

APPENDIX A

Sample Survey Forms

INFORMATION NEEDS FOR SAMPLES/SAMPLE LOCATIONS

This package of contains a series of forms designed to collect the relevant information for all of the samples taken at one particular building.

The following SECTIONS are included:

1. General information about the sampling event (page 3)
2. Information about the building the samples will be taken around and from (page 4-5)
3. Information for the sample taken outside of the building (page 6)
4. Information for the sample taken inside the building from a common area (page 7-8)
5. Information for each sample taken inside the building from residential Unit 1 (page 9-12)
6. Information for each sample taken inside the building from residential Unit 2 (page 13-16)
7. Site Sketches (outside sample on page 17, inside common area on page 18, residential unit 1 on page 19, and residential unit 2 on page 20).

Each sample must be associated with one form from SECTION 3, 4, or 5. The collection of samples from the building must be associated with the forms from both SECTIONS 1 and 2.

Page 2 of this package contains a checklist to be completed at the end of the sampling event. This checklist will be used to validate information collection.

Finally, use the supplied camera to take photos of the outside structure of the building, the outside sampled area, inside sampled residential unit 1 and inside sampled residential unit 2. Note the exposure number for each set on the final checklist.

FINAL CHECKLIST

Sample Location Site Sketches Completed on the appropriate page?	Y	N	
Include:			
Building location with respect to streets (include street names)			
Number building sides			
North arrow			
Location of building entrance(s)			
Location of broken windows			
Location of debris generated by WTC collapse or other conditions			
Location of outside sample			
Plan view location of inside sample(s) (include floor number)			
Location/description of other dust generating activities (e.g., construction, road work, traffic)			
Photos of Building Taken?	Y	N	
If yes, were photos taken of the			Exposure Range (e.g., 1-4)
Outside structure	Y	N	_____
Inside sampled residential unit1	Y	N	_____
Inside sampled residential unit2	Y	N	_____
Building number noted on camera	Y	N	_____
Camera number			_____
Total number of exposures for this sampling event			_____

SECTION 1. General Information About the Sampling Event

- A. Sampling Event Number _____
- B. Date of Sampling Event _____
- C. Names of Sampling Team Members _____

Weather Conditions:

- D. Expected Daytime High Temp. _____
- E. Average Wind Velocity **calm light moderate strong gusty**
- F. General Wind Direction **N NE E SE S SW W NW Variable**
- G. Rain During the Last 3 Days? **Y N**
 If yes, was the amount of rain in general **light moderate heavy**

SECTION 2. Information About the Building

Background Information

- A. Building Address _____
- B. Building Point of Contact
 Name _____
 Phone Number _____
 Relationship to Building (e.g., manager) _____
- C. Name of Building Owner _____
- D. Mailing Address of Building Owner

- E. Reason this building was selected for sampling?

Building Area/Characteristics Information

- F. Have neighboring streets been cleaned since the WTC collapse? **Y** **N** **Not Sure**
 If yes, date of last cleaning _____
- G. Total number of floors _____
- H. Is the entire building residential? **Y** **N** **Not Sure**
 If no, which floors have residential occupants?
 (ground floor=1) _____
- I. How many walk-in entrances to the building?
 (include entrances from parking areas) _____
- J. How many of these entrances are on - Side 1
 (see reference site sketch map) Side 2
 Side 3
 Side 4
 Other side (specify) _____

SECTION 3. Information for SAMPLE taken OUTSIDE of the building

A. Location number of Sampling Event _____

B. Side of building where sample was taken? (*see reference site sketch*)

Side 1 (_____)	Side 2	Side 3	Side 4	Other Side
-------------------	--------	--------	--------	------------

C. Is sample location (with sample number) shown on map?	Y	N
--	---	---

D. How far is the sample location from the building edge?	_____ (feet)
---	--------------

E. How far is the sample location from the nearest busy street?	_____ (feet)
---	--------------

F. Is there obvious evidence of WTC generated dust visible?		
On building	Y	N
On adjoining sidewalk	Y	N
On street near the building	Y	N
On roof	Y	N

**Not
Available
Applicable**

Have these areas been cleaned since WTC collapse?	Y	N
---	---	---

G. Are there dust generating activities in the area?		
Construction	Y	N
Road work	Y	N
Truck traffic	Y	N
Heavy car traffic	Y	N
Bus stop	Y	N

H. Is dust visible?		
In this area where dust sample will be gathered	Y	N
On the surface where the air sampler will be set-up	Y	N
In the air of this area	Y	N

I. For dust samples, estimate the size of the area sampled _____ (specify units)
If this information is included in the chain of custody form please skip this question.

SECTION 4. Information for SAMPLE taken inside the building from COMMON AREA

- A. Floor Number (ground floor = 1, basement = B) _____
- B. Type of Common Area
 _____ Stairwell _____ Lobby _____ Hallway _____ Other (describe)
- C. Are sample locations (with sample number) shown on map? **Y** **N**
- D. Is dust visible in this area? **Y** **N**
- E. Has the area where sample was obtained been cleaned since WTC event? **Y** **N**
Not Sure

If yes:

Date of last cleaning _____
 Who conducted cleaning?
 _____ Building owner
 _____ Tenant
 _____ Asbestos remediation contractor
 _____ Professional cleaning contractor
 _____ Private cleaning contractor
 Name and Contact Information for Contractor: _____

- F. How was this area cleaned?

_____ Wet mopping			
_____ Dusting			
_____ Sweeping	Broom	Vacuum	HEPA Vacuum
_____ Carpet cleaner			
_____ Curtains	Removed	Cleaned In Place	Cleaned and Rehung
_____ Furniture	Removed	Cleaned In Place	Cleaned and Returned

- G. How much dust was present in this area prior to cleaning?

Normal Amount	Slight Increase Over Normal	Moderate Increase Over Normal	Large Increase Over Normal
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- H. Has there been routine cleaning since the WTC collapse? **Y** **N** **Not Sure**

- I. If yes, how is this area routinely cleaned?

_____ Wet mopping			
_____ Dusting			
_____ Sweeping	Broom	Vacuum	HEPA Vacuum
_____ Carpet cleaner			

4. Information for SAMPLES taken inside the building from COMMON AREAS(continued)

- J. Were windows near the common area open during WTC collapse? **Y** **N** **Not Sure**

If yes, how many were open? _____

- K. Were windows near the common area broken during WTC collapse? **Y** **N** **Not Sure**

If yes, how many were broken? _____

How many windows are still broken? _____

L. Distance from sample location to closest broken/open window _____ (feet)
NA

M. Which side of the building is this window?
Side 1 Side 2 Side 3 Side 4 Other Side (_____)

N. Is there an HVAC system for the common area? **Y N Not Sure**
 (If No or Not Sure, skip to SECTION 5)

Is it separate from the building's HVAC system? **Y N Not Sure**
 (If No or Not Sure, skip to SECTION 5)

What type of filter is used? **High Efficiency Filter Regular Filter Not Sure**
 Filter Name _____
 Filter Size _____
 Filter Type _____ Paper _____ Electrostatic _____ Fiberglass _____ Other (describe)

Filter Efficiency Rating _____
 Has the filter been changed since the WTC collapse? **Y N Not Sure**
 If yes, date _____

Have the ducts been cleaned since the WTC collapse? **Y N Not Sure**
 If yes, date _____

Does system recycle air? **Y N Not Sure**
 If yes, what percent of the air is recycled? _____ % **Not Sure**

Has the system been recycling since the WTC collapse? **Y N Not Sure**

O. Has the HVAC system been **SERVICED** since the WTC collapse? **Y N Not Sure**
 If yes, date _____

P. Has the HVAC system been **CLEANED** since the WTC collapse? **Y N Not Sure**
 If yes, date _____

Q. Was the HVAC fan ON during the entire air sampling period? **Y N Not Sure**
 If NO, how long did the fan run (in hours)? _____ **hours Not Sure**

SECTION 5. Information for samples taken from RESIDENTIAL UNIT 1.

