	na	na	na	na
03-Nov	61000	na	na	na	na	na	na	na	na	na
04-Nov	85	7500	na	nd	nd	na	na	na	na	na
04-Nov	30	na	na	na	na	na	na	na	na	na

Table 3. Benzene at WTC and Surrounding Sites; Units: ppb; Grab Samples from EPA 'Hot Maps'

Date	WTC Sites				Surrounding Lower Manhattan Sites					
	North Tower Center	South Tower (Location 1)	Building 5 SW	Austin Tobin Plaza	North Park Pier 25 Rockefeller Park	Greenwich & Liberty St	Murray & West Broadway	Church & Day St	Liberty & Trinity	Liberty & West St
05-Nov	440	530	na	na	nd	na	na	na	na	na
06-Nov	990	770	na	nd	nd	na	na	na	na	na
07-Nov	83000	51000	na	nd	nd	na	na	na	na	na
08-Nov	180000	1100	na	85	na	na	na	na	na	na
09-Nov	85000	590	na	nd	na	na	na	na	na	na
11-Nov	44	290	na	na	na	na	na	na	na	na
12-Nov	1400	7500	na	38	na	na	na	na	na	na
13-Nov	4900	210	na	nd	na	na	na	na	na	na

'na' indicates that the results are not reported in the 'Hot Maps' on EPA's web site.

'nd' indicates that benzene was not detected, usually at 20 ppb.

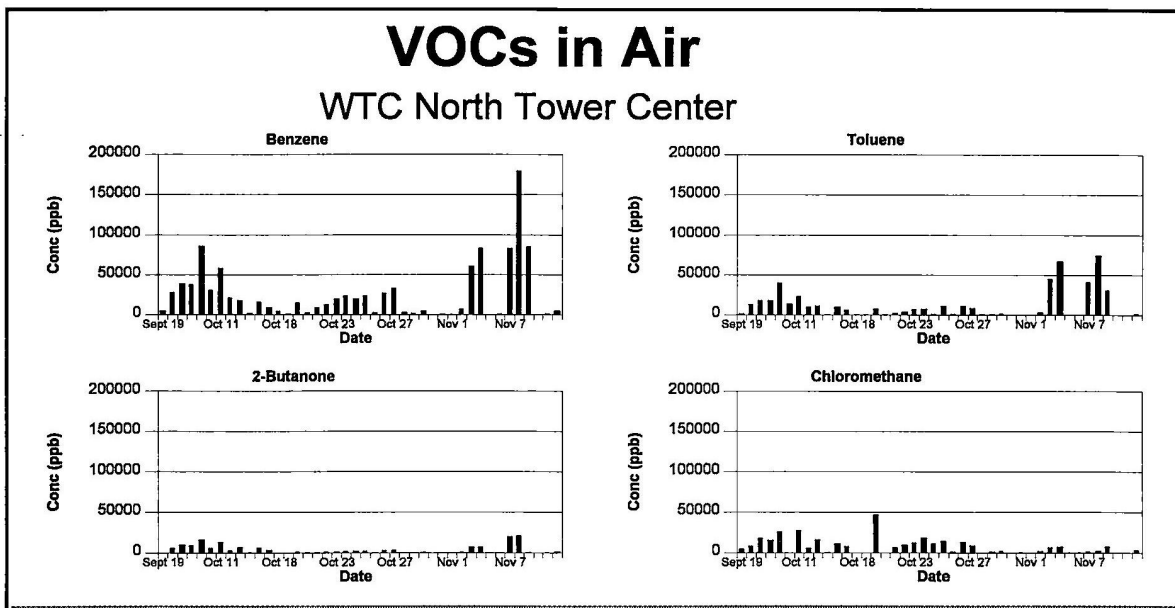


Figure 1. Select VOCs at WTC North Tower Center; Sept 16 - Nov 12, 2001.

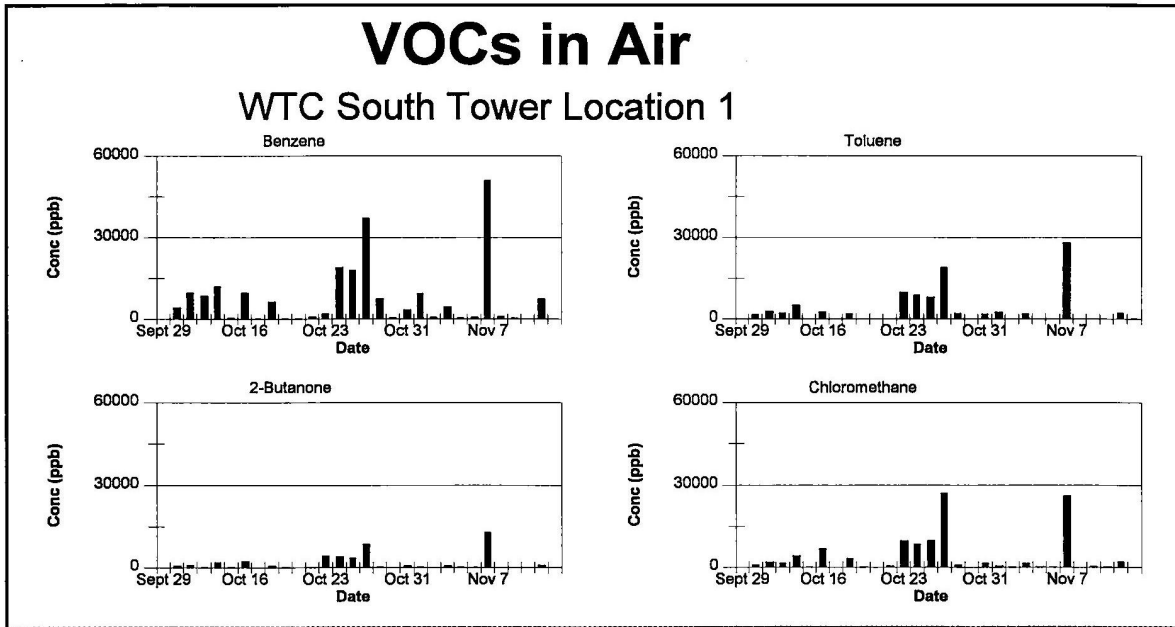


Figure 2. Select VOCs at WTC South Tower Location 1; Sept 16 - Nov 12, 2001.

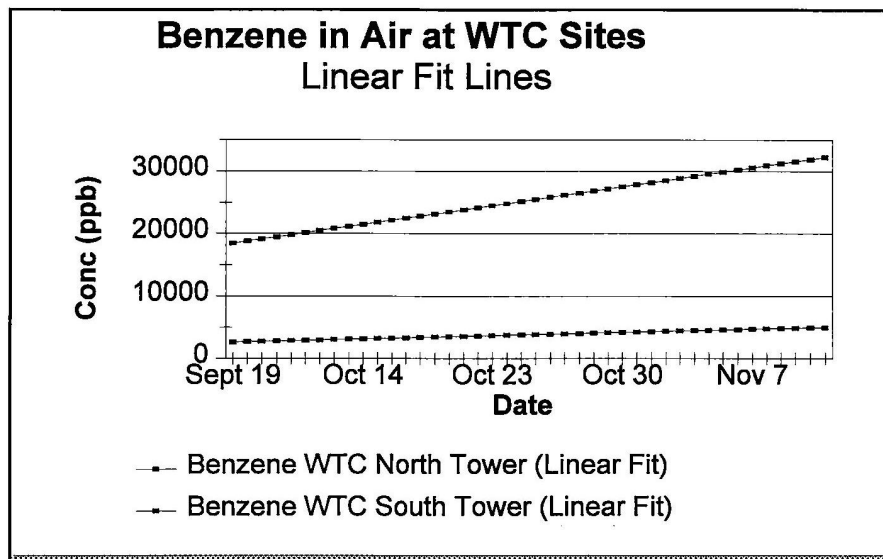


Figure 3. Benzene Fitted Lines at WTC North and South Towers

Full-scale charts of VOCs discussed in this section are provided in Attachment 3. These charts show concentration versus sample collection date from location exhibiting the highest VOC concentrations. Linear trend lines have been plotted on these charts, but, as mentioned earlier, because of high day-to-day concentration variability, caution must be used when looking at the overall trends.

Asbestos

As of November 9th, 22506 lines of data representing the analysis of 4176 samples for total fiber concentration, asbestos fiber concentration, or percentage asbestos had been entered into the NYC Response database. These samples, the majority of which were collected in Lower Manhattan and the Fresh Kills Landfill, were analyzed by a combination of Phase Contrast Microscopy (PCM), Transmission Electron Microscopy (TEM), and Polarized Light Microscopy (PLM). Other sampling locations are located in New Jersey and Brooklyn, NY. Sample media collected include bulk dust, ambient air, indoor air, and personal air monitoring (PAM) samples. In general, ambient air, indoor air, and PAM samples were analyzed by PCM to determine total fiber content in fibers per cubic centimeter (f/cc), and by TEM to determine the presence of asbestos fibers in structures per millimeter squared (S/mm²). Bulk samples were analyzed by PLM and are reported as percent asbestos (% Asbestos). It is important to note that PCM is a determination of total detectable fibers and can not be used to differentiate between, or identify, fiber type.

The following summaries and trend analyses, presented by media type, were developed from data available in the NYC Response database on November 9th and do not take into consideration data entered since that time. The figures and tables in this report have been developed under the assumption that all data points (analytical results) reported in the database have already been adjusted for sample volume and other factors.

Ambient Air Samples:

Of the 4176 samples collected, 83%, or 3466, are ambient air samples collected in Lower Manhattan, New Jersey, and the Fresh Kills Landfill Between September 12th and November 2nd. One thousand six hundred two (1602) of these ambient air samples were collected in Lower Manhattan (Locations A-V), 1301 were collected at the Fresh Kills Landfill, 190 were collected in New Jersey, and 373 were collected at various other locations in Manhattan. All of the samples were analyzed by PCM, with fibers detected at measurable concentrations in 891 samples from Lower Manhattan, 308 samples from the Fresh Kills Landfill, 8 samples from New Jersey, and 184 samples from other various Manhattan locations. Of these 1391 detected results, 526 were reported at concentrations greater than 0.01 f/cc and six (6) were reported at concentrations greater than 0.1 f/cc. After review of the available PCM data, several locations in both Lower Manhattan (Locations B, D, E & F) and the Fresh Kills Landfill (Location 09-A, 09-B & 12-A) were selected for trend analysis. The selection of these locations was based on the ratio of samples with reported detectable concentrations of fibers versus the total number of samples. Those locations exhibiting higher ratios were selected. The date collected and reported concentrations, along with the corresponding PM 2.5 results and average wind speed, are tabulated in Table 4. For those dates in which more than one sample was collected and analyzed for a given location, the higher of the reported results is used. PM 2.5 and average wind speed data are included in Table 4 and were added to determine if they had any bearing on fiber concentrations at the different locations. No correlating trends were observed. The highest results on a given day for the Fresh Kill Landfill locations (09-A, 09-B & 12-A) and the highest results on those days for the Lower Manhattan locations (B, D, E & F) were then plotted by date collected (x-axis) and f/cc (y-axis). The attempt here was to eliminate site-specific factors and show

general trends from sites within close proximity. The results, illustrated in Figure 4, show a noticeable decrease in the concentration of f/cc over time at the selected Lower Manhattan locations, and a corresponding increase in the concentration of f/cc over time at the selected Fresh Kills Landfill locations.

Of the 3466 ambient air samples analyzed by PCM, 89%, or 3100, were also analyzed by TEM to determine the concentration of asbestos fibers in S/mm². One thousand five hundred seventy three (1573) of these samples were collected at Locations A-V in Lower Manhattan. A total of twelve (12) results were reported at concentrations greater than 70 S/mm² at Locations A, D, E, F & K. At the Fresh Kills Landfill, TEM analysis was performed on 1243 samples, with 17 results reported at concentrations greater than 70 S/mm². The highest results, ranging from 88 to 128 S/mm², were measured at the Screening Operations (Locations 09-A & 09-B) and Location 12-A between October 8th and October 31st. There were also eight (8) results reported at concentrations greater than 70 S/mm² at other Manhattan locations. These include results of 105 S/mm² reported at Site 02 - Manhattan Boro Community College on September 9th, 157 S/mm² at Spruce and Gold St on September 12th, and 93 S/mm² at Site 08 - Public School 199 - 3290 48th Avenue on October 1st. To allow for a comparison between total fibers detected by PCM and asbestos fibers detected by TEM, the same locations tabulated and trended for the PCM results were also tabulated and trended for the TEM results. The date collected and reported concentrations, along with the corresponding PM 2.5 results and average wind speed, are shown in Table 5. As with the PCM data, for those dates in which more than one sample was collected and analyzed for a given location, the higher of the reported results is used. As with the PCM data, no trends were observed between reported TEM concentration, and the PM 2.5 and average wind speed data. The highest of the results from the Fresh Kills Landfill locations (09-A, 09-B & 12-A) and Lower Manhattan locations (B, D, E & F) were then plotted by date collected (x-axis) and f/cc (y-axis). The results illustrated in Figure 5 show a decrease in the concentration of S/mm² over time at the selected Lower Manhattan locations, and an increase in the concentration of S/mm² over time at the selected Fresh Kills Landfill locations.

PAM Samples:

A total of three hundred fifty eight (358) personal air monitoring (PAM) samples were collected from locations in Lower Manhattan and at the Fresh Kills Landfill between September 11th and September 23rd. Three hundred thirty eight (338) or 94% of these samples were collected in Lower Manhattan locations. The Lower Manhattan samples were collected from three zones: the Work Zone, the Perimeter, and Nearby Neighborhoods. The PCM results from these three zones have been plotted by date collected (x-axis) and f/cc (y-axis). The results illustrated in Figure 6 show a decrease in total fiber concentrations from September 12th to September 23rd from all three zones. Twenty (20) PAM samples were collected at Fresh Kills Landfill locations on September 18th and 19th, with results reported between 0.018 f/cc and 0.175 f/cc (see Table 6). Additional TEM analyses were performed on 23 of the PAM samples collected in the Lower Manhattan Zones on September 12th and 15th. Nine (9) of these samples were reported at concentrations greater than 70 S/mm² (see Table 7). For both the Fresh Kills Landfill PCM results, and the Lower Manhattan TEM results, too few data points were available to determine possible trends.

Indoor Air Samples:

Between September 14th and 23rd, twenty-five (25) indoor air samples were collected at various locations in Lower Manhattan and analyzed by PCM.. Detectable fibers were reported from 16 of the samples with 4 concentrations greater than 0.01 f/cc. The highest reported result, 0.044 f/cc, was collected on September 18th at 225 Rector St. The indoor air results for the 25 samples analyzed are tabulated in Table 8. Too few data points are available to perform trend assessment.

Bulk Dust Samples:

A total of three hundred eight (308) bulk dust samples were collected in the Work Zone, Disposal Zone, and various Lower Manhattan locations between September 11th and October 14th. These include 171 in the Work Zone, 68 in the Disposal Zone, and 59 at various Lower Manhattan locations. In the Work Zone, 133 samples, or 78 % of the samples collected, were reported to contain detectable amounts of asbestos. Of these, eight (8) samples were reported to contain Amosite in amounts less than 1%, 115 samples were reported to contain Chrysotile in amounts ranging from trace (<1%) to 40%, and 10 samples were reported as detected with no asbestos class identified. The highest asbestos levels reported were 38% Chrysotile from Ground Zero (Sample WTC919-1B2) collected on September 19th and 40% Chrysotile from Building 6 (Sample 03819B) collected on October 10th, respectively. In the Disposal Zone, 10 of 68 bulk dust samples collected were reported to contain detectable amounts of asbestos. Of these, nine (9) samples were reported to contain Chrysotile at amounts ranging from trace (<1%) to 2.7 %, and one sample was reported to contain trace amounts (<1%) of Amosite. The highest asbestos level, 2.7% Chrysotile, was reported from a sample collected at the Bulk Steel Pile (Sample 03825B) on October 10th. Of the 59 samples collected from Lower Manhattan, 34 were reported to contain detectable amounts of asbestos fibers; 30 samples were reported to contain Chrysotile from trace amounts (<1%) to 4%, and 4 samples were reported to contain Amosite at trace amounts (<1%). The highest result, 4.5% Chrysotile, was reported from a sample collected at Murray Street and West Side Highway (Sample 111979) on September 11th. Bulk dust sample results greater than 1% asbestos are tabulated in Table 9. Too few data points are available to determine possible trends.

Conclusions:

With the available data, several conclusions concerning asbestos may be drawn:

- Ambient air sample results indicate a decrease in both total fibers (f/cc) and asbestos fibers (S/mm²) in the Lower Manhattan area from September 18th to November 2nd.
- Ambient air sample results indicate an increase in both total fibers (f/cc) and asbestos fibers (S/mm²) at the Fresh Kills Landfill from September 14th to November 2nd.
- It appears from the PAM sample data provided that the level of total fiber (f/cc) exposure to personnel in the Work Zone, Perimeter, and Nearby Neighborhoods has steadily decreased from September 11th to September 23rd.

- Bulk dust sample results (% asbestos) indicate the presence of asbestos in 57% of the samples collected in the Work Zone, Disposal Zone, and various Manhattan locations.
- Too few data point were available to determine trends over time for PAM samples collected at the Fresh Kills Landfill, and indoor samples and bulk dust samples collected in Lower Manahattan.

Table 4.
Total Fibers (PCM) and Particulate Matter (PM 2.5) in Ambient Air, and Average Wind Speed (mph)
Select Fresh Kills Landfill and Lower Manhattan Locations

Date	Fresh Kills Landfill Locations					Lower Manhattan Locations						
	09-A (f/cc)	09-B (f/cc)	12-A (f/cc)	(1) PM 2.5 (ug/m ³)	B (f/cc)	D (f/cc)	E (f/cc)	F (f/cc)	(2) PM 2.5 (ug/m ³)	(3) PM 2.5 (ug/m ³)	(4) PM 2.5 (ug/m ³)	Wind (mph)
18-Sep-01	0.029	0.029	na	17.43	na	0.047	na	na	na	na	na	5.09
19-Sep-01	0.01	0.01	na	21.86	0.032	0.027	0.037	0.013	na	na	na	8.54
20-Sep-01	0.01	0.006	na	10.98	nd	nd	nd	0.013	na	na	na	12.70
21-Sep-01	nd	0.006	na	10.46	0.013	0.025	0.051	0.018	na	na	na	6.33
22-Sep-01	nd	nd	na	25.61	0.011	0.004	0.007	0.011	na	na	na	6.41
23-Sep-01	nd	nd	na	19.93	0.006	0.005	0.004	0.006	na	na	na	6.90
24-Sep-01	0.005	nd	na	31.23	0.006	nd	nd	nd	na	na	na	10.22
25-Sep-01	na	na	na	8.33	nd	0.021	0.021	nd	na	na	na	11.97
26-Sep-01	0.005	0.005	na	9.37	0.015	0.018	0.021	0.018	na	na	na	10.67
27-Sep-01	0.016	0.021	na	12.96	0.026	0.004	nd	0.009	na	na	na	9.29
28-Sep-01	nd	nd	na	na	0.007	0.048	0.009	0.005	na	na	na	7.37
29-Sep-01	nd	nd	na	na	0.013	0.045	0.009	0.004	na	na	na	na
30-Sep-01	nd	nd	na	5.18	nd	0.017	0.005	nd	na	na	na	15.80
1-Oct-01	nd	nd	na	3.82	nd	0.006	0.007	nd	12.27	10.66	10.08	11.36
2-Oct-01	0.005	0.006	na	12.69	0.005	0.006	0.005	0.01	21.74	26.23	16.37	4.22
3-Oct-01	0.014	0.008	na	22.84	0.029	nd	0.004	0.018	37.42	35.25	30.05	7.60
4-Oct-01	0.019	nd	na	26.82	0.006	0.004	nd	nd	35.33	38.61	33.11	10.28
5-Oct-01	0.016	0.004	na	26.05	0.007	0.007	nd	0.009	38.81	33.7	32.28	9.06
6-Oct-01	0.011	0.008	na	7.46	0.012	0.021	0.009	0.009	12.31	8.99	9.09	18.36
7-Oct-01	0.011	0.012	na	na	0.007	0.009	0.015	0.004	3.33	10.92	4.61	18.33
8-Oct-01	0.008	0.042	0.005	na	0.004	0.007	0.005	nd	6.5	9.62	6.25	12.66
9-Oct-01	0.006	0.015	0.007	9.60	0.016	0.027	0.006	0.02	13.59	15.69	10.33	7.37
10-Oct-01	0.006	0.013	0.013	10.62	0.012	0.003	0.012	0.009	17.83	17.98	12.36	9.13
11-Oct-01	0.012	nd	0.015	9.97	0.008	0.003	0.002	0.007	17.08	17.57	13.28	8.34
12-Oct-01	nd	nd	0.006	11.31	0.011	0.003	0.003	0.003	18.91	17.82	16.45	6.21
13-Oct-01	nd	nd	0.012	14.71	0.003	0.007	0.004	0.006	21.7	23.37	20.02	na
14-Oct-01	nd	nd	0.007	8.34	0.009	0.023	0.012	0.007	12.1	11.39	12.75	na
15-Oct-01	nd	nd	0.007	7.05	0.005	0.014	0.008	0.006	9.93	18.38	7.34	8.52
16-Oct-01	nd	nd	0.007	11.36	0.009	0.006	0.01	0.007	10.32	10.63	13	11.62
17-Oct-01	0.007	nd	0.009	5.04	0.01	0.003	0.004	0.013	6.18	15.43	5.07	11.28
18-Oct-01	0.004	nd	0.016	7.75	0.015	0.012	0.003	nd	9.54	13.77	7.09	12.81
19-Oct-01	nd	nd	0.029	17.07	0.019	0.006	0.009	0.005	18.6	27.99	15.76	9.11

Table 4.
Total Fibers (PCM) and Particulate Matter (PM 2.5) in Ambient Air, and Average Wind Speed (mph)
Select Fresh Kills Landfill and Lower Manhattan Locations

Date	Fresh Kills Landfill Locations					Lower Manhattan Locations							
	09-A (f/cc)	09-B (f/cc)	12-A (f/cc)	(1)		B (f/cc)	D (f/cc)	E (f/cc)	F (f/cc)	(2) PM 2.5 (ug/m ³)	(3) PM 2.5 (ug/m ³)	(4) PM 2.5 (ug/m ³)	Wind (mph)
				PM 2.5 (ug/m ³)									
20-Oct-01	nd	nd	0.011	17.24	0.005	0.005	0.004	0.005	0.005	24.04	27.66	19.35	7.57
21-Oct-01	nd	nd	nd	22.75	0.016	nd	0.005	0.023	0.023	30.15	29.59	25.62	10.24
22-Oct-01	nd	nd	0.007	15.76	0.012	0.029	0.006	nd	nd	22.82	26.21	22.04	na
23-Oct-01	nd	nd	0.024	14.95	0.03	0.015	0.013	0.017	0.017	19.51	16.69	19.92	8.63
24-Oct-01	0.006	nd	0.006	15.23	0.02	0.008	0.004	0.019	0.019	23.45	20.53	19.06	9.20
25-Oct-01	0.01	0.009	0.006	9.02	0.027	0.009	0.009	0.007	0.007	13.5	20.87	11.52	12.81
26-Oct-01	nd	0.008	0.004	6.01	0.03	nd	0.006	0.006	0.006	8.5	18.71	6.69	18.97
27-Oct-01	0.004	nd	0.004	4.73	0.012	0.004	nd	nd	nd	6.87	11.97	5.2	16.56
28-Oct-01	0.006	0.018	0.017	4.17	0.004	nd	0.035	nd	nd	6.1	5.68	5.8	10.55
29-Oct-01	0.025	0.005	0.036	9.20	0.01	0.009	0.027	0.009	0.009	14.87	19.93	12.76	6.06
30-Oct-01	nd	0.028	0.033	10.75	0.007	0.017	0.007			16.98	16.19	14.27	9.32
31-Oct-01	nd	nd	0.039	9.37	0.006	nd	nd	0.035	0.035	11.63	8.49	10.21	9.11
1-Nov-01	0.007	0.013	0.015	19.54	0.009	na	nd	nd	nd	25.49	22.16	20.86	8.87
2-Nov-01	nd	nd	0.005	15.31	0.007	na	na	na	na	24.18	19.61	18.61	11.02

- (1) Fresh Kills Landfill
- (2) Borough of Manhattan
- (3) Pace University
- (4) Coast Guard Battery Park

‘na’ indicates that results for this day have not been reported in the NYC database, and have not been evaluated.

‘nd’ indicates not detected about the detection limit.