A. Point of Contact for Residential Unit 1

Name _____
 Address _____
 Phone Number _____

The following questions describe the characteristics of the area the listed samples were taken from.

B. Location of Floor Above Ground Level Number (ground floor = 1, basement = B) _____

C. Type of Residential Area Sampled

☐ Living Room	☐ Bedroom
☐ Dining Room	☐ Den/Office
☐ Kitchen	☐ Bathroom
☐ Hallway	☐ Other (please describe)

D. Are sample locations (with sample number) shown on map?	Y	N	
E. Is dust visible in this area?	Y	N	
F. Has area where sample was obtained been cleaned since WTC event?	Y	N	Not Sure

If yes:

Date of last cleaning _____

**Not
Sure**

Who conducted cleaning?

☐ Building owner
☐ Tenant
☐ Asbestos remediation contractor
☐ Professional cleaning contractor
☐ Private cleaning contractor

Name and Contact Information for Contractor:

G. How was this area cleaned?

☐ Wet mopping			
☐ Dusting			
☐ Sweeping	Broom	Vacuum	HEPA Vacuum
☐ Carpet cleaner			
☐ Curtains	Removed	Cleaned In Place	Cleaned and Replaced
☐ Furniture	Removed	Cleaned In Place	Cleaned and Replaced

SECTION 5. Information for samples taken from RESIDENTIAL UNIT 1 (continued)

H. How much dust was present in this area prior to cleaning?

Normal Amount	Slight Increase Over Normal	Moderate Increase Over Normal	Large Increase Over Normal
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I. Has there been routine cleaning since the WTC collapse? **Y** **N** **Not Sure**

J. If yes, how is this area routinely cleaned?

☐	Wet mopping			
☐	Dusting			
☐	Sweeping	Broom	Vacuum	HEPA Vacuum
☐	Carpet cleaner			

These next two questions refer to large appliances (dishwashers, refrigerator, washer/dryer, etc). If no appliances are present, please skip to question M.

K. How were appliances cleaned?

In Place	Replaced	Removed	Not Cleaned	Not Necessary to Clean
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L. How were the walls and floors near the appliances cleaned:

Wall Surfaces	Underlying Floor	Between Appliance and Walls	Not Necessary to Clean
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M. Were windows near the area open during WTC event?

Y **N** **Not Sure**

If yes, how many were open?

N. Were windows near the area broken during WTC event?

Y **N** **Not Sure**

If yes, how many were broken?

How many windows are still broken?

O. Distance from sample location to closest broken/open window

_____ (feet)
NA

P. Which side of the building is this window? (see reference site sketch map)

Side 1	Side 2	Side 3	Side 4	Other Side
(_____)				

SECTION 5. Information for samples taken from RESIDENTIAL UNIT 1 (continued)

Q. Is this unit currently occupied? Y N

Is there a **separate** HVAC system for this residential unit? Y N

Is there a **significant** amount of dust that would preclude aggressive sampling? Y N

*Recommend: Aggressive sampling for unoccupied residential units that have their own HVAC and **DO NOT** have a significant amount of dust.*

R. Did this unit meet the criteria to be aggressively sampled? Y N

If **YES**, was this unit aggressively sampled? Y N

If this unit met the criteria for aggressive sampling and was not aggressively sampled, why not?

If this unit does not have it's own HVAC system, please skip to question W.

S. What type of filter is used?	High Efficiency Filter	Regular Filter	Not Sure
Filter Name _____			
Filter Size _____			
Filter Type _____	_____ Paper _____ Electrostatic	_____ Fiberglass	_____ Other (describe)
Filter Efficiency Rating _____			
Has the filter been changed since the WTC collapse?	Y	N	Not Sure
If yes, date _____			
Have the ducts been cleaned since the WTC collapse?	Y	N	Not Sure
If yes, date _____			
Does the system recycle air?	Y	N	Not Sure
If yes, what percent of the air is recycled?			% Not Sure
Has the system been recycling since the WTC collapse?	Y	N	Not Sure
T. Has the HVAC system been SERVICED since the WTC collapse?	Y	N	Not Sure
If yes, date _____			
U. Has the HVAC system been CLEANED since the WTC collapse?	Y	N	Not Sure
If yes, date _____			
V. Was the HVAC fan ON during the entire air sampling period	Y	N	Not Sure
If NO, how long did the fan run (in hours)? _____ hours			

W. Do any residents or frequent visitors smoke in this unit?	Y	N	Not Sure	
X. Residential Activities	During Sampling		Previous 24 hours	
Smoke?	Y	N	Y	N
Use Stove?	Y	N	Y	N
Use Oven?	Y	N	Y	N
If use either, were these	Gas	Electric	Gas	Electric
Was the exhaust fan on?	Y	N	Y	N
Use the dishwasher?	Y	N	Y	N
Have a Fire in the Fireplace/Wood Stove?	Y	N	Y	N
Clean?	Y	N	Y	N
Vacuum?	Y	N	Y	N
Burn Candles or Incense, etc.?	Y	N	Y	N
Open Windows?	Y	N	Y	N
Children playing near the equipment?	Y	N	—	—
Y. Window position change from the start of sampling?	Opened	Closed	No Change	
Z. How much activity occurred in the sampled room?	None	Occasional	Frequent	
		walk by equipment	movement	

SECTION 5. Information for samples taken from RESIDENTIAL UNIT 1.

B. Point of Contact for Residential Unit 1

Name _____
 Address _____
 Phone Number _____

The following questions describe the characteristics of the area the listed samples were taken from.

B. Location of Floor Above Ground Level Number (ground floor = 1, basement = B) _____

C. Type of Residential Area Sampled

☐ Living Room	☐ Bedroom
☐ Dining Room	☐ Den/Office
☐ Kitchen	☐ Bathroom
☐ Hallway	☐ Other (please describe)

D. Are sample locations (with sample number) shown on map on page 19? Y N

E. Is dust visible in this area? Y N

F. Has area where sample was obtained been cleaned since WTC event? Y N Not Sure

If yes:

Date of last cleaning _____

**Not
Sure**

Who conducted cleaning?

☐ Building owner
☐ Tenant
☐ Asbestos remediation contractor
☐ Professional cleaning contractor
☐ Private cleaning contractor
 Name and Contact Information for Contractor:

G. How was this area cleaned?

☐ Wet mopping			
☐ Dusting			
☐ Sweeping	Broom	Vacuum	HEPA Vacuum
☐ Carpet cleaner			
☐ Curtains	Removed	Cleaned In Place	Cleaned and Replaced
☐ Furniture	Removed	Cleaned In Place	Cleaned and Replaced

SECTION 5. Information for samples taken from RESIDENTIAL UNIT 1 (continued)

H. How much dust was present in this area prior to cleaning?

Normal Amount	Slight Increase Over Normal	Moderate Increase Over Normal	Large Increase Over Normal
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I. Has there been routine cleaning since the WTC collapse? **Y** **N** **Not Sure**

J. If yes, how is this area routinely cleaned?

☐	Wet mopping			
☐	Dusting			
☐	Sweeping	Broom	Vacuum	HEPA Vacuum
☐	Carpet cleaner			

These next two questions refer to large appliances (dishwashers, refrigerator, washer/dryer, etc). If no appliances are present, please skip to question M.

K. How were appliances cleaned?

In Place	Replaced	Removed	Not Cleaned	Not Necessary to Clean
-----------------	-----------------	----------------	--------------------	-------------------------------

L. How were the walls and floors near the appliances cleaned:

Wall Surfaces	Underlying Floor	Between Appliance and Walls	Not Necessary to Clean
----------------------	-------------------------	------------------------------------	-------------------------------

M. Were windows near the area open during WTC event?

Y **N** **Not Sure**

If yes, how many were open?

N. Were windows near the area broken during WTC event?

Y **N** **Not Sure**

If yes, how many were broken?

How many windows are still broken?