Table 5.
Asbestos Fibers (TEM) and Particulate Matter (PM 2.5) in Ambient Air, and Average Wind Speed (mph)
Select Fresh Kills Landfill and Lower Manhattan Locations

Date	Fresh Kills Landfill Locations				Lower Manhattan Locations								Wind (mph)
	09-A (S/mm ²)	09-B (S/mm ²)	12-A (S/mm ²)	(1) PM 2.5 (Ug/m ³)	B (S/mm ²)	D (S/mm ²)	E (S/mm ²)	F (S/mm ²)	(2) PM 2.5 (Ug/m ³)	(3) PM 2.5 (Ug/m ³)	(4) PM 2.5 (Ug/m ³)		
14-Sep-01	na	na	na	na	16	na	48	16	na	na	na	na	
15-Sep-01	na	na	na	na	nd	na	90	24	na	na	na	na	
16-Sep-01	na	na	na	na	nd	na	16	40	na	na	na	na	
17-Sep-01	nd	nd	nd	nd	8	na	na	16	na	na	na	na	
18-Sep-01	na	na	na	17.43	8	na	na	nd	na	na	na	5.09	
19-Sep-01	na	na	na	21.86	30.71	6.15	30.77	nd	na	na	na	8.54	
20-Sep-01	na	na	na	10.98	nd	12	nd	nd	na	na	na	12.70	
21-Sep-01	nd	nd	na	10.46	nd	48	24	8.89	na	na	na	6.33	
22-Sep-01	nd	nd	na	25.61	8.89	53.33	44.44	17.78	na	na	na	6.41	
23-Sep-01	24	32	n	19.93	17.78	17.78	8.89	35.56	na	na	na	6.90	
24-Sep-01	nd	nd	na	31.23	8.89	nd	8.89	nd	na	na	na	10.22	
25-Sep-01	na	na	na	8.33	nd	nd	nd	nd	na	na	na	11.97	
26-Sep-01	24	nd	na	9.37	8.89	97.78	17.78	71.11	na	na	na	10.67	
27-Sep-01	16	8	na	12.96	8.89	8	17.78	17.78	na	na	na	9.29	
28-Sep-01	nd	nd	na	na	nd	nd	nd	17.78	na	na	na	7.37	
29-Sep-01	nd	24	n	na	26.87	17.78	80	26.67	na	na	na	na	
30-Sep-01	nd	8.89	na	5.18	nd	88.88	nd	8.89	na	na	na	15.80	
1-Oct-01	nd	nd	na	3.82	8.89	nd	nd	nd	12.27	10.66	10.08	11.36	
2-Oct-01	8.89	nd	na	12.69	nd	26.67	8.89	nd	21.74	26.23	16.37	4.22	
3-Oct-01	28.87	nd	na	22.84	8	nd	17.78	nd	37.42	35.25	30.05	7.60	
4-Oct-01	17.78	8.89	na	26.82	16	nd	nd	16	35.33	38.61	33.11	10.28	
5-Oct-01	nd	nd	na	26.05	nd	32	nd	nd	38.81	33.7	32.28	9.06	
6-Oct-01	nd	8.61	na	7.46	7.75	15.5	7.75	nd	12.31	8.99	9.09	18.36	
7-Oct-01	nd	40	na	na	nd	nd	nd	nd	3.33	10.92	4.61	18.33	
8-Oct-01	71.11	64	88	na	15.5	15.5	nd	nd	6.5	9.62	6.25	12.66	
9-Oct-01	8	40	14.55	9.60	nd	62.02	nd	nd	13.59	15.69	10.33	7.37	
10-Oct-01	nd	nd	26.67	10.62	15.5	nd	nd	nd	17.83	17.98	12.36	9.13	
11-Oct-01	26.67	35.56	64	9.97	nd	nd	nd	nd	17.08	17.57	13.28	8.34	
12-Oct-01	nd	8.89	nd	11.31	31.5	15.75	nd	nd	18.91	17.82	16.45	6.21	
13-Oct-01	8	16	8.89	14.71	nd	nd	nd	nd	21.7	23.37	20.02	na	
14-Oct-01	nd	nd	17.75	8.34	nd	nd	nd	nd	12.1	11.39	12.75	na	
15-Oct-01	24	16	8.89	7.05	nd	46.51	nd	nd	9.93	18.38	7.34	8.52	
16-Oct-01	nd	nd	124.44	11.36	16	nd	nd	nd	10.32	10.63	13	11.62	

Table 5.
Asbestos Fibers (TEM) and Particulate Matter (PM 2.5) in Ambient Air, and Average Wind Speed (mph)
Select Fresh Kills Landfill and Lower Manhattan Locations

Date	Fresh Kills Landfill Locations				Lower Manhattan Locations								Wind (mph)
	09-A (S/mm ²)	09-B (S/mm ²)	12-A (S/mm ²)	(1) PM 2.5 (Ug/m ³)	B (S/mm ²)	D (S/mm ²)	E (S/mm ²)	F (S/mm ²)	(2) PM 2.5 (Ug/m ³)	(3) PM 2.5 (Ug/m ³)	(4) PM 2.5 (Ug/m ³)		
17-Oct-01	26.25	96.24	96.24	5.04	nd	nd	nd	nd	6.18	15.43	5.07	11.28	
18-Oct-01	17.78	17.78	44.44	7.75	nd	nd	nd	nd	9.54	13.77	7.09	12.81	
19-Oct-01	nd	6.67	44.44	17.07	nd	nd	nd	nd	18.6	27.99	15.76	9.11	
20-Oct-01	nd	nd	80	17.24	nd	nd	nd	nd	24.04	27.66	19.35	7.57	
21-Oct-01	8.75	nd	nd	22.75	nd	nd	nd	13.33	30.15	29.59	25.62	10.24	
22-Oct-01	8	nd	nd	15.76	nd	nd	nd	nd	22.82	26.21	22.04	na	
23-Oct-01	nd	nd	48	14.95	8.61	nd	nd	nd	19.51	16.69	19.92	8.63	
24-Oct-01	nd	nd	53.33	15.23	nd	nd	nd	nd	23.45	20.53	19.06	9.20	
25-Oct-01	128	64	62.22	9.02	8.61	nd	nd	nd	13.5	20.87	11.52	12.81	
26-Oct-01	17.83	nd	53.33	6.01	nd	nd	nd	nd	8.5	18.71	6.69	18.97	
27-Oct-01	26.7	nd	26.7	4.73	nd	35.56	nd	8.89	6.87	11.97	5.2	16.56	
28-Oct-01	8.61	nd	nd	4.17	nd	8	nd	nd	6.1	5.68	5.8	10.55	
29-Oct-01	nd	nd	nd	9.20	8.89	nd	53.33	26.67	14.87	19.93	12.76	6.06	
30-Oct-01	nd	nd	35	10.75	8.89	8.89	25.84	nd	16.98	16.19	14.27	9.32	
31-Oct-01	nd	nd	115.56	9.37	nd	nd	nd	nd	11.63	8.49	10.21	9.11	
1-Nov-01	8	8	62.22	19.54	nd	na	nd	nd	25.49	22.16	20.86	8.87	
2-Nov-01	8	16	26.25	15.31	nd	na	nd	nd	24.18	19.61	18.61	11.02	

- (1) Fresh Kills Landfill
- (2) Borough of Manhattan
- (3) Pace University
- (4) Coast Guard Battery Park

‘na’ indicates that results for this day have not been reported in the NYC database, and have not been evaluated.

‘nd’ indicates not detected about the detection limit.

Table 6.
Total Fibers (PCM) Detected from PAM Samples
Fresh Kills Landfill

Location (sample ID)	Date	PCM (f/cc)
FRESH KILLS LANDFILL (091801-5)	Sept - 18	0.018
FRESH KILLS LANDFILL (SI918-3)	Sept - 18	0.03
FRESH KILLS LANDFILL (091801-4)	Sept - 18	0.035
FRESH KILLS LANDFILL (091801-2)	Sept - 18	0.069
FRESH KILLS LANDFILL (SI918-2)	Sept - 18	0.092
FRESH KILLS LANDFILL (091801-1)	Sept - 18	0.093
FRESH KILLS LANDFILL (SI918-1)	Sept - 18	0.094
FRESH KILLS LANDFILL (091801-8)	Sept - 18	0.103
FRESH KILLS LANDFILL (SI918-9)	Sept - 18	0.135
FRESH KILLS LANDFILL (SI918-15)	Sept - 18	0.14
FRESH KILLS LANDFILL (091801-6)	Sept - 18	0.144
FRESH KILLS LANDFILL (SI918-10)	Sept - 18	0.155
FRESH KILLS LANDFILL (SI918-14)	Sept - 18	0.175
FRESH KILLS LANDFILL (091901-2)	Sept - 19	0.019
FRESH KILLS LANDFILL (091901-3)	Sept - 19	0.019
FRESH KILLS LANDFILL (091901-8)	Sept - 19	0.043
FRESH KILLS LANDFILL (091901-4)	Sept - 19	0.057
FRESH KILLS LANDFILL (091901-7)	Sept - 19	0.068
FRESH KILLS LANDFILL (091901-9)	Sept - 19	0.116

Table 7.
Asbestos Fibers (TEM) Detected in PAM Samples
Lower Manhattan

Location (sample ID)	Date	TEM (S/mm ²)
BROADWAY & MURRAY ST (01-09028-013)	Sept 12	Not detected
GOLD & BEEKMAN (01-09028-005)	Sept 12	Not detected
NASSAU & BEEKMAN (01-09028-002)	Sept 12	10
PARK ROW & BEEKMAN (01-09028-001)	Sept 12	Not detected
RECTOR ST & TRINITY PL (01-09028-009)	Sept 12	15
THAMES ST & TRINITY PL (01-09028-006)	Sept 12	Not detected
THAMES ST & TRINITY PL (01-09028-007)	Sept 12	7.5
W. BROADWAY & WARREN TO CHURCH AND MURRAY12 (01-09028-010)	Sept 12	Not detected
WARREN ST & WEST BROADWAY (01-09028-011)	Sept 12	Not detected
WARREN ST & WEST BROADWAY (01-09028-012)	Sept 12	2.5
130 WEST LIBERTY STREET (AHT 24)	Sept 15	44.5
GROUND ZERO (AHT 15)	Sept 15	160.1
MURRAY ST & WEST ST (NYC 9)	Sept 15	355.9
NOT SPECIFIED (AHT 34)	Sept 15	44.5
WEST CENTRAL FRONT LINE AREAS (AHT 30)	Sept 15	17.8
WEST CENTRAL FRONT LINE AREAS (AHT 36)	Sept 15	44.35
WEST CENTRAL FRONT LINE AREAS (AHT 35)	Sept 15	80.1
WEST CENTRAL FRONT LINE AREAS (AHT 31)	Sept 15	97.9
WEST CENTRAL FRONT LINE AREAS (AHT 21)	Sept 15	133.5
WEST CENTRAL FRONT LINE AREAS (AHT 27)	Sept 15	142.3
WEST CENTRAL FRONT LINE AREAS (AHT 20)	Sept 15	151.2
WEST CENTRAL FRONT LINE AREAS (AHT 26)	Sept 15	266.9
WEST STREET (ATC 13)	Sept 15	160.1

Table 8.
Total Fibers (PCM) Detected in Indoor Air Samples
Lower Manhattan

Location (sample ID)	Date	PCM (f/cc)
184 AVE D DEP PUMPING STATION - FOUR BAY AREA (10914/A207006)	14-Sep-01	0.005
CITY HALL 1ST FL. - BLUE ROOM (10916/A207002)	16-Sep-01	0.011
CITY HALL 2ND FL OUTSIDE JULIE MENDIK'S OFFICE (10916/A207001)	16-Sep-01	0.022
22 RIVER TERRACE (10917/A100002)	17-Sep-01	Not detected
41 RIVER TERRACE TRIBECA POINT LOBBY (10917/A307003)	17-Sep-01	Not detected
41 RIVER TERRACE TRIBECA POINT PHB (10917/A307004)	17-Sep-01	0.003
22 RIVER TERRACE (10917/A100001)	17-Sep-01	0.004
400 CHAMBERS ST (302/002)	17-Sep-01	0.007
400 CHAMBERS ST TRIBECA POINT LOBBY (10917/A307002)	17-Sep-01	0.014
225 RECTOR ST (302/002)	18-Sep-01	0.03
225 RECTOR ST (10918/A307002)	18-Sep-01	0.044
101 MURRAY (LAB3#6)	22-Sep-01	Not detected
101 MURRAY (LAB3#7)	22-Sep-01	Not detected
101 MURRAY 2ND FL BY ROOM 214 (10922A003002)	22-Sep-01	Not detected
101 MURRAY (LOBBY AREA - CAFETERIA (10922A003001)	22-Sep-01	0.003
100 CHURCH ST (11934)	23-Oct-01	0.001
100 CHURCH ST (11931)	23-Oct-01	0.002
100 CHURCH ST (11932)	23-Oct-01	0.002
100 CHURCH ST (11933)	23-Oct-01	0.003
100 CHURCH ST (11937)	23-Oct-01	0.004
100 CHURCH ST (11940)	23-Oct-01	0.005
100 CHURCH ST (11935)	23-Oct-01	Not detected
100 CHURCH ST (11936)	23-Oct-01	Not detected
100 CHURCH ST (11938)	23-Oct-01	Not detected
100 CHURCH ST (11939)	23-Oct-01	Not detected

Table 9.
Bulk Dust Samples Collected in the Work Zone and Other Various
Lower Manhattan Locations with Detectable Levels > 1% Asbestos

Location (Sample ID)	Date	PLM (%)
CHURCH ST & VESSEY ST (4)	11-Sep-01	1.3
WEST ST & WATT (ST01-08995-001)	11-Sep-01	1.3
LOCATION F - VESEY ST & WEST (ST01-08996-003)	11-Sep-01	1.5
217 BROADWAY (2)	11-Sep-01	4
PARK PLACE & CHURCH (9)	11-Sep-01	4
MURRAY & WEST SIDE HIGHWAY (111979)	11-Sep-01	4
MURRAY ST & WEST ST (111979)	11-Sep-01	4.5
OLD SLIP & FRONT ST. /CAR ON CORNER (B004)	13-Sep-01	2.1
MAIDEN LN & BROADWAY (B007)	13-Sep-01	2.2
7 HANOVER SQ. CORNER OF HANOVER (B003)	13-Sep-01	2.3
CORNER OLD SLIP & FRONT ST./PARKED EXPLORER (B001)	13-Sep-01	2.4
55 WATER /CCIA MECH SYS CO VAN PRKED FRON OF 55 WATER (B006)	13-Sep-01	2.4
7 HANOVER SQ./ AFA PROTECTIVE VAN PARKED OPPOSITE TO SQ (B005)	13-Sep-01	2.8
PARK AREA BTW. 55 WATER-DIANA (B002)	13-Sep-01	3.3
BATTERY PL & WEST ST (438)	15-Sep-01	1.1
LOCATION D - ALBANY ST & GREENWICH ST (1166)	15-Sep-01	1.1
GREENWICH ST & WARREN ST (431)	15-Sep-01	1.2
BROADWAY & MURRAY ST (6344)	15-Sep-01	1.2
THAMES ST & TRINITY PL (433)	15-Sep-01	1.3
LOCATION C - BROADWAY & LIBERTY ST (1165)	15-Sep-01	1.3
CHAMBERS ST & NORTH END AVE (6347)	15-Sep-01	1.3
MURRAY ST & WEST ST (6350)	15-Sep-01	1.3
BATTERY PK & 2ND PL (437)	15-Sep-01	1.4
LOCATION A - BARCLAY ST & WEST BROADWAY (1163)	15-Sep-01	1.4
LOCATION E - LIBERTY ST & SOUTH END AVE (1167)	15-Sep-01	1.4
LOCATION F - VESEY ST & WEST ST (1168)	15-Sep-01	1.4
42 MURRAY ST (6339)	15-Sep-01	1.4
SOUTH END AVE & W THAMES ST (436)	15-Sep-01	1.6
WTC (C06354)	16-Sep-01	2
WTC (C06355)	16-Sep-01	2
BATTERY PARK @ MONUMENT (439)	16-Sep-01	2.1
ALBANY ST & WEST ST-WTC (C06351)	16-Sep-01	3
WTC (C06353)	16-Sep-01	4
CORTLAND ST & TRINITY ST (6374)	18-Sep-01	1.2
LOCATION F - VESEY ST & WEST ST (6368)	18-Sep-01	1.5
ALBANY ST & WASHINGTON ST (6371)	18-Sep-01	1.5
MURRAY ST & WEST ST (6367)	18-Sep-01	1.7
CHURCH ST & FULTON ST (6375)	18-Sep-01	1.7
PARK PLACE & WEST BROADWAY (6377)	18-Sep-01	1.9
HUDSON TOWER NORTH (6387)	19-Sep-01	1.2
200 RECTOR STREET (6389)	19-Sep-01	1.2
225 RECTOR ST (6388)	19-Sep-01	1.3
LOCATION L - NORTH SIDE OF STUYVESANT HIGH (6378)	19-Sep-01	1.4
400 CHAMBER COURTYARD (6382)	19-Sep-01	1.4
LOCATION L - NORTH SIDE OF STUYVESANT HIGH (6379)	19-Sep-01	1.5
22 RIVER TERRACE (6383)	19-Sep-01	1.6
400 GATEWAY PLAZA (6384)	19-Sep-01	1.7
GATEWAY PLAZA WEST (6385)	19-Sep-01	1.7
455 NORTH END AVE (6381)	19-Sep-01	1.8
BATTERY PLACE (6390)	19-Sep-01	1.8
LOCATION L - NORTH SIDE OF STUYVESANT HIGH (6380)	19-Sep-01	2.1

Table 9.
Bulk Dust Samples Collected in the Work Zone and Other Various
Lower Manhattan Locations with Detectable Levels > 1% Asbestos

Location (Sample ID)	Date	PLM (%)
GROUND ZERO - WTC (WTC919-1B2)	19-Sep-01	38
100 CHURCH ST (03821B)	10-Oct-01	1.1
BUILDING 6 (819B)	10-Oct-01	40



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Total Fibers (PCM) in Ambient Air - Fresh Kills Landfill (Locations 09-A, 09-B & 12-A) Vs Lower Manhattan (Locations B, D, E & F)

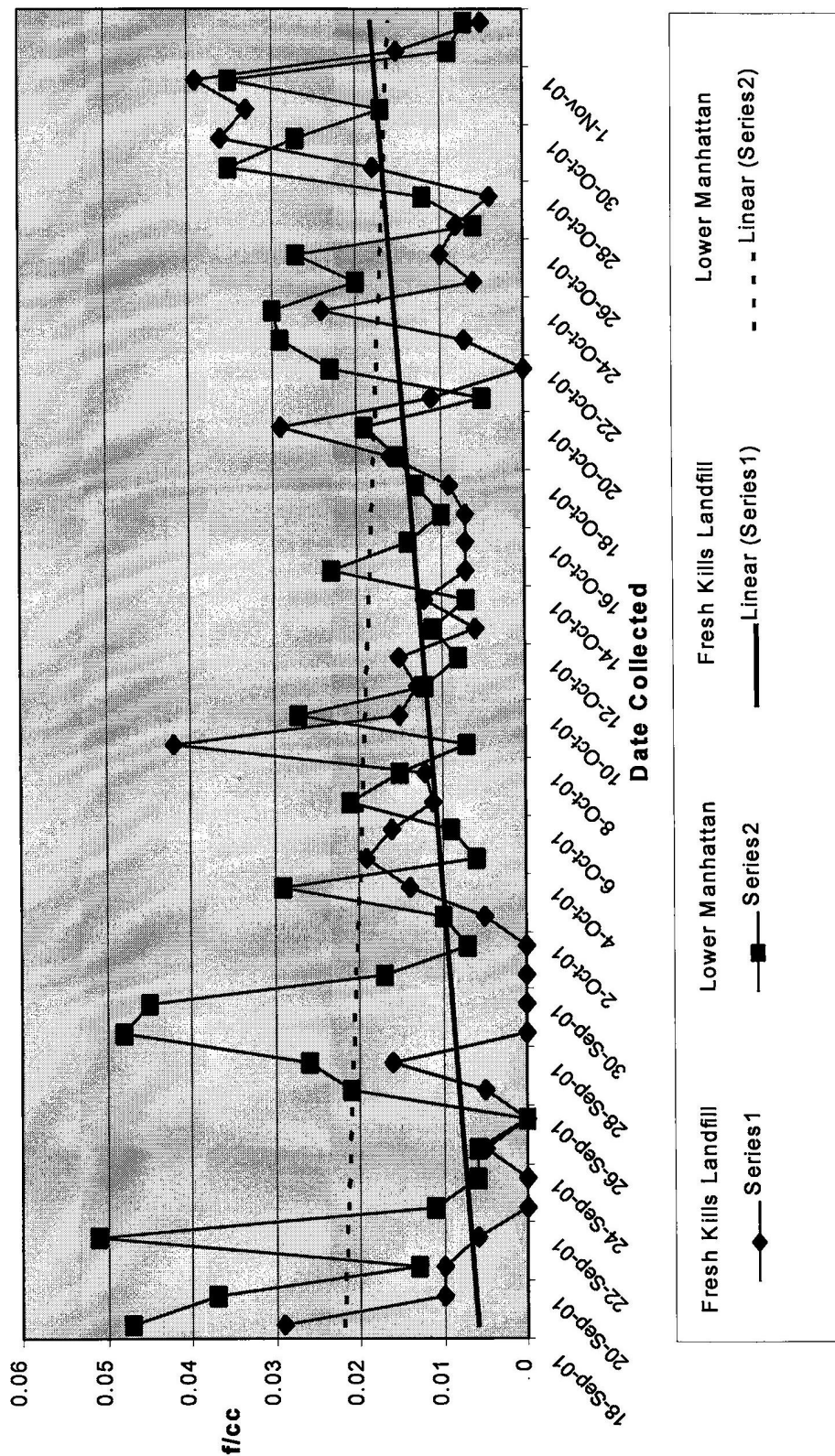


Figure 4. Total Fibers (PCM) in Ambient Air from Lower Manhattan and Fresh Kills Landfill.

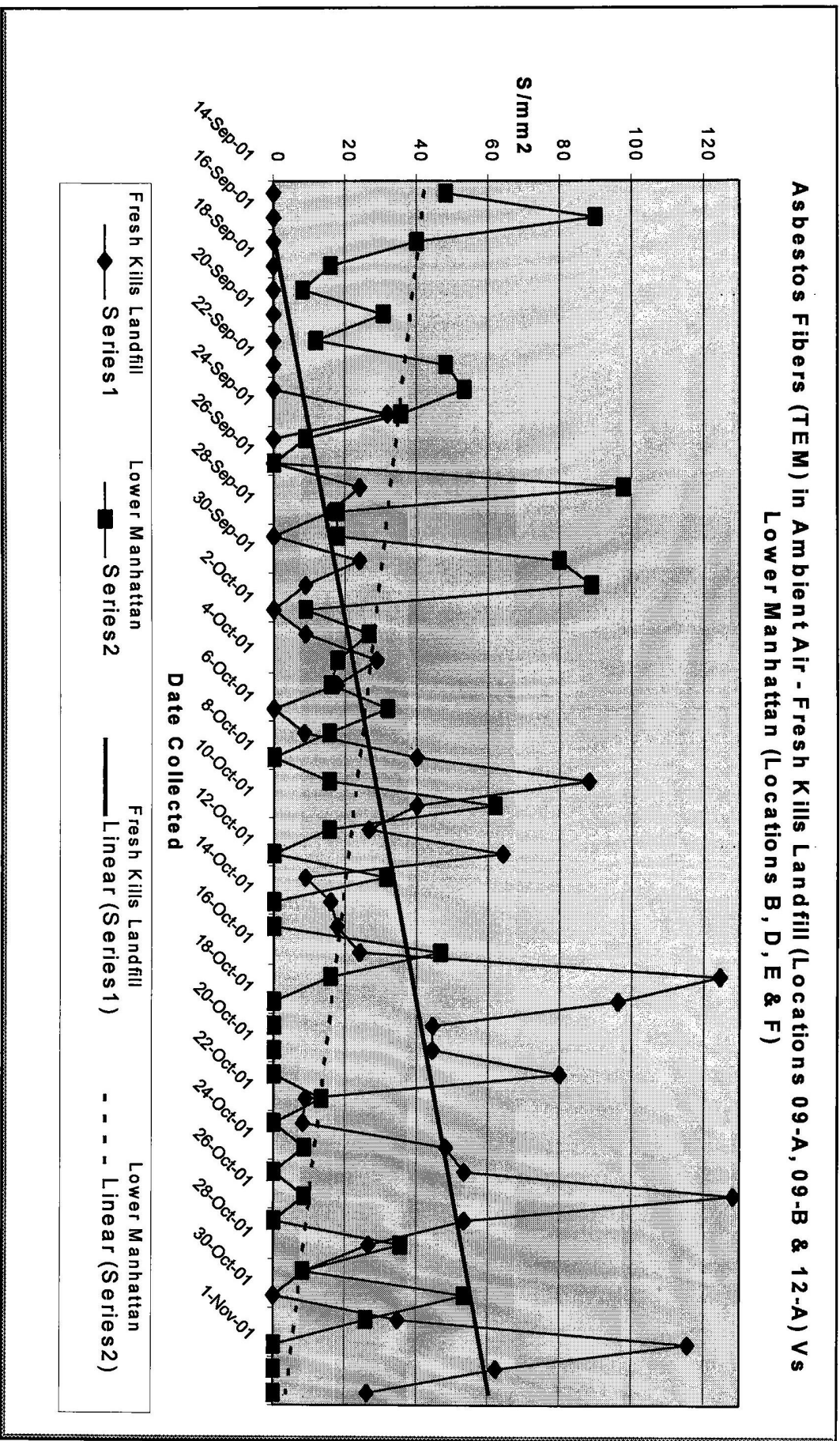


Figure 5. TEM asbestos results and fitted lines from Lower Manhattan and Fresh Kills Landfill