O. Distance from sample location to closest broken/open window

_____ (feet)
NA

P. Which side of the building is this window? (see reference site sketch map)

Side 1	Side 2	Side 3	Side 4	Other Side
---------------	---------------	---------------	---------------	-------------------

(_____)

SECTION 5. Information for samples taken from RESIDENTIAL UNIT 1 (continued)

Q. Is this unit currently occupied? Y N

Is there a **separate** HVAC system for this residential unit? Y N

Is there a **significant** amount of dust that would preclude aggressive sampling? Y N

*Recommend: Aggressive sampling for unoccupied residential units that have their own HVAC and **DO NOT** have a significant amount of dust.*

R. Did this unit meet the criteriato be aggressively sampled? Y N

If **YES**, was this unit aggressively sampled? Y N

If this unit met the criteria for aggressive sampling and was not aggressively sampled, why not?

If this unit does not have it's own HVAC system, please skip to question W.

S. What type of filter is used? High Efficiency Filter	Regular Filter	Not Sure
Filter Name _____		
Filter Size _____		
Filter Type _____ Paper _____ Electrostatic	_____ Fiberglass	_____ Other (describe)
Filter Efficiency Rating _____		
Has the filter been changed since the WTC collapse? If yes, date _____	Y N	Not Sure
Have the ducts been cleaned since the WTC collapse? If yes, date _____	Y N	Not Sure
Does the system recycle air? If yes, what percent of the air is recycled? _____ %	Y N	Not Sure
Has the system been recycling since the WTC collapse?	Y N	Not Sure
T. Has the HVAC system been SERVICED since the WTC collapse? If yes, date _____	Y N	Not Sure
U. Has the HVAC system been CLEANED since the WTC collapse? If yes, date _____	Y N	Not Sure
V. Was the HVAC fan ON during the entire air sampling period If NO, how long did the fan run (in hours)? _____ hours	Y N	Not Sure

W. Do any residents or frequent visitors smoke in this unit?	Y	N	Not Sure	
X. Residential Activities	During Sampling		Previous 24 hours	
Smoke?	Y	N	Y	N
Use Stove?	Y	N	Y	N
Use Oven?	Y	N	Y	N
If use either, were these	Gas	Electric	Gas	Electric
Was the exhaust fan on?	Y	N	Y	N
Use the dishwasher?	Y	N	Y	N
Have a Fire in the Fireplace/Wood Stove?	Y	N	Y	N
Clean?	Y	N	Y	N
Vacuum?	Y	N	Y	N
Burn Candles or Incense, etc.?	Y	N	Y	N
Open Windows?	Y	N	Y	N
Children playing near the equipment?	Y	N	-	-
Y. Window position change from the start of sampling?	Opened	Closed	No Change	
Z. How much activity occurred in the sampled room?	None	Occasional	Frequent	
		walk by equipment	movement	

OUTSIDE SAMPLE LOCATION SITE SKETCH

INSIDE SAMPLE LOCATION SITE SKETCH- Common Area

INSIDE SAMPLE LOCATION SITE SKETCH- RESIDENTIAL UNIT 1

INSIDE SAMPLE LOCATION SITE SKETCH - RESIDENTIAL UNIT 2

APPENDIX B

Screening Guidelines/Recommendations

Screening Guidelines/Recommendations

The screening guidelines that follow were developed for use in interpreting the results of the sampling effort. If contaminants are below screening guidelines, further health evaluation of the data is not necessary. If guidelines are exceeded, additional review of the data and the sample collection circumstances is necessary. If a guideline is exceeded, it does not automatically indicate that a health concern exists.

ASBESTOS

Interpretation of bulk and air samples: The following table provides a general guide for determining public health actions based upon sampling of both bulk material and indoor air. The table integrates the Environmental Assessment Workgroup multi-agency recommendations for reoccupation of residences in lower Manhattan (see attachment 1). It is important to note that the ultimate decision criteria for reoccupation is the ambient air level of asbestos. Bulk asbestos determinations are useful for (1) determining the potential for decontaminating ambient air and (2) for determining the type of further sampling needed.

In general the sampling and resampling strategy encompasses testing of bulk material and clean up until such a time that further clean up will not lower bulk asbestos levels. Confirmation is made by air sampling; reoccupation of residents is acceptable below 0.01 f / cc.

ATSDR, with multi-agency concurrence, has provided guidance for re-entry into New York City buildings and has concluded that the 0.1 f/cc OSHA PEL is not acceptable for schools or residences (see attachment 1 ATSDR, CDC, EPA, OSHA Environmental Assessment Workgroup Asbestos Action Levels for World Trade Center Response October 11, 2001).

FINAL (October 11, 2001) ATSDR, CDC, EPA, OSHA Environmental Assessment Workgroup Asbestos Action Levels for World Trade Center Response			
Action Level & Analysis Method	General Public/Recommendations	Supporting Information ²	Comments
NYC Background ³ PCM/PCMe ⁴ f/cc (see footnotes 2 and 3)	No restriction on access to any area.	AHERA standards (40 CFR 763); ATSDR Toxicological Profile for Asbestos; OSHA 29 CFR 1926.1101	- Remediation goal is to achieve background levels. - AHERA guidance for schools requires that when schools are remediated for asbestos, the indoor air levels of asbestos should be similar to local outdoor air levels. - Lowest attainable cancer risk
NYC Background to 0.01 f/cc PCM/PCMe ³	- No restriction on access to streets and public/commercial building; continue to monitor - Evaluate to determine if long-term access is acceptable; evaluate trends over months. - Identify source - Take action, as practical, to reduce levels to background	AHERA standards (40 CFR 763); ATSDR Toxicological Profile for Asbestos; IRIS; OSHA 29 CFR 1926.1101	- No significant cancer risk for short-term occupancy for residential and school buildings. - AHERA guidance for schools requires that when schools are remediated for asbestos, the indoor air levels of asbestos should be similar to local outdoor air levels

Respirable Particulate $PM_{4.0}^7$		
60	● Compare results to representative background.** ● Use for evaluation of outdoor contribution to indoor concentrations ● Identify meteorological conditions and factors such as road traffic during sampling.⁴	● Compare results to representative background.** ● Evaluate multiple source contributions (WTC, outdoor, indoor) ● Review pre-sampling questionnaire responses.
Thoracic Particulate 24 hour PM_{10}^1		

155	● Compare results to representative background.** ● Identify meteorological conditions and factors such as road traffic during sampling. ● Use for evaluation of outdoor contribution to indoor concentrations ● Compare to DEC monitors	● Compare results to representative background.** ● Review pre-sampling questionnaire responses. ● Evaluate multiple source contributions (WTC, outdoor, indoor activities cooking ⁵, cleaning,...). ● Assess ventilation systems (heating and cooling). ● Recommend proper clean-up techniques be employed. ● Consider re-sampling and evaluate nearby residences/common areas.
Inhalable Particulate 24 hour TSP ²		
250	● Compare results to representative background.** ● Identify meteorologic conditions, activities such as road traffic or construction activities during sampling. ● Assess the need for dust suppression procedures.	● Compare results to representative background.** ● Assess ventilation systems (heating and cooling). ● Consider evaluating with modification to occupational standards. ⁶ ● Recommend proper clean-up techniques be employed. ● Consider re-sampling after clean-up has occurred.

** As sampled in "Ambient and Indoor Sampling for Public Health Evaluations of Residential Areas Near WTC."

¹ National Ambient Air Quality Standard (NAAQS)

² Total Suspended Particulates, New York State Ambient Air Quality Standard

³ The range of ratios reported in the 1996 and 2001 draft Ambient Air Criteria Documents for Indoor and Outdoor concentrations of PM_{2.5} could be used to select a multiplier to be applied to the area level of concern. While estimates (from a limited number of studies) range from slightly less than one, to two (higher if smoking

pH Guidelines

The pH of a substance represents the hydrogen ion concentration of the substance. The range of pH values is generally from 0 to 14 with 7 being considered a neutral pH. Substances with a pH of less than 7 are considered to be acidic and will yield hydrogen ions when they are in solution. Acids will change litmus paper red. A base is a substance with a pH greater than 7 and will yield hydroxyl ions in solution. Bases will react with acids to form salts and water. In the body, a normal balance between acids and bases is maintained that keeps the extracellular fluids in the body with a pH between 7.35 and 7.45. A pH out of this range indicates a state of acidosis or alkalosis. Regulation of the pH in the body depends on the function of the lungs and the kidneys.