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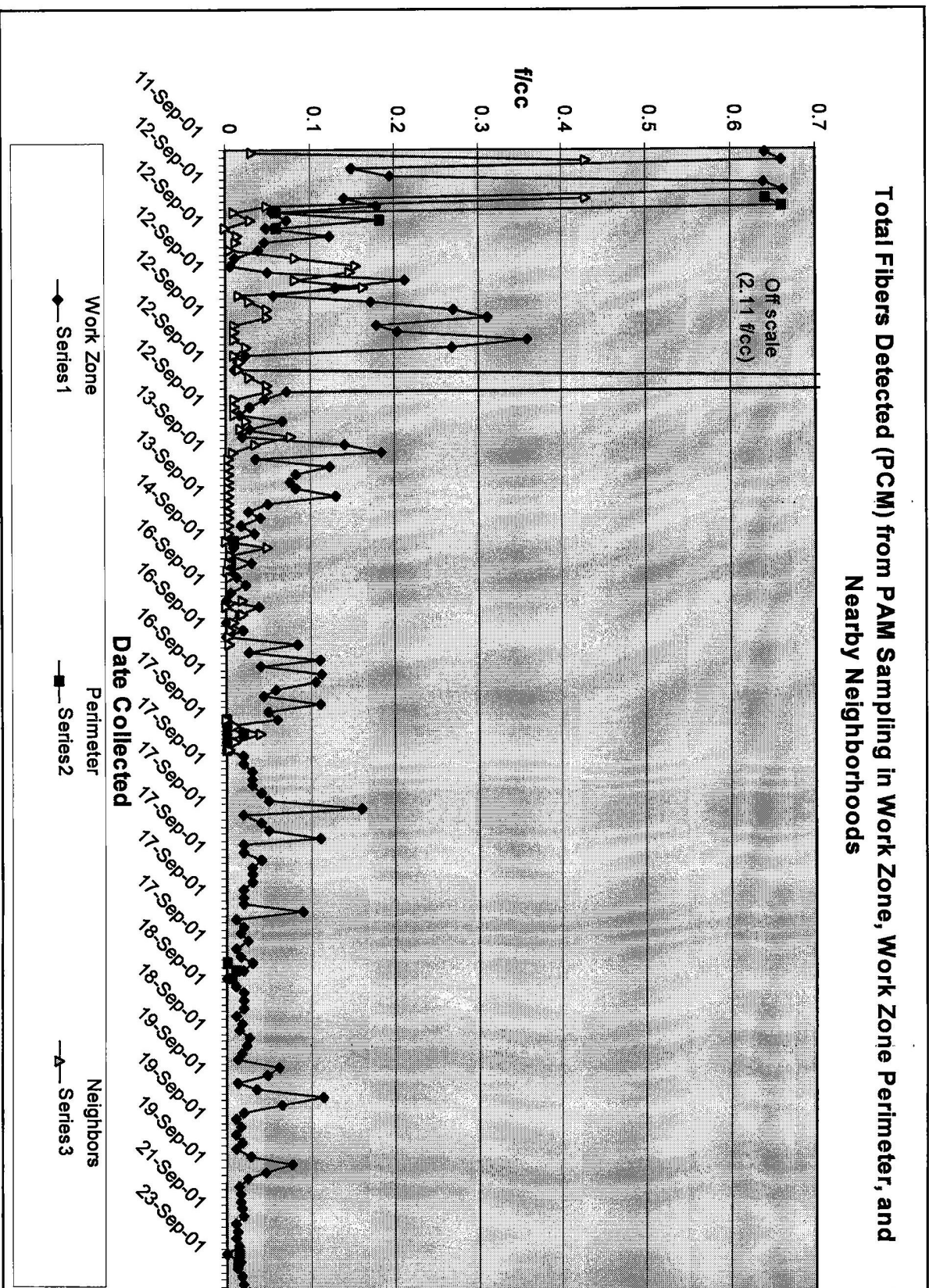
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Chlorinated Dioxins and Furans (CDD/CDF)

Several different CDD/CDF data sets were found in the NYC Response database, including individual congeners, PCDD/PCDF, Dioxins, and TEQ (toxic equivalents). CDD/CDF isomer or congener-specific samples in the NYC Response database include seven (7) bulk dust samples and six (6) water samples. The bulk dust samples are all from the Battery PK & 2nd Pl location taken on September 16th. The water samples appear to be from various treatment locations of the Newtown Creek STP taken on September 15th. In the water samples, 2,3,7,8-TCDD was not detected with an MDL of 0.01 ng/L (ppt). As of November 16th, no additional CDD/CDF sample results have been found in the NYC Response database.

The results from four (4) CDD/CDF bulk dust samples taken on September 16th at the Battery Pk & 2nd Pl sampling site are summarized in Table 10 and Figure 7. At the time of this Draft Report, no additional data has been posted in the NYC Response database. From the bulk dust results, the pattern in CDD/CDF congeners and congener class concentrations in the different samples are highly correlated suggesting a single source. The correlation coefficient calculated between samples AO6353 and AO6351 using the data in Table 3 is 0.9726. In each of the four samples, CDD concentrations generally increase with the level of chlorination. In three of the four samples, OCDD is approximately ten times (10x) the concentration of total TCDD. The reverse is true of CDF concentrations where the concentration decreases with the level of chlorination. In all four samples, the concentration of OCDF is approximately one-tenth (1/10) the concentration of total TCDF. The highest reported concentration of 2378-TCDD, the most toxic CDD/CDF, was 5.18 pg/g (ppt).

Comparing the Battery Pk & 2nd Pl bulk dust CDD/CDF profile to nine (9) references in Chemosphere, 1990, Vol 20, which includes CDD/CDF profiles for urban and background soil, paper pulp, incinerator fly ash, and others, the best correlation is with samples from a paper and oil incinerator described by Brown, et. al. (p. 1785 - 1791), with a correlation coefficient of 0.9464.

PCDD/PCDF is also reported for sediment, bulk dust, air, and water samples. All of the sixteen (16) sediment samples were taken at the Foot of Vesey BY CSO M-6 location on September 15th. The highest concentration of PCDD/PCDF reported for the sediment samples was 39.9 pg/g (ppt).

Six (6) PCDD/PCDF bulk dust samples from the WTC location (no sample date listed) were also reported with a high value of 84.4 pg/g (ppt).

From five (5) water samples taken on September 16th, with no location listed, the highest PCDD/PCDF value reported was 0.016 ng/L (ppb).

Four (4) PCDD/PCDF air samples were also reported for samples taken on September 16th from four (4) different locations on Lower Manhattan. The highest reported PCDD/PCDF value in the air samples was 0.066 ng/m³ from the Location B - Church St & Dey St site. The PCDD/PCDF values are the same as the TEQ values also reported for the same four (4) sites from September 16th.

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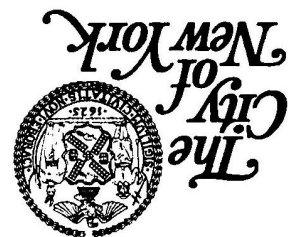


Table 10. CDD/CDF in Bulk Dust
Battery Pk and 2nd Pl; Sept 16th
Units: pg/g (ppt)

CDD/CDF	Sample ID			
	AO6354	AO6353	AO6355	AO6351
2378-TCDD	1.44	2.68	3.41	5.18
Total TCDD	102	109	167	325
Total PeCDD	64.2	66.7	135	189
Total HxCDD	72.4	79.2	156	224
Total HpCDD	125	360	445	696
OCDD	299	1890	2630	3170
2378-TCDF	10.7	20.6	23.9	43.8
Total TCDF	656	910	1170	2190
Total PeCDF	392	451	693	1110
Total HxCDF	233	241	373	579
Total HpCDF	136	154	232	356
OCDF	81.5	113	168	238

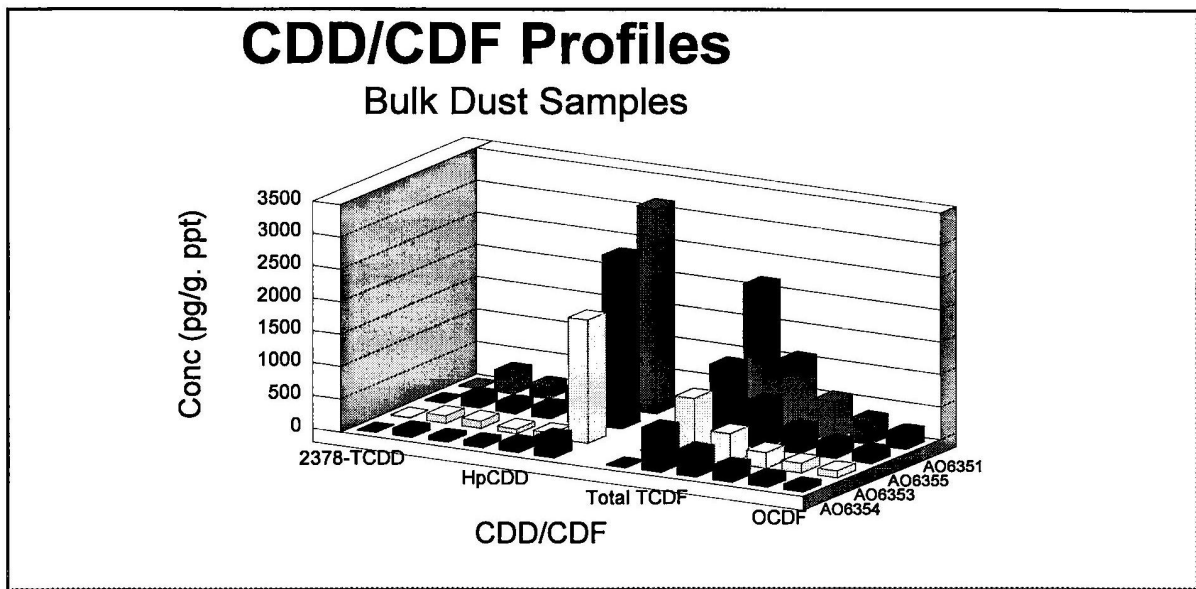
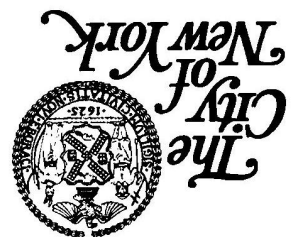


Figure 7. CDD/CDF Profile in Bulk Dust from Sept 16th at Battery Park and 2nd Pl.

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The complete CDD/CDF 2378-specific results for one of the bulk dust samples, AO6351, is listed in Table 11, along with a calculation of Toxicity Equivalence (TEQ) using the USEPA Method 8290, September 1994, Toxicity Equivalency Factors (TEFs). The total TEF adjusted concentration calculated here, 84.9, is slightly different from the NYC Response TEQ (EMPC, ND=0) database value listed for AO6351 as 84.4. At the time of this Draft Report, the source of the difference is still in review.

Table 11. CDD/CDF Results for Bulk Dust Sample AO6351

Target CDD/CDF	AO6351 Concentration Units: pg/g (ppt)	TEF	TEF-Adjusted Concentration
2378-TCDD	5.18	1.00	5.18
12378-PeCDD	8.48	0.50	4.24
123678-HxCDD	16.5	0.10	1.65
123789-HxCDD	11.9	0.10	1.19
123478-HxCDD	11	0.10	1.1
1234678-HpCDD	354	0.01	3.54
OCDD	3170	0.001	3.17
2378-TCDF	43.8	0.1	4.38
12378-PeCDF	41.8	0.05	2.09
23478-PeCDF	77.1	0.5	38.55
123678-HxCDF	46.8	0.1	4.68
123789-HxCDF	16.7	0.1	1.67
123478-HxCDF	49.2	0.1	4.92
234678-HxCDF	62.5	0.1	6.25
1234678-HpCDF	165	0.01	1.65
1234789-HpCDF	38.2	0.01	0.382
OCDF	238	0.001	0.238
Total			84.88

Note that a comparison of the CDD/CDF values from these samples at Battery Park on September 16th with historical CDD/CDF levels in New York City was not performed. This type of comparison may be useful in determining if future sampling/analysis is warranted.

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Polychlorinated Biphenyls (PCBs)

PCB results in the NYC Response database includes Aroclors, PCBs-Totals, and individual PCB Congener BZ #s. Aroclor 1254 and Aroclor 1260 results from the WTC database reveal high levels of Aroclor 1260 in several bulk dust samples from several sampling sites. Three (3) of the ten (10) Aroclor 1260 samples listed in Table 12 were found to contain Aroclor 1260 at levels greater than 1000 mg/Kg (ppm). The four (4) samples from September 16th contained the highest concentrations. Aroclor 1254 results were generally lower or not detected. Other Aroclors, including 1221, 1234, 1242, and 1248, were reported as not detected.

Total PCBs in two (2) bulk dust samples from October 10 were also reported. The reason for the difference between the Aroclor 1260 and PCB-Total results is not known.