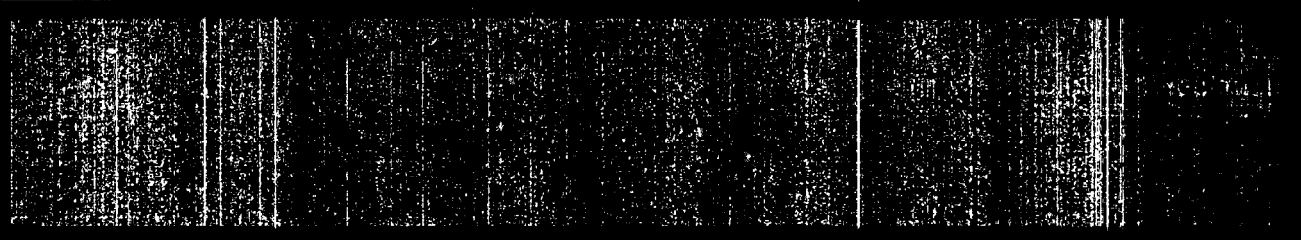
Guidelines for the interpretation of the pH values of the dust samples being proposed are included in this plan to assist in defining what role if any that the pH may be in the irritant properties of the dust. An irritant effect is one where the tissue has been stimulated and responds with a reversible inflammatory response. Common symptoms from exposure to an irritant are cough, burning of eyes, nose, & throat, tearing, dyspnea, and wheezing.

There are very few standards for the regulation of the pH of a substance. The national Secondary Drinking water standards set the pH range at 6.5 - 8.5. EPA has established guidelines for the testing of the acute dermal irritation and the acute eye irritation properties of substances. Those guidelines state that it is not necessary to test substances with a pH of less than 2.0 or greater than 11.5 as they are known to be corrosive. A corrosive is a highly reactive substance that causes irreversible damage to living tissue after less than 4 hours of exposure. Using this information as a basis, the following guide is proposed:

0 - 2.0	Strongly acidic	Corrosive
>2.0 - 6.5	Weakly acidic	Irritant
>6.5 - 8.5	Neutral	
>8.5 - 11.5	Weakly basic	Irritant
>11.5	Strongly basic	Corrosive

To put these levels into perspective, the pH of some common substances is included below.

Gastric Juice	1.4

Lemon Juice	2.4
Vinegar	3.0
Tomatoes	4.2
Rain	5.5
	
Household Ammonia	11.5
Household Bleach	12.5

Avaltroni, Robert
From: Kelpin, Gerry
Sent: Wednesday, February 13, 2002 1:15 PM
To: Gilsenan, Michael; Avaltroni, Robert
Cc: Nudelman, Harold
Subject: FW: [OEM] UC-Davis: WTC Particulates "Unprecedented"

*Important!
 Reference point
 for Tom Friedman
 DOT Commission
 and Mayor Bloomberg.
 Bob A
 2/13*

I'm sure we will be hearing more on this. At this point, only FYI.

—Original Message—

From: Data WTC [mailto:wtcdata@gw.dec.state.ny.us]
Sent: Wednesday, February 13, 2002 11:54 AM
To: amirpat@aol.com; kmw2@cdc.gov; sneurath@cdc.gov; SRodenbeck@cdc.gov;
 FoxJ@coned.com; adamsr@ddc.nyc.gov; gerryk@dep.nyc.gov; cherasard-paul@dol.gov;
 Garvey-Robert@dol.gov;

Group.Enviromail@epamail.epa.gov; Mintz.David@epamail.epa.gov;
 turpin.rod@epamail.epa.gov; Carl Johnson; Dave Shaw; David O'Toole;

Edwin Dassatti; Gerald Barnhart; Georgene Luft; Italo Carcich; Mike Murray; Jennifer Rommel;
 James Tuffey; Karen Chytalo; Larry Enoch; Larry Skinner; Neil Isabelle; Phil Galvin; Philip
 DeGaetano; Paul Counterman;

Robert Warland; SiuHong Mo; Susan Taluto; Thomas Kunkel; Tom Gentile;
 cbragdon@health.nyc.gov; jleight@health.nyc.gov;
 jprudhom@health.nyc.gov; kcarlino@health.nyc.gov;
 mperrin@health.nyc.gov; akg02@health.state.ny.us;
 gac01@health.state.ny.us; jah18@health.state.ny.us;
 mal03@health.state.ny.us; mpm08@health.state.ny.us;
 nkk01@health.state.ny.us; rjw03@health.state.ny.us;
 rlc07@health.state.ny.us; rpd04@health.state.ny.us;
 smb02@health.state.ny.us; tot01@health.state.ny.us;

PII

jharrison@iuoeietc.org; ageyh@jhsph.edu; jocj3@ny.ngb.army.mil;
 tmatte@nyam.org; gkelpin@nysnet.net; maureen.cox@osha.gov;
 norman.labbe@osha.gov; tanya.ross@osha.gov; DEisenhardt@psc.gov;
 envmonrpts@sdm-moses.com; mossm@sdm-moses.com; opsdmna@semo.state.ny.us;
 qed@westnet.com; DOHeocDesk@yahoo.com; epa_eoc@yahoo.com

Cc: Jeff Lindell; Matt Darcangelo
Subject: FW: [OEM] UC-Davis: WTC Particulates "Unprecedented"

FYI

—Original Message—

From: Rodenbeck, Sven
Sent: Wednesday, February 13, 2002 8:35 AM
To: Lam, Penny
Subject: FW: [OEM] UC-Davis: WTC Particulates "Unprecedented"
Importance: High

Penny,

Please forward this information to the WTC Environmental Assessment Workgroup members.

Thank you!!!

Sven

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**Trade Center Air Held Unprecedented Amounts of Very Fine Particles,
Silicon, Sulfates, Metals, Say UC Davis Scientists**

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February 11, 2002

In the most thorough analysis yet of the dust and smoke blown through lower Manhattan after the collapse of the World Trade Center, researchers at the University of California, Davis, today described unprecedented clouds of very fine particles that should be considered in evaluating rescue workers' and residents' health problems.

Based on their findings, the UC Davis researchers also recommended specific cleaning methods for contaminated apartments, offices, schools and other indoor spaces.

"No one has ever reported a situation like the one we see in the World Trade Center samples," said UC Davis researcher Thomas Cahill, Ph.D., an international authority on the constituents and transport of airborne particles. "The air from Ground Zero was laden with extremely high amounts of very small particles, probably associated with high temperatures in the underground debris pile. Normally, in New York City and in most of the world, situations like this just don't exist."

Cahill, a UC Davis professor emeritus of physics and atmospheric sciences and a research professor in applied science, heads the UC Davis DELTA Group (for Detection and Evaluation of Long-range Transport of Aerosols), a collaborative association of aerosol scientists at several universities and national laboratories. The DELTA Group has made detailed studies of aerosols from the 1991 Gulf War oil fires, volcanic eruptions, global dust storms, and most recently Asia.

The Manhattan air samples were collected at the request of a U.S. Department of Energy scientist from Oct. 2 through mid-December, by a DELTA Group air monitor placed on a rooftop at 201 Varick St., one mile north-northeast of the trade center complex.

The samples were collected continuously in eight separate size modes from coarse (12 micrometers diameter) to ultra-fine (0.09 micrometer diameter). Regional meteorology showed that the site at Varick Street could have received material from the World Trade Center site about half the time.

The samples were periodically shipped back to Davis, where the DELTA Group analyzed the samples for size, shape and composition. They used a suite of seven techniques including synchrotron-induced X-ray fluorescence (at DOE's Advanced Light Source at Lawrence Berkeley Laboratory), scanning transmission ion microscopy and proton elastic scattering analysis (at DOE's Lawrence Livermore National Laboratory), and soft beta mass measurements and scanning electron microscopy (at UC Davis).

"The UC Davis DELTA Group's ability to measure and analyze particle size, composition and time continuously, day and night, is unequalled," Cahill said.