Table 12. Bulk Dust Samples Aroclor 1260 and Aroclor 1254 Results
Units: ug/Kg (ppb)

Date	Location	Aroclor 1254	Aroclor 1260	PCBs-Total
Sept 11	Warren St & West Broadway	190	na	na
	Greenwich St & Warren St	<65	340	na
	Hudson St & Reade St	440	1100	na
	Murray St & West St	590	910	na
Sept 16	Albany St & West St (WTC)	nd	1,400,000	na
	Battery Pk & 2 nd Pl	nd	1,600,000	na
	North End & Park Pl	nd	1,100,000	na
	Park Place & West Broadway	nd	159,000	na
Sept 26	110 Greenwich St	<740	<740	na
Oct 10	22 Cortlandt	550	1,200	923
	600 Gateway Plaza	170	1,500	441

Five (5) Aroclor 1260 and 1254 drinking water sample results are also listed in the database. In all five (5) samples, the Aroclors were not detected at 0.05 MCG/L. Thirteen (13) other water samples identified as 'SS-IFO' at various street locations were also analyzed for Aroclors 1254 and 1260. The results for these samples range from 0.16 ug/L to 0.19 ug/L with no detect status indicated. No PCBs-Totals for any water samples were found.

PCB Congener data for water samples was also found in the NYC Response database. In the case of PCB Congener BZ #100, eleven (11) water samples were analyzed. Results range from 0.0051 ug/L to 0.0059 ug/L with no sample location or detect status listed. Similar results for several other PCB

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Congeners in water samples were also found, also with no locations or detect status. No PCB Congener data was available for bulk dust or air samples.

PCBs-Totals in dust wipe samples were reported for four (4) samples at three (3) locations, including Manhattan Community College (two (2) samples on Sept 28), PS 234-Chambers & Greenwich St (Sept 29), and Stuyvesant High School (Sept 28). In all four of these samples, PCBs-Totals were not detected at 0 ng/100 cm² or <5 ng/100 cm².

To date, PCBs-Totals in air samples were reported for twelve (12) Lower Manhattan locations on nine (9) sampling dates. Results have been recorded in the database for samples taken up to October 26th. Detected values were reported in six (6) of the twelve (12) sites, as listed in Table 13 and illustrated in Figure 8. PCBs-Totals in air were not detected at Location E - Liberty & South End Ave, Location F-Vesey & West St, Location P - Albany & South End Ave, Location R - EPA TAGA Bus, and Location S - Rector Pl & South End Ave.

The WTC - Building 5 SW and Location A - Barclay & West Broadway sites had the highest PCBs-Totals in air results. The highest reported value was 153 ng/m³ on October 2nd at the WTC Building 5 SW site. For these two (2) sites, the correlation coefficient is low at 0.0351, indicating different patterns of change. Comparison of the results from the Location B - Church & Dey St and WTC - Building 5 SW sites through October 15th reveals a correlation coefficient of 0.8690.

The linear fit lines in Figure 9 indicates a steady decrease in Total PCBs at the WTC Building 5 SW, Location B, and Location A sites. At all of the sites, except WTC-Building 5 SW, the most recent results from October 15th, 18th, and 26th are all zero (0) or undetected.

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Table 13. PCBs - Totals in Air
Units: ng/m³

Date	Liberty & Trinity St	Location A - Barclay & West Broadway	Location B - Church & Dey St.	Location C - Broadway & Liberty St	Location D - Albany & Greenwich St	WTC - Building 5 SW
16-Sept	8.11	na	6.98	na	<2.3	na
23-Sept	na	< 3.44	4.14	< 3.18	<2.44	55.9
27-Sept	na	38.7	4.99	< 1.81	<1.81	na
2-Oct	na	8.3	17.9	8.16	<2.08	153
4-Oct	na	77.2	13.3	< 1.8	na	58.6
8-Oct	na	< 1.77	4.54	15.7	9.23	18.1
11-Oct	na	25.4	2.21	0 (nd)	0 (nd)	28.2
15-Oct	na	0 (nd)	0 (nd)	0 (nd)	0 (nd)	16
18-Oct	na	<2.07	<2.07	<2.07	<2.07	5.69
26-Oct	na	<1.36	<1.36	<1.32	<1.38	6.76

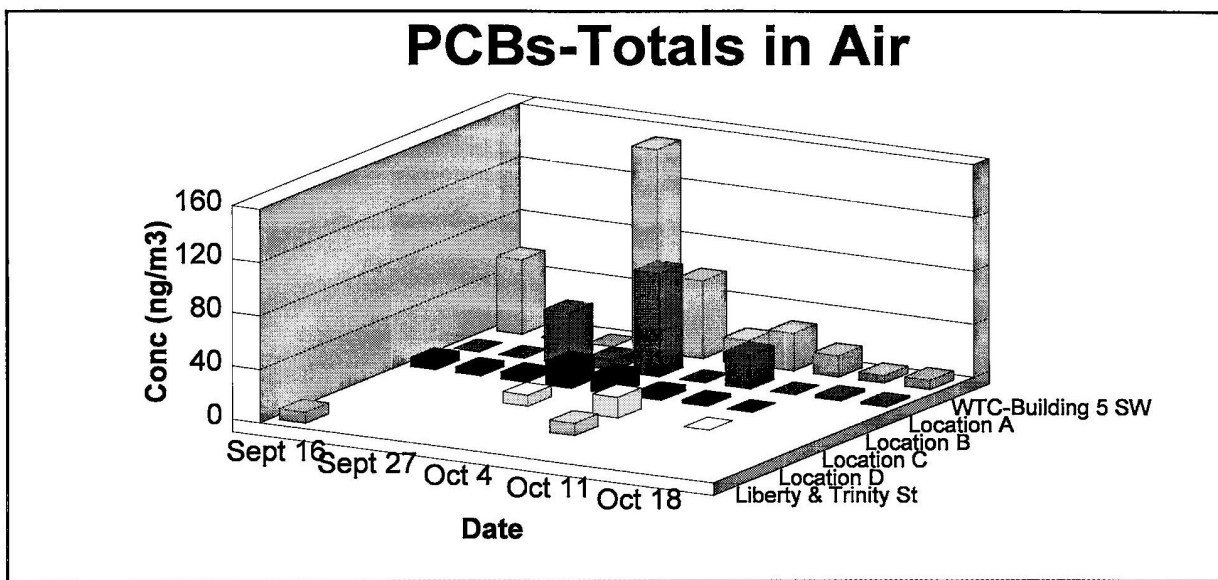


Figure 8. PCBs-Totals in Air at Six Locations.

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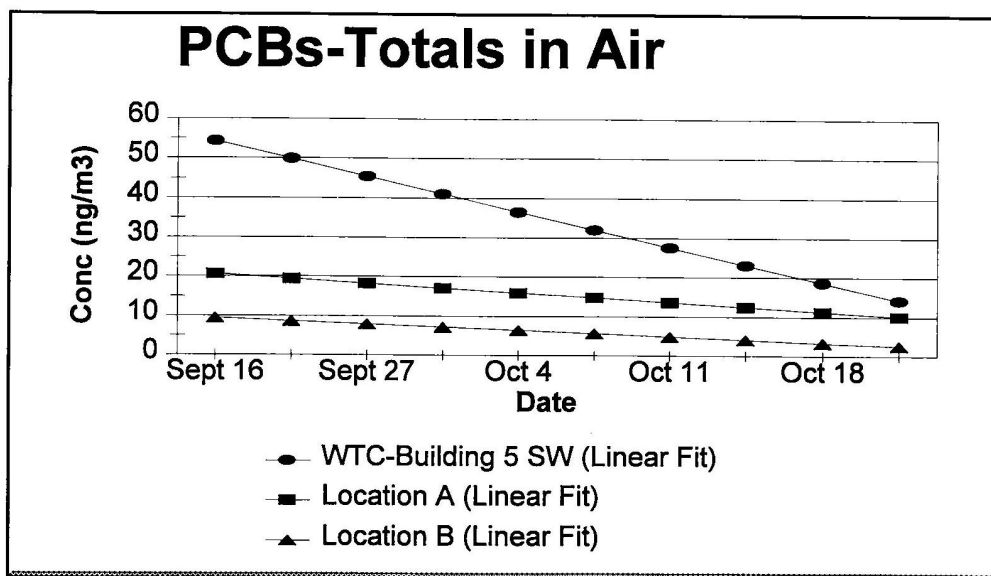
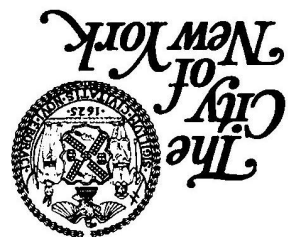


Figure 9. Linear Fit Lines for PCBs - Totals at Three Locations.

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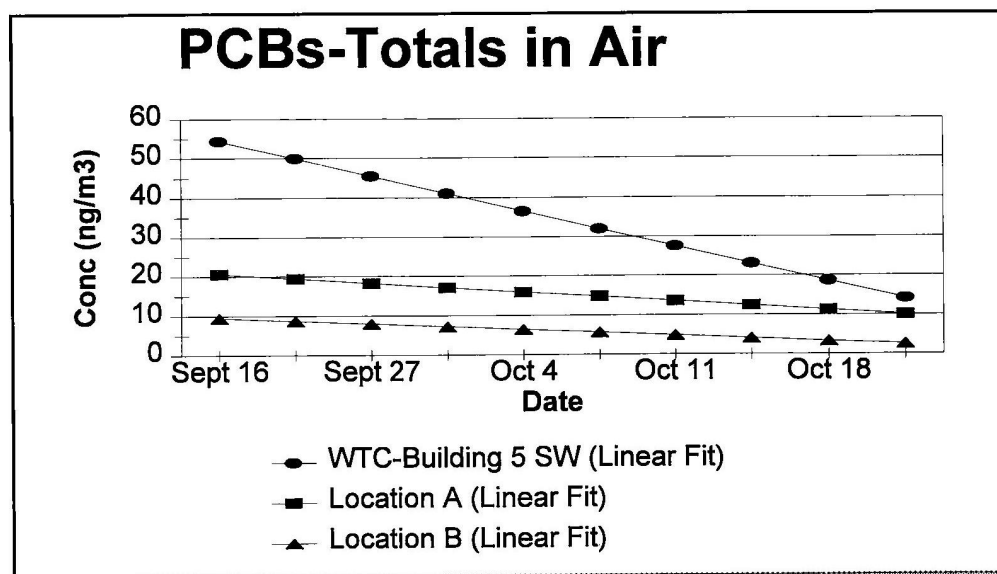


Figure 9. Linear Fit Lines for PCBs - Totals at Three Locations.



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Polynuclear Aromatic Hydrocarbons (PAHs)

The NYC Response database contains results for many different individual PAH compounds. The database also contains a 'PAH' analyte which contains air sample results from various locations, all from September 16th. Those results are all '<' approximately 5 ppbv.

The Bulk Dust sample results for five (5) representative PAH compounds, including naphthalene, fluoranthene, pyrene, chrysene, and benzo(a)pyrene, representing increasing ring structures, are listed in Table 14. Figure 5 illustrates the concentration profile from the September 11th samples. The highest PAH concentration found was fluoranthene at 210,000 ppb in the October 8th Cortlandt sample.

Table 14. PAHs in Bulk Dust
Units: ug/Kg (ppb)

Date	Location	Napthalene	Fluoranthene	Pyrene	Chrysene	Benzo(a)pyrene
Sept 11	Greenwich St & Warren St	2000	4100	3400	1400	1500
	Hudson St & Reade St	590	5400	3800	3400	3500
	Murray St & West St	850	7700	6300	2600	2900
	Warren St & West Broadway	1400	4100	3200	1600	1700
Sept 16	North End & Park Pl	1200	na	11000	5400	6100
	Battery Pk & 2 nd Pl	1000	na	15000	7300	7900
	Albany St & West St (WTC)	1500	na	12000	5700	6200
	Park Pl & West Broadway	nd	na	630	nd	nd
Oct 8	22 Cortlandt	13000	210000	170000	68000	76000
	600 Gateway Plaza	1700	20000	16000	7200	8500

'na' indicates that the results are not found in the NYC Response database.

'nd' indicates that the target compound was not detected.

There have been no PAH in bulk dust entries to the NYC Response database for samples taken since October 8th. The three (3) sampling dates shown in Table 14 suggest an upward trend.



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The profile of PAH concentrations in the September 11th samples is shown in Figure 10. As with the CDD/CDF bulk dust samples, the PAH profile from the four (4) samples suggest a common source.