All analyses were done on a volunteer basis and will be available as public documents. We report today on the data from Oct. 2 through Oct. 31, 2001.

Airborne particles and human health

In general, there are myriad ways that materials released into the air can affect human health. What the particles are made of matters; so do size, shape and quantity.

The DELTA team analyzed the samples for the unique chemical and physical signatures of dozens of substances, including elements from concrete and glass, such as silicon; from burning fuel oil, such as sulfur, vanadium and nickel; and from burning computers and electrical systems, such as lead. They also looked for organic, or carbon-based, compounds from burning wood, plastic and carpets. And they tested for glass shards and asbestos.

Some of these materials are known to cause health problems in some people when they are inhaled in sufficient amounts. Sulfur, for example, can irritate lung tissues. Lead can damage the central nervous system. Some carbon-based compounds can cause cancer. So can the mineral asbestos.

Just as the composition of inhaled particles can affect health, so can size.

The team analyzed the particles by size in eight ranges from coarse (12 micrometers to 5 micrometers in diameter) to very fine (0.24 micrometers to 0.09 micrometers in diameter). Most of the ultrafine mode (particles less than 0.1 micrometers) was not collected.

Coarse particles are typically filtered by the nose or coughed out of the throat and upper lungs. They can irritate the mucous membranes, causing coughs and nosebleeds. In some individuals, they can cause allergic reactions such as dry eyes; nose, throat and skin irritation; coughing, sneezing and respiratory distress. They can also cause breathing problems or aggravate pre-existing breathing problems, such as asthma.

However, very fine particles can travel deep into human lungs. Such small particles may have no immediate apparent health effects in moderate concentrations, but they typically are removed from the lungs through the bloodstream and heart, increasing the possibility of health impacts.

There are no established safe limits for inhaled very fine particles. The closest reference is the U.S. EPA "PM2.5" standard, which limits the allowable mass of airborne particles in the size range 2.5 micrometers to 0 micrometers. That standard is based on health studies of typical air samples, in which very fine particles are a small fraction of the total mass.

In contrast, in the World Trade Center samples analyzed at UC Davis, the very fine particles are a large fraction of the total mass.

In a news conference today, the DELTA researchers described key findings in these categories: very fine particles, coarse particles, metals, asbestos and glass.

Very fine particles

There were numerous events when bursts of wind lasting six to eight hours carried unprecedented amounts of very fine particles to the sampling site.

In the largest spike, the DELTA Group analysis found 58 micrograms per cubic meter of very fine particles in one 45-minute period—"an extremely high peak," Cahill said.

Cahill said the very fine particles contained high levels of sulfur and sulfur-based compounds, which in early analyses appear to have been contaminated by sulfuric acid. The very fine particles also contain high levels of very fine silicon, potentially from the thousands of tons of glass in the debris.

Cahill noted that even those large amounts were likely to be smaller than those present at Ground Zero and some other parts of Lower Manhattan, since weather data show that typically only part of the dust clouds traveled directly over the sampling site.

"Even on the worst air days in Beijing, downwind from coal-fired power plants, or in the Kuwaiti oil fires, we did not see these levels of very fine particulates," Cahill said. The amounts of very fine particles, particularly very fine silicon, decreased sharply during the month of October.

Coarse particles

Similar to the high concentrations of very fine particles, virtually all the air samples from the trade center site carried high concentrations of coarse particles—those about 12 micrometers to 5 micrometers in diameter.

"These particles simply should not be there," Cahill said. "It had rained, sometimes heavily, on six days in the prior three weeks. That rain should have settled these coarse particles." The finding suggests that coarse particles were being continually generated from the hot debris pile. This observation is at least qualitatively supported, for while they are still being analyzed, the coarse particles appear to be coated with combustion products, including soot, Cahill said.

Metals

Many different metals were found in the samples of very fine particles, and some were found at the highest levels ever recorded in air in the United States.

However, there are few established safety guidelines for airborne metals. One metal for which there is a guideline, lead, was present at low levels in fine and very fine particles.

Some of the metals for which there are no guidelines that were present in very fine particles in relatively high concentrations were iron, titanium (some associated with powdered concrete), vanadium and nickel (often associated with fuel-oil combustion), copper and zinc. Mercury was seen occasionally in fine particles but at low concentrations. Many of those metals are widely used in building construction, wiring and plumbing. Some are common in computers.

The metal content of the coarse particles is still being analyzed.

Asbestos and glass

Although some asbestos was used in the buildings for fireproofing and in floor tiles, and the DELTA group checked for it carefully using the electron microscope, they found very few asbestos fibers, even in the very fine particles.

Some particles that appeared to be glass were seen, but they were not in the form of long shards, which can mimic asbestos fibers.

Clean-up recommendations

All evidence indicates that ambient air in New York City now is little influenced by the World Trade Center collapse, especially since the fires are out and the debris pile has cooled.

However, the presence of large amounts of very fine particles as late as October means that indoor clean up should be done carefully, Cahill said. Very fine particles will have penetrated crevices and fabrics in a way normal dust doesn't. And they are easily re-suspended, which re-exposes the room's occupants to them.

Cahill strongly supports the recommendations made by the New York Department of Health regarding washing with water, and said:

- Don't use vacuum cleaners or brooms because they re-suspend particles. Do use wet rags, mops and wet-vacuum-type cleaners.
- Wipe all surfaces, including window blinds, picture tops and door frames, with wet rags.
- Drapes and curtains should be washed or dry-cleaned. Furniture fabrics should be steam-cleaned. Carpets should be wet-cleaned.
- Use high efficiency electrostatic or HEPA air filters in furnaces and air conditioners.
- Keep humidity reasonably high indoors, to keep very fine particles from floating around.

UC Davis DELTA Group

The UC Davis DELTA Group is one of the world's leading research groups in analyzing the size, composition and movement of airborne particles. DELTA Group scientists analyzing the trade center samples included Cahill; engineering professor James Shackelford, Ph.D., who led the scanning electron microscopy; chemistry professor Peter Kelly, Ph.D. who led the mass spectroscopy; assistant research engineer Steve Cliff, Ph.D., who is project manager for the synchrotron program, and laboratory and field manager Michael Jimenez-Cruz, toxicologist.

Key collaborators from other institutions were Kevin Perry, Ph.D., a former Cahill postdoctoral collaborator and now an assistant professor of meteorology at the University of Utah, Salt Lake City; Graham Bench, Ph.D., a project investigator at the Center for Accelerator Mass Spectroscopy, U.S. Department of Energy's Lawrence Livermore National Laboratory, and his team of scientists; and Jodye Selco, Ph.D., a visiting professor at UC Davis and a professor of chemistry at the University of Redlands, Redlands, California.

The DELTA Group's many previous research projects include studies of the smoke from the Kuwaiti oil fires and two international ACE studies (for Aerosol Characterization Experiment), which are designed to shed light on the roles of aerosols in global weather, water pollution and human disease. The most recent, ACE-Asia, operated under National Science Foundation funding with 21 aerosol-sampling sites from Asia to western North America from March through August 2001.

DELTA Group currently is continuing analyses of the 2001 ACE samples, as well as studies of Alaskan air quality, the nature of diesel-vehicle exhaust, the impacts of air pollution on human health in California's great Central Valley, and the environmental health of the Lake Tahoe Basin.

For more information, visit the DELTA Web site at:

<http://delta.ucdavis.edu>.

The University of California, Davis, is one of the world's leading institutions in the environmental sciences. More than 250 faculty members support an unmatched array of environmental programs in human and animal health, agriculture, biological sciences, engineering, physical sciences, law, social sciences, literature and the arts.

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Results of Fiber Analyses

Results of fiber analyses in air and dust samples from 30 residential buildings (1–30) in lower Manhattan and 4 comparison buildings (31–34) above 59th Street. The range of values measured in the comparison buildings is shown in the summary of comparison areas above 59th Street.

Building Number	Sample Location	Results From Air Samples			Results From Dust Samples		
		Fibers in Air PCM (f/cc)	Asbestos in Air TEM (f/cc)	SVF in Air SEM (f/cc)	Asbestos in Dust PLM (%)	Asbestos in Dust TEM (%)	SVF in Dust PLM (%)
Summary of Comparison Areas Above 59th Street							
	Outside	<.001–0.001	NA	ND–<.000043	Not Sampled	Not Sampled	Not Sampled
	Common	<.001–0.002	NA	ND–0.000043	ND	ND	ND
	Residences	<.001–0.003	NA	ND–0.000087	ND	ND	ND
Results for Individual Buildings Sampled in Lower Manhattan (Buildings 1–30)							
1	Outside	0.001			ND	<1	22
1	Common	<.001			Not Sampled	Not Sampled	Not Sampled
1	Residence 1	0.006	<.001	0.000162	ND	NA	20
1	Residence 2	<.001			ND	NA	20
2	Outside	0.003			<1	1.2	28
2	Outside co-located	Not Sampled	Not Sampled	Not Sampled	1.3	NA	25
2	Common	0.005	<.001	0.000255	ND	NA	27
2	Residence 1	<.001			ND	NA	25
2	Residence 2	0.002			ND	NA	20
2	Window sill	Not Sampled	Not Sampled	Not Sampled	<1	<1	30
3	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
3	Res 2 co-located	<.001			Not Sampled	Not Sampled	Not Sampled
3	Common	<.001			Not Sampled	Not Sampled	Not Sampled
3	Residence 1	<.001			Not Sampled	Not Sampled	Not Sampled
3	Residence 2	<.001			Not Sampled	Not Sampled	Not Sampled
4	Outside	0.001			Not Sampled	Not Sampled	Not Sampled
4	Outside co-located	<.001			Not Sampled	Not Sampled	Not Sampled
4	Common	0.001			ND	<1	15
4	Common co-located	0.001			Not Sampled	Not Sampled	Not Sampled
4	Residence 1	<.001			ND	<1	2
4	Residence 2	0.001			ND	<1	5
5	Outside	0.002			3.4	NA	25

Appendix C. Detailed Analytic Results

Building Number	Sample Location	Results From Air Samples			Results From Dust Samples		
		Fibers In Air PCM (f/cc)	Asbestos In Air TEM (f/cc)	SVF In Air SEM (f/cc)	Asbestos In Dust PLM (%)	Asbestos In Dust TEM (%)	SVF In Dust PLM (%)
5	Outside co-located	0.003			Not Sampled	Not Sampled	Not Sampled
5	Common	0.002			Not Sampled	Not Sampled	Not Sampled
5	Residence 1	0.002			<1	<1	10
5	Residence 2	<.001			ND	<1	20
6	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
6	Common	<.001			ND	<1	10
6	Res 2 co-located	0.002			Not Sampled	Not Sampled	Not Sampled
6	Residence 1	<.001			ND	ND	15
6	Residence 2	<.001			ND	ND	15
7	Outside	<.001			ND	1.7	35
7	Common	0.001			ND	ND	5
7	Residence 1	0.001			ND	ND	ND
7	Residence 2	<.001			ND	ND	5
7	Window sill (R2)	Not Sampled	Not Sampled	Not Sampled	ND	ND	40
8	Outside	0.001			Not Sampled	Not Sampled	Not Sampled
8	Common	0.002			ND	ND	ND
8	Residence 1	0.003			ND	ND	ND
8	Residence 2	0.002			ND	ND	ND
9	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
9	Common	0.001			ND	ND	7
9	Common co-located	0.001			Not Sampled	Not Sampled	Not Sampled
9	Residence 1	0.001			ND	<1	2
9	Residence 2	0.003			ND	<1	5
10	Outside	0.001			ND	ND	ND
10	Common	0.002			ND	1.5	20
10	Common, TEM re-analysis					<1	
10	Residence 1	0.001			ND	ND	15
10	Residence 2	0.001			ND	ND	10
11	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
11	Common	<.001			ND	ND	ND
11	Common co-located	<.001			Not Sampled	Not Sampled	Not Sampled
11	Residence 1	<.001			ND	<1	ND
11	Residence 2	<.001			ND	1.5	ND
12	Outside	<.001			Not Sampled	Not Sampled	Not Sampled

Building Number	Sample Location	Results From Air Samples			Results From Dust Samples		
		Fibers in Air PCM (f/cc)	Asbestos in Air TEM (f/cc)	SVF in Air SEM (f/cc)	Asbestos in Dust PLM (%)	Asbestos in Dust TEM (%)	SVF in Dust PLM (%)
12	Common	<.001			ND	ND	ND
12	Residence 1	0.001			ND	ND	5
12	Residence 2	<.001			ND	ND	5
13	Outside	0.001			Not Sampled	Not Sampled	Not Sampled
13	Common	0.001			ND	ND	ND
13	Residence 1	0.003			ND	ND	10
13	Residence 2	0.002			ND	ND	ND
14	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
14	Common	0.0013			ND	ND	5
14	Residence 1	0.001			ND	ND	ND
14	Res 1 co-located	<.001			Not Sampled	Not Sampled	Not Sampled
14	Residence 2	<.001			ND	ND	ND
15	Outside	<.001			ND	1.9	72
15	Common	0.001			ND	ND	ND
15	Residence 1	<.001			ND	<1	ND
15	Residence 2	<.001			ND	ND	5
16	Outside	<.001			ND	ND	1
16	Common	<.001			ND	ND	ND
16	Residence 1	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
16	Residence 2	<.001			ND	ND	ND
16	Res 2 co-located	Not Sampled	Not Sampled	Not Sampled	ND	NA	ND
16	Res 2 filter piece	Not Sampled	Not Sampled	Not Sampled	ND	NA	ND
17	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
17	Common	<.001			ND	ND	2
17	Residence 1	<.001			ND	ND	ND
17	Residence 2	<.001			ND	ND	ND
18	Outside	<.001			ND	ND	30
18	Common	<.001			ND	ND	ND
18	Residence 1	0.002			ND	ND	30
18	Residence 2	0.002			ND	ND	35

Building Number	Sample Location	Results From Air Samples			Results From Dust Samples		
		Fibers in Air PCM (f/cc)	Asbestos in Air TEM (f/cc)	SVF in Air SEM (f/cc)	Asbestos in Dust PLM (%)	Asbestos in Dust TEM (%)	SVF in Dust PLM (%)
19	Outside	<.001			ND	NA	ND
19	Common	overloaded	<.006		ND	ND	ND
19	Residence 1	<.001			ND	ND	ND
19	Residence 2	<.001			ND	ND	ND
20	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
20	Outside co-located	<.001			Not Sampled	Not Sampled	Not Sampled
20	Common	<.001			ND	ND	ND
20	Residence 1	<.001			ND	ND	ND
20	Residence 2	<.001			ND	ND	ND
21	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
21	Common	<.001			ND	ND	ND
21	Residence 1	<.001			ND	ND	ND
21	Residence 2	<.001			ND	ND	ND
22	Outside	<.001			ND	ND	7
22	Common	0.001			ND	ND	3
22	Residence 1	<.001			ND	ND	2
22	Residence 2	<.001			ND	ND	ND
22	Res 2 co-located	<.001			Not Sampled	Not Sampled	Not Sampled
23	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
23	Common	<.001			ND	ND	ND
23	Residence 1	<.001			ND	ND	ND
23	Residence 2	<.001			ND	ND	ND
24	Outside	0.002			ND	ND	55
24	Common	0.001			ND	<1	5
24	Residence 1	0.001			ND	ND	ND
24	Residence 2	0.005	<.001	0.000037	ND	ND	10
24	Res 2 co-located	0.005	<.001		Not Sampled	Not Sampled	Not Sampled
25	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
25	Common	<.001			ND	ND	5
25	Residence 1	<.001			ND	ND	5
25	Residence 2	0.001			ND	ND	ND
26	Outside	0.001			Not Sampled	Not Sampled	Not Sampled
26	Common	0.004	<.001	<0.00004	ND	ND	5
26	Residence 1	0.012	<.001	<0.00004	ND	ND	ND