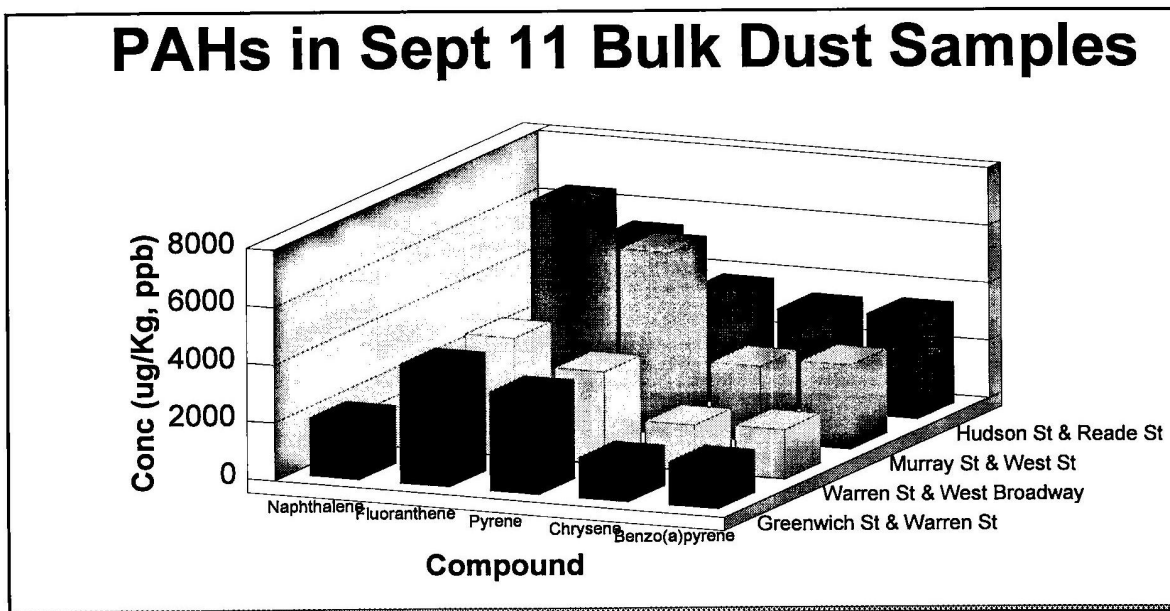


Figure 10. Select PAHs in Bulk Dust Lower Manhattan samples from Sept 11th.

Most of the water sample NYC Response database results for the PAHs indicate no sample site or detect status. For the compounds listed in Table 14, complete records for benzo(a)pyrene were found for thirteen (13) drinking water samples, all with 'End Date' September 15th. The concentrations reported range from 5.1 to 6 ug/L, with no listed detect status. No other sample matrices or results are listed for the PAHs.



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Metals

The NYC Response database include results for metals in air, water, bulk dust, sludge, and sediment samples. The lead, cadmium, chromium, arsenic, beryllium, and mercury results in air samples are discussed. To date (November 19th), metals in air concentrations have been reported for samples through October 18th. Of those described above, lead was the most frequently detected metal. The lead results from five (5) Lower Manhattan locations are presented below in Table 15 and the following figures. Lead was detected at a maximum of 5.4 ug/m³ on September 23rd at the WTC Building 5 SW site. 'Not detected' results were also reported for October 2nd samples without sample begin dates or signs and are therefore omitted in the table and graph.

At three (3) of the five (5) sites listed in Table 15, the linear fit lines and correlation coefficient calculations indicate a steady decrease in lead air concentrations. The correlation coefficients comparing concentration with time (day) is -0.9459 for Location A, -0.8780 for Location B, and -0.6386 for the WTC Building 5 site. The WTC Building 5 SW lead concentrations have been fairly steady over the past 4 sampling dates. The negative correlation coefficient indicates an inverse trend, i.e., as days increase, the concentration decreases. The trends at Location C and D are much less well defined. At Location C, the correlation coefficient of concentration vs time is 0.0148. At Location D, the correlation coefficient is 0.2136. Correlation coefficients approaching zero (0) indicate no similarity.

Cadmium was detected in only one (1) of the listed samples from the WTC-Building 5 site at 0.2 ug/m³. The only other detected cadmium in air that we have found was from Location E-Liberty St & South End Ave, at 0.13 ug/m³ on Oct 11, 2001. Chromium was detected at several sites ranging from 0.24 to 0.38 ug/m³. Arsenic was also detected at the Location A-Barclay & West Broadway site on September 27th and October 4th at 0.053 and 0.049 ug/m³, respectively. Beryllium and mercury were not detected in any of the air samples with detection limits for beryllium listed at approximately 0.05 ug/m³ in most of the samples.

Table 15. Lead in Air
Units: ug/m3

Date	Location A - Barclay & West Broadway	Location B - Church & Dey St	Location C - Broadway & Liberty St	Location D - Albany & Greenwich St	WTC- Building 5 SW
18-Sept	na	1.9	na	na	na
23-Sept	4.3	1.7	0.69	0.38	5.4
27-Sept	2.8	0.69	<0.043	<0.042	1.1
4-Oct	1.4	0.26	0.079	0.098	0.42
8-Oct	0.55	0.32	0.51	0.95	0.73
11-Oct	0.49	0.23	<0.05	0.093	0.48
15-Oct	0.13	0.28	0.056	0.47	1.1
18-Oct	0.065	0.16	0.56	0.32	0.66



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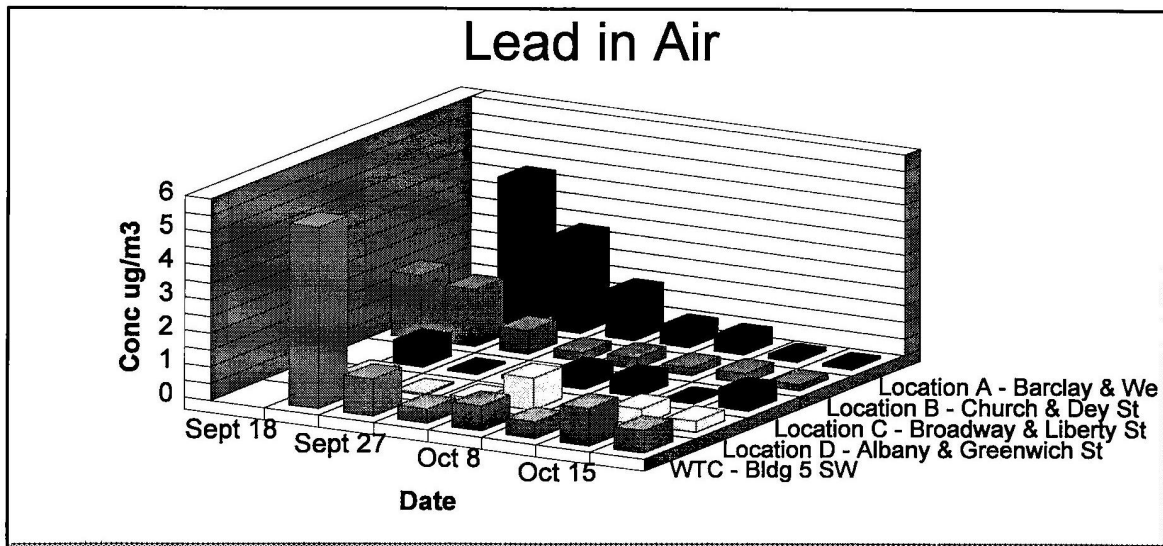


Figure 11. Lead in Air at Five Locations.

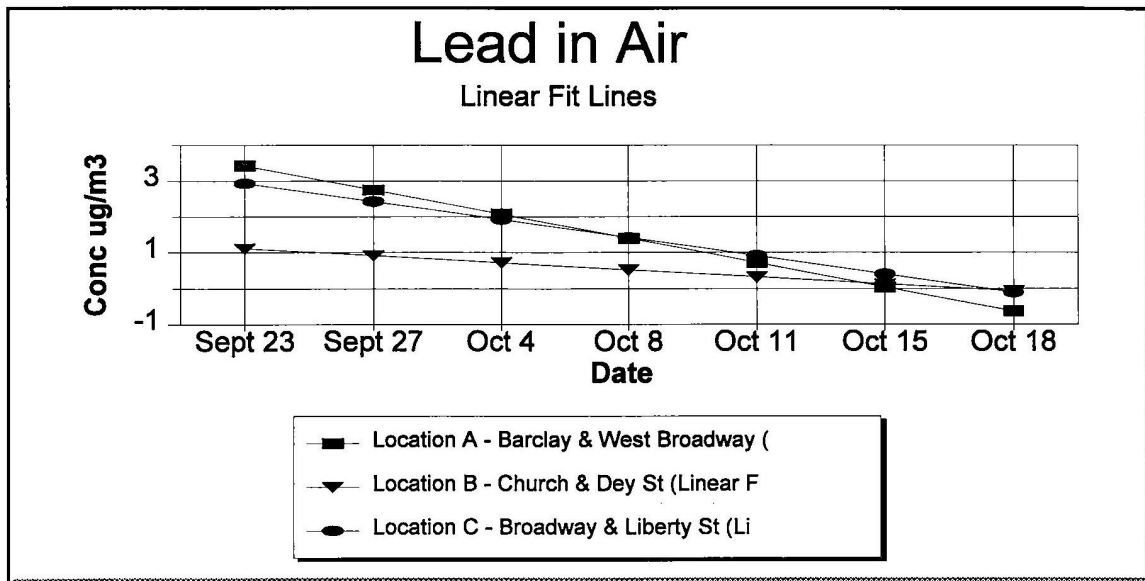


Figure 12. Linear Fitted Lines for Lead in Air at Three locations.

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As illustrated in Figure 13, lead in air is not correlated with Total PCBs in air at the WTC Building 5 SW sampling site. The correlation coefficient for this pair of analytes from the WTC Building 5 SW location on six (6) sampling dates is 0.1267.

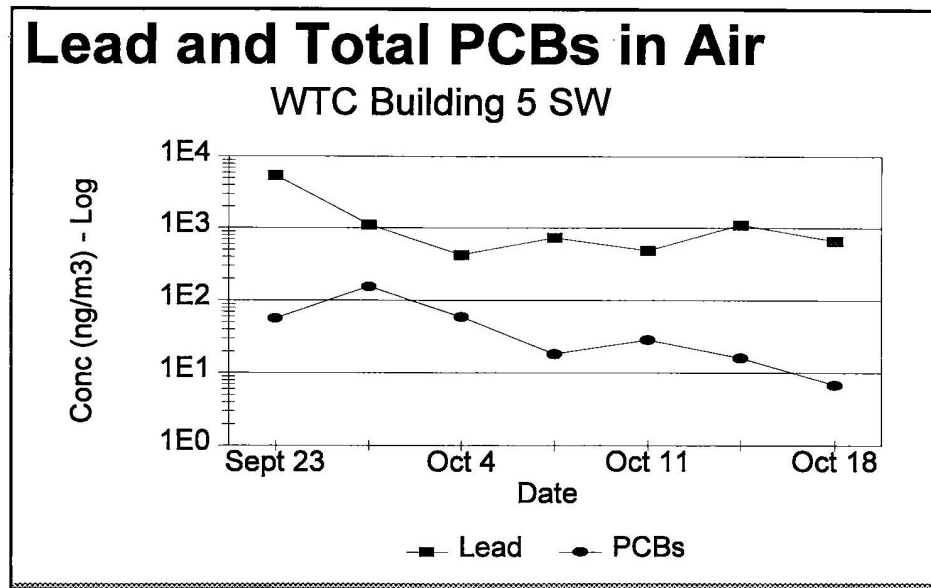


Figure 13. Uncorrelated Lead and Total PCBs in Air at WTC Building 5 SW site.

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The maximum concentration of lead in bulk dust samples reported was 370 mg/Kg (ppm) in a sample from the Park Place & West Broadway location on September 16th. To date, the latest bulk dust sample results are from September 26th. The highest value for chromium in bulk dust was 100 mg/Kg from a Battery Pk & 2nd Pl sample, also of September 16th. The highest concentration of cadmium was 4.9 mg/Kg, also from bulk dust at Battery Pk & 2nd Pl on September 16th. Select metals found in the bulk dust samples are summarized in Table 16. The profile of target analytes and concentrations did not changed significantly over the time of the sampling events, as illustrated in Figure 14 for four (4) samples, one (1) from each sampling date.