Building Number	Sample Location	Results From Air Samples			Results From Dust Samples		
		Fibers in Air PCM (f/cc)	Asbestos in Air TEM (f/cc)	SVF in Air SEM (f/cc)	Asbestos in Dust PLM (%)	Asbestos in Dust TEM (%)	SVF in Dust PLM (%)
26	Residence 2	<.001			ND	ND	ND
27	Outside	<.001			ND	<1	15
27	Common	<.001			ND	<1	10
27	Residence 1	<.001			ND	<1	10
27	Residence 2	<.001			ND	ND	10
28	Outside	<.001			ND	ND	15
28	Common	0.001			ND	ND	10
28	Residence 1	<.001			ND	Insufficient Material	ND
28	Residence 2	0.002			ND	ND	ND
29	Outside	<.001			ND	ND	ND
29	Common	<.001			ND	ND	ND
29	Residence 1	<.001			ND	ND	ND
29	Residence 2	<.001			ND	ND	ND
30	Outside	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
30	Common	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
30	Residence 1	<.001			ND	ND	ND
30	Residence 2	<.001			ND	ND	ND
Results for Comparison Buildings Sampled Above 59th Street (Buildings 31–34)							
31	Outside	<.001			Not Sampled	Not Sampled	Not Sampled
31	Outside co-located	0.001		0.000039	Not Sampled	Not Sampled	Not Sampled
31	Common	<.001			ND	ND	ND
31	Residence 1	<.001		<0.000039	ND	ND	ND
31	Residence 2	<.001		<0.000038	ND	ND	ND
32	Outside	<.001		<0.000039	Not Sampled	Not Sampled	Not Sampled
32	Common	0.002		<0.00004	ND	ND	ND
32	Residence 1	<.001			ND	ND	ND
32	Res 1 co-located	0.001		0.000087	Not Sampled	Not Sampled	Not Sampled
32	Residence 2	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
33	Outside	Not Sampled			Not Sampled	Not Sampled	Not Sampled
33	Common	Not Sampled			Not Sampled	Not Sampled	Not Sampled
33	Residence 1	Not Sampled			Not Sampled	Not Sampled	Not Sampled
33	Residence 2	<.001		<0.000041	ND	ND	ND
34	Outside	<.001		<0.000043	Not Sampled	Not Sampled	Not Sampled

Building Number	Sample Location	Results From Air Samples			Results From Dust Samples		
		Fibers In Air PCM (f/cc)	Asbestos In Air TEM (f/cc)	SVF In Air SEM (f/cc)	Asbestos In Dust PLM (%)	Asbestos In Dust TEM (%)	SVF In Dust PLM (%)
34	Common	<.001		0.000043	ND	ND	ND
34	Residence 1	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
34	Residence 2	0.002			ND	Insuf. Material	ND
34	Res 2 co-located	0.003		<0.000047	Not Sampled	Not Sampled	Not Sampled

f/cc: fibers per cubic centimeter of air

NA: not analyzed

ND: not detected

PCM: phase contrast microscopy

PLM: polarized light microscopy

SEM: scanning electron microscopy

SVF: synthetic vitreous fibers

TEM: transmission electron microscopy

%: percent

Results of Mineral Analyses in Dust and Air

The following table shows the results of analyses of the minerals in settled dust and air samples for 30 residential buildings in lower Manhattan (1–30) and 4 comparison buildings (31–34) above 59th Street. For each building, the table shows the highest estimated air concentration of mineral for each size fraction. In addition, estimated levels of each mineral in the settled surface dust are shown for each sampled location within a building.

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
Summary of Comparison Areas Above 59th Street										
	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND–3 J	ND	ND
	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND–3 J	ND	ND
	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND–5 J	ND	ND
	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND–3 J	ND	ND
	Settled surface dust (%)	Common Area	ND–1 J	ND	ND	ND–0.4 J	ND–0.05 J	ND–3 J	ND	ND
	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
	Settled surface dust (%)	Residence 1&2	ND–2 J	ND	ND	ND–0.9 J	ND–0.08 J	2–4 J	ND–0.08 J	ND–0.4 J
Results for Individual Buildings Sampled in Lower Manhattan (Buildings 1–30)										
1	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	6 J	ND	ND
1	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	14 J	ND	ND
1	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	6 J	84 J	12 J	ND	ND
1	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
1	Settled surface dust (%)	Common area	NS	NS	NS	NS	NS	NS	NS	NS
1	Settled surface dust (%)	Outdoor	27 J	ND	ND	15 J	6 J	14 J	ND	ND
1	Settled surface dust (%)	Residence 1	19 J	ND	ND	18 J	2 J	30 J	0.3 J	ND
1	Settled surface dust (%)	Residence 2	31 J	ND	ND	21 J	6 J	4 J	0.05 J	ND
2	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
2	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
2	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	7 J	ND	ND
2	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
2	Settled surface dust (%)	Common area	1 J	ND	ND	ND	2 J	14 J	ND	ND
2	Settled surface dust (%)	Outdoor	21 J	ND	ND	19 J	3 J	27 J	ND	<0.03 J
2	Settled surface dust (%)	Residence 1	3 J	ND	ND	2 J	0.9 J	6 J	ND	ND
2	Settled surface dust (%)	Residence 2	23 J	ND	ND	15 J	4 J	9 J	ND	ND
3	Air ($\mu\text{g}/\text{m}^3$)	PM100	6 J	15 J	ASN	5 J	24 J	5 J	13 J	ND
3	Air ($\mu\text{g}/\text{m}^3$)	PM10	5 J	ND	ASN	5 J	25 J	6 J	ND	ND
3	Air ($\mu\text{g}/\text{m}^3$)	PM4	6 J	ND	ASN	6 J	26 J	7 J	ND	ND
3	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
3	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
3	Settled surface dust (%)	Common	NS	NS	NS	NS	NS	NS	NS	NS
3	Settled surface dust (%)	Residence 1	NS	NS	NS	NS	NS	NS	NS	NS
3	Settled surface dust (%)	Residence 2	NS	NS	NS	NS	NS	NS	NS	NS
4	Air ($\mu\text{g}/\text{m}^3$)	PM100	4 J	ND	ASN	4 J	16 J	3 J	9 J	5 J
4	Air ($\mu\text{g}/\text{m}^3$)	PM10	4 J	ND	ASN	3 J	16 J	3 J	ND	4 J
4	Air ($\mu\text{g}/\text{m}^3$)	PM4	6 J	ND	ASN	6 J	28 J	5 J	14 J	8 J
4	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
4	Settled surface dust (%)	Common area	ND	ND	ND	1 J	0.4 J	8 J	ND	ND
4	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
4	Settled surface dust (%)	Residence 1	0.2 J	ND	ND	0.06 J	0.7 J	1 J	ND	ND
4	Settled surface dust (%)	Residence 2	14 J	ND	ND	5 J	2 J	9 J	ND	0.1 J
5	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	14 J	95 J	14 J	ND	14 J
5	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	14 J	ND	ND
5	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	15 J	ND	ND
5	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
5	Settled surface dust (%)	Common area	NS	NS	NS	NS	NS	NS	NS	NS
5	Settled surface dust (%)	Outdoor	23 J	ND	ND	8 J	ND	ND	ND	ND
5	Settled surface dust (%)	Residence 1	2 J	ND	ND	ND	ND	9 J	ND	ND
5	Settled surface dust (%)	Residence 2	11 J	ND	ND	4 J	0.5 J	2 J	ND	ND
6	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
6	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
6	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
6	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
6	Settled surface dust (%)	Common area	17 J	ND	ND	10 J	3 J	20 J	0.6 J	ND
6	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
6	Settled surface dust (%)	Residence 1	27 J	ND	ND	17 J	8 J	13 J	ND	ND
6	Settled surface dust (%)	Residence 2	24 J	ND	ND	15 J	4 J	4 J	0.03 J	ND
7	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	8 J	54 J	10 J	ND	ND
7	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	11 J	ND	ND
7	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	11 J	ND	ND
7	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
7	Settled surface dust (%)	Common area	11 J	ND	ND	8 J	3 J	15 J	0.09 J	0.04 J
7	Settled surface dust (%)	Outdoor	14 J	ND	ND	7 J	1 J	12 J	ND	0.1 J
7	Settled surface dust (%)	Residence 1	14 J	ND	ND	13 J	2 J	2 J	ND	ND