Table 16. Metals in Bulk Dust; Units mg/Kg (ppm)

Date	Location	Lead	Barium	Chromium	Cadmium	Arsenic	Beryllium	Mercury
Sept 11	Greenwich & Warren St	120	370	100	3.8	11	1.4	na
	Hudson & Reade St	250	290	81	4.5	<7.8	2.5	na
	Murray & West St	200	220	95	2.5	<7.8	2.1	na
	Warren & West Broadway	170	340	95	4.4	<8	1.4	na
Sept 16	Battery Pk & 2 nd Pl	150	280	100	3.8	2.9	2.6	0.31
	Battery Pk & 2 nd Pl	210	330	na	4.9	3	3	0.32
	Park Place & West Broadway	370	220	57	2	3.1	1.5	0.06
Sept 18	Albany & West St	230	180	82	3.2	0 (nd)	1.8	0.24
Sept 26	110 Greenwich St	97.7	195	71.5	3.8	<0.96	1.76	0.373

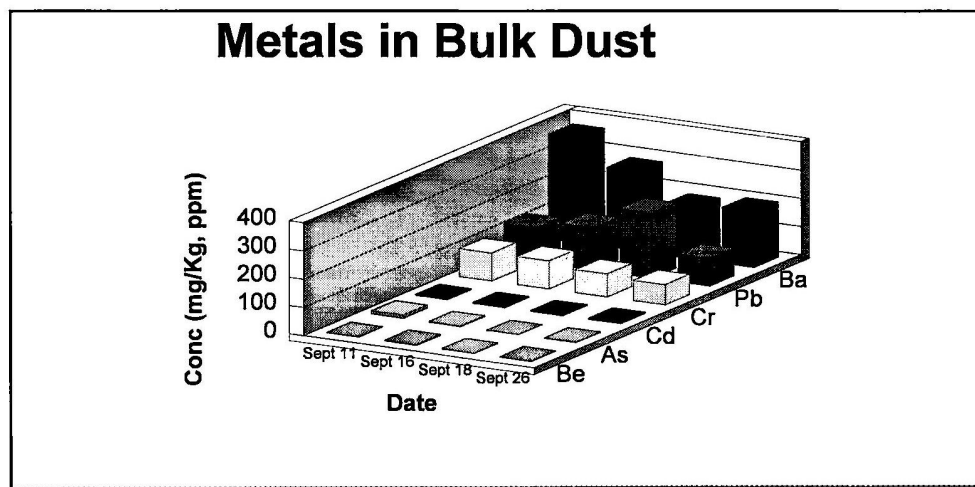
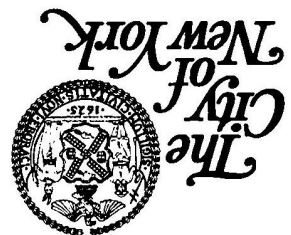


Figure 14. Metals Profile in Bulk Dust; Four Sites over Four Dates

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Bulk dust results listed in ug/wipe were also reported. The highest lead result listed in ug/wipe units was 9.7 ug/wipe from the Manhattan Borough Community College Gym Bleachers on September 28th. Lead was also reported at 4.5 ug/wipe in a September 28th sample from the Stuyvesant High School Elevator. To date, all of the Manhattan Community College and Stuyvesant High School samples were from September 28th. Lead in three (3) bulk dust samples taken on September 24 from the Southwest Corner of WTC and West Side of Pile were reported at <1 ug/m³.

Lead was also detected in several PS 234 Chambers & Greenwich St Dust Wipe samples taken on September 29th at levels ranging from 0.15 ug/wipe to 1.5 ug/wipe.

Review of the metals in water sample results from the NYC Response database indicate that many of the database fields are incomplete. The highest level of lead in water, with the notable exception of the Rector St-Runoff sample taken on September 14th was 35 ug/L. This 35 ug/L result, however, is listed with no sample location.

The Rector St - Runoff sample from September 14th had high levels of all of the target metals, including lead at 1500 ug/L, arsenic at 140 ug/L, and mercury at 9 ug/L.



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Particulate Matter (PM 10 and PM 2.5) and Rain

The PM 10 and PM 2.5 data from two weeks of the month of October is presented in the following Table 17 and Figure 15. PM 10 daily results are available on the NYC Response database for five (5) sites from Lower Manhattan and Brooklyn (see Attachment 2, Figure 13) from October 2nd through October 15th. All of the sites show the same pattern of decreasing concentrations. PM 2.5 data is available for hourly samples for a much larger number of sites. In this comparison, daily average PM 2.5 data has been calculated for the Coast Guard Battery Park site.

**Table 17. PM 10 and PM 2.5
PM 10 from Coast Guard Bldg (Site 3) and PM 2.5 from Coast Guard Battery Park
(Rooftop); Units: ug/m3**

Date	PM 10	PM 2.5	Rain
Oct 1	na	na	Rain
Oct 2	37.2	16.6	na
Oct 3	63.7	30.6	na
Oct 4	61.9	31.9	na
Oct 5	62.4	32.7	na
Oct 6	20.2	7.67	Rain
Oct 7	12.4	4.73	na
Oct 8	19.1	6.34	na
Oct 9	29.2	10.4	na
Oct 10	34.2	12.4	na
Oct 11	33.6	13.3	na
Oct 12	43.6	16.7	na
Oct 13	43.8	20.5	na
Oct 14	25.5	12.2	na
Oct 15	24.0	7.91	na
Oct 16	na	na	Rain



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During the month of October, rain was reported in New York City on the 1st, 6th, 16th, and 17th. These dates correspond to the dips in the PM results.

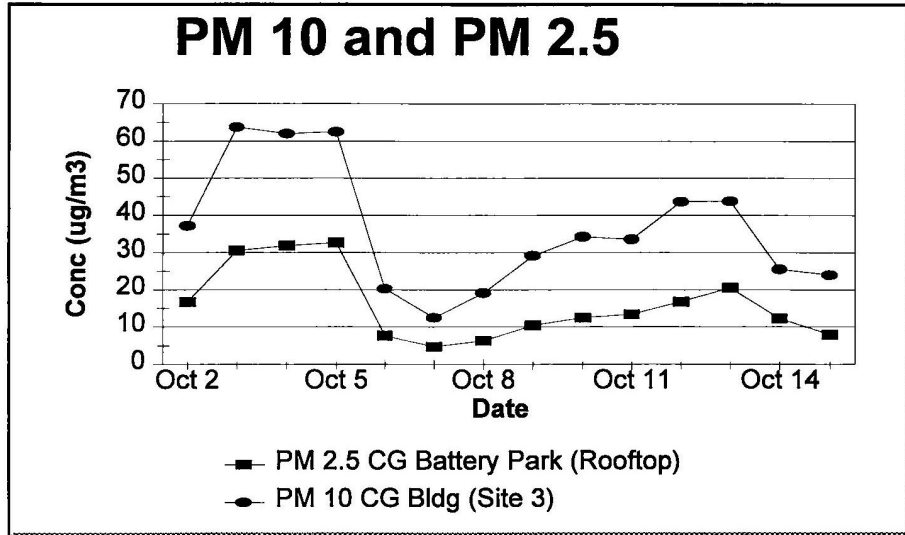


Figure 15. PM 10 and PM 2.5 at Coast Guard Locations.

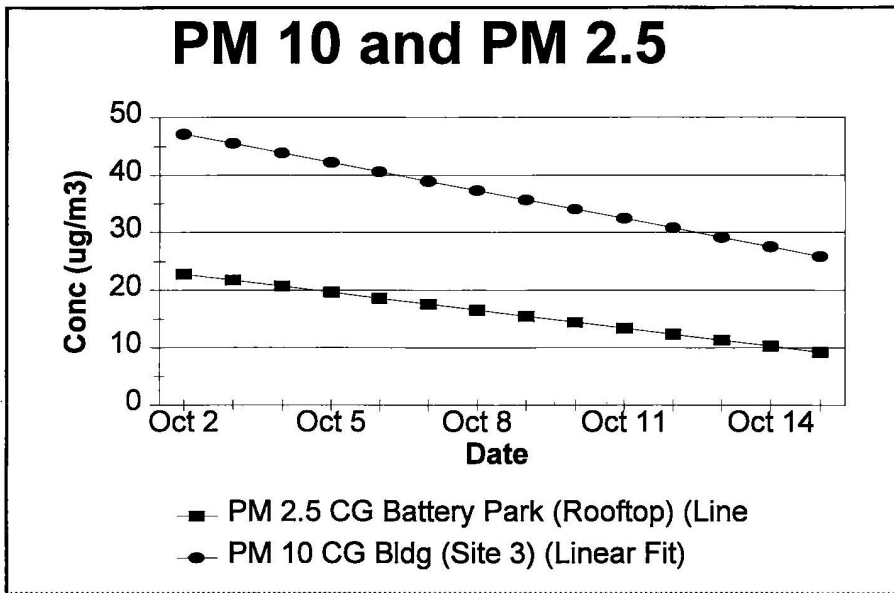


Figure 16. Linear Fitted Line for PM 10 and PM 2.5 at Coast Guard Locations.

PM 10 and PM 2.5 at the Coast Guard Building Site 3 and the Coast Guard Battery Park Rooftop sites are clearly correlated (correlation coefficient = 0.983). Additional trend charts of PM 10 for other locations are provided in Attachment 3.



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Table 18.
New York City Weather September 11 - October 23

Date	Mean Temperature (F)	Wind Speed (mph)	Conditions
11-Sep-01	73.5	8.77	Partly Cloudy
12-Sep-01	70.5	10.59	Partly Cloudy
13-Sep-01	74.8	9.74	Partly Cloudy
14-Sep-01	60.3	9.29	Rain and then Partly Cloudy
15-Sep-01	62.3	7.98	Mostly Clear
16-Sep-01	63.1	5.44	Partly Cloudy
17-Sep-01	70.8	7.41	Partly Cloudy
18-Sep-01	70.3	5.09	Partly Cloudy
19-Sep-01	70.2	8.54	Partly Cloudy
20-Sep-01	69.7	12.70	Rain
21-Sep-01	72.9	6.33	Partly Cloudy
22-Sep-01	72.1	6.41	Partly Cloudy
23-Sep-01	77.0	6.90	Partly Cloudy
24-Sep-01	72.3	10.22	Light Rain
25-Sep-01	67.4	11.97	Partly Cloudy
26-Sep-01	56.3	10.67	Partly Cloudy
27-Sep-01	60.9	9.29	Partly Cloudy
28-Sep-01	57.9	7.37	Partly Cloudy and then Rain
29-Sep-01	NA	NA	NA
30-Sep-01	53.7	15.80	Rain
1-Oct-01	55.1	11.36	Rain
2-Oct-01	61.0	4.22	Partly Cloudy
3-Oct-01	71.3	7.60	Partly Cloudy
4-Oct-01	75.3	10.28	Partly Cloudy
5-Oct-01	70.7	9.06	Clear
6-Oct-01	65.4	18.36	Partly Cloudy and then Rain
7-Oct-01	52.3	18.33	Partly Cloudy
8-Oct-01	46.6	12.66	Clear
9-Oct-01	54.3	7.37	Partly Cloudy
10-Oct-01	60.7	9.13	Partly Cloudy
11-Oct-01	65.9	8.34	Partly Cloudy
12-Oct-01	62.2	6.21	Clear
13-Oct-01	NA	NA	NA
14-Oct-01	NA	NA	NA
15-Oct-01	64.0	8.52	Clear
16-Oct-01	62.4	11.62	Partly Cloudy and then Rain
17-Oct-01	51.4	11.28	Partly Cloudy and then Rain
18-Oct-01	51.4	12.81	Partly Cloudy
19-Oct-01	54.8	9.11	Partly Cloudy
20-Oct-01	63.3	7.57	Partly Cloudy
21-Oct-01	64.2	10.24	Partly Cloudy
22-Oct-01	NA	NA	NA
23-Oct-01	60.5	8.63	Partly Cloudy

NA - Not available



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TREND SUMMARY

The trends described above are summarized in Table19.

Table 19. Target Compounds in Air - Trend Summary

Target Compound / Parameter	Location	Matrix	Dates	Trend
VOCs (except Freons)	WTC North Tower Center	Air	Sept 19 - Nov 13	Increasing
VOCs (except Freons)	WTC South Tower (Location 1)	Air	Sept 29 - Nov 13	Increasing
PAHs	Four (4) Lower Manhattan sites	Bulk Dust	Sept 11 - Oct 8	Increasing
Total PCBs	Four (4) Lower Manhattan sites	Air	Sept 16 - Oct 26	Decreasing
Metals	Three (3) Lower Manhattan sites	Air	Sept 23 - Oct 18	Decreasing
PM 10	Coast Guard Bldg Site 3	Air	Oct 1 - Oct 16	Decreasing
PM 2.5	Coast Guard Battery Park Rooftop	Air	Oct 1 - Oct 16	Decreasing
Asbestos	Lower Manhattan	Air	Sept 11 - Nov 2	Decreasing
Asbestos	Fresh Kills Landfill	Air	Sept 11 - Nov 2	Increasing



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SUMMARY OF INITIAL FINDINGS AND RECOMMENDED FOLLOW-UP

- Continuing removal activities and fires at the WTC sites may be contributing to high variability in VOC concentrations. Recent high values on November 7th and 8th suggest an increasing trend but are also indicative of spiking high concentrations which are followed by noticeably low values. Trends for VOCs at the WTC North and South Tower sites are not well defined.
- Outside the WTC work zones, VOC and other target analyte concentrations in air are low or not detected. Relatively few VOC air results, however, are available from sites off the WTC work areas.
- Lead, total PCBs, PM, and asbestos in air concentrations are decreasing at Lower Manhattan sites.
- Asbestos in air concentrations at the Landfill are increasing.
- Relatively high concentrations of CDD/CDF, PCBs, PAHs, and metals were detected in the bulk dust samples and few sample results have been reported since mid-October. The method of sampling for bulk dust, and the likelihood of future data to demonstrate trends, is unknown.
- Several fields in the database are inconsistently completed, including “Detect” status, the method used, the method detection limits, location and address information, and several others. Also, likely due to delays in obtaining fixed laboratory results, we have observed that some data are not entered until weeks after sample have been collection. These factors, which can influence the direction of specific analyte trends, add to the challenge of making appropriate data assessments.



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