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
7	Settled surface dust (%)	Residence 2	21 J	ND	ND	19 J	3 J	4 J	ND	0.09 J
7	Settled surface dust (%)	Residence 2-co	18 J	ND	ND	9 J	1 J	2 J	ND	ND
8	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	7 J	ND	10 J	ND	ND
8	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	9 J	ND	ND
8	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	6 J	ND	12 J	43 J	19 J
8	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
8	Settled surface dust (%)	Common area	19 J	ND	ND	9 J	2 J	15 J	ND	ND
8	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
8	Settled surface dust (%)	Residence 1	15 J	ND	ND	10 J	3 J	17 J	ND	ND
8	Settled surface dust (%)	Residence 2	28 J	ND	ND	21 J	4 J	6 J	ND	ND
9	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	3 J	ND	ND
9	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	4 J	ND	6 J	ND	ND
9	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
9	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
9	Settled surface dust (%)	Common area	25 J	ND	ND	9 J	4 J	16 J	0.09 J	0.06 J
9	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
9	Settled surface dust (%)	Residence 1	10 J	ND	ND	2 J	0.9 J	5 J	ND	ND
9	Settled surface dust (%)	Residence 2	4 J	ND	ND	ND	ND	2 J	ND	ND
10	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
10	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
10	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	8 J	ND	ND	ND	ND
10	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
10	Settled surface dust (%)	Common area	2 J	ND	ND	3 J	ND	1 J	ND	ND
10	Settled surface dust (%)	Common area-co	NS	NS	NS	NS	NS	NS	NS	NS
10	Settled surface dust (%)	Outdoor	21 J	ND	ND	14 J	3 J	5 J	0.09 J	0.05 J
10	Settled surface dust (%)	Residence 1	3 J	ND	ND	ND	0.06 J	ND	ND	ND
10	Settled surface dust (%)	Residence 2	2 J	ND	ND	ND	ND	0.8 J	ND	0.04 J
11	Air ($\mu\text{g}/\text{m}^3$)	PM100	NS	NS	NS	NS	NS	NS	NS	NS
11	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
11	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
11	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
11	Settled surface dust (%)	Common area	2 J	ND	ND	ND	ND	1 J	ND	ND
11	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
11	Settled surface dust (%)	Residence 1	0.2 J	ND	ND	0.02 J	ND	2 J	ND	ND
11	Settled surface dust (%)	Residence 2	0.07 J	ND	ND	ND	ND	ND	ND	ND

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
12	Air ($\mu\text{g}/\text{m}^3$)	PM100	NS	NS	NS	NS	NS	NS	NS	NS
12	Air ($\mu\text{g}/\text{m}^3$)	PM10	3 J	ND	ASN	5 J	18 J	4 J	8 J	5 J
12	Air ($\mu\text{g}/\text{m}^3$)	PM4	5 J	ND	ASN	7 J	28 J	6 J	15 J	7 J
12	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
12	Settled surface dust (%)	Common area	4 J	ND	ND	2 J	3 J	1 J	ND	ND
12	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
12	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	0.3 J	ND	ND
12	Settled surface dust (%)	Residence 2	0.4 J	ND	ND	0.09 J	0.06 J	0.8 J	ND	ND
13	Air ($\mu\text{g}/\text{m}^3$)	PM100	5 J	ND	ASN	5 J	16 J	3 J	ND	ND
13	Air ($\mu\text{g}/\text{m}^3$)	PM10	4 J	ND	ASN	5 J	16 J	3 J	ND	ND
13	Air ($\mu\text{g}/\text{m}^3$)	PM4	7 J	ND	ASN	10 J	26 J	5 J	ND	ND
13	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
13	Settled surface dust (%)	Common area	0.05 J	ND	ND	0.3 J	0.04 J	1 J	ND	ND
13	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
13	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	1 J	ND	ND
13	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	0.8 J	ND	ND
14	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
14	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
14	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
14	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
14	Settled surface dust (%)	Common area	0.03 J	ND	ND	ND	ND	2 J	ND	0.04 J
14	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
14	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	ND	ND	ND
14	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	0.08 J	ND	ND
15	Air ($\mu\text{g}/\text{m}^3$)	PM100	8 J	ND	ASN	3 J	18 J	ND	ND	ND
15	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	3 J	ND	ND
15	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	5 J	ND	ND
15	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
15	Settled surface dust (%)	Common area	0.4 J	ND	ND	0.02 J	ND	1 J	ND	ND
15	Settled surface dust (%)	Outdoor	1 J	ND	ND	ND	0.3 J	2 J	ND	ND
15	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	1 J	ND	ND
15	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	ND	ND	ND
16	Air ($\mu\text{g}/\text{m}^3$)	PM100	4 J	ND	ASN	3 J	17 J	3 J	ND	ND
16	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	4 J	ND	ND
16	Air ($\mu\text{g}/\text{m}^3$)	PM4	18 J	ND	ASN	5 J	27 J	7 J	ND	ND

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
16	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
16	Settled surface dust (%)	Common area	ND	ND	ND	ND	ND	0.09 J	ND	ND
16	Settled surface dust (%)	Outdoor	3 J	ND	ND	1 J	0.6 J	0.04 J	0.06 J	0.04 J
16	Settled surface dust (%)	Residence 1	NS	NS	NS	NS	NS	NS	NS	NS
16	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	0.9 J	ND	ND
16	Settled surface dust (%)	R2 filter piece	2 J	ND	ND	0.3 J	0.4 J	1 J	ND	ND
17	Air ($\mu\text{g}/\text{m}^3$)	PM100	NS	NS	NS	NS	NS	NS	NS	NS
17	Air ($\mu\text{g}/\text{m}^3$)	PM10	12 J	ND	ASN	4 J	17 J	6 J	ND	5 J
17	Air ($\mu\text{g}/\text{m}^3$)	PM4	5 J	ND	ASN	5 J	27 J	6 J	15 J	ND
17	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
17	Settled surface dust (%)	Common area	2 J	ND	ND	ND	ND	1 J	0.06 J	ND
17	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
17	Settled surface dust (%)	Residence 1	0.9 J	ND	ND	ND	0.05 J	2 J	0.05 J	0.03 J
17	Settled surface dust (%)	Residence 2	1 J	ND	ND	0.8 J	ND	1 J	ND	ND
18	Air ($\mu\text{g}/\text{m}^3$)	PM100	3 J	ND	ASN	ND	ND	ND	ND	ND
18	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	3 J	ND	ND
18	Air ($\mu\text{g}/\text{m}^3$)	PM4	5 J	ND	ASN	ND	ND	5 J	ND	ND
18	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
18	Settled surface dust (%)	Common area	0.9 J	ND	ND	ND	ND	ND	ND	ND
18	Settled surface dust (%)	Outdoor	7 J	ND	ND	1 J	ND	ND	0.2 J	ND
18	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	0.3 J	ND	ND
18	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	1 J	ND	ND
19	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
19	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
19	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
19	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
19	Settled surface dust (%)	Common area	1 J	ND	ND	0.08 J	0.05 J	1 J	ND	ND
19	Settled surface dust (%)	Outdoor	5 J	ND	ND	1 J	0.6 J	1 J	0.09 J	0.04 J
19	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	1 J	ND	ND
19	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	2 J	ND	ND
20	Air ($\mu\text{g}/\text{m}^3$)	PM100	3 J	ND	ASN	3 J	16 J	3 J	ND	ND
20	Air ($\mu\text{g}/\text{m}^3$)	PM10	3 J	ND	ASN	3 J	16 J	4 J	ND	ND
20	Air ($\mu\text{g}/\text{m}^3$)	PM4	5 J	ND	ASN	5 J	29 J	6 J	ND	ND
20	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
20	Settled surface dust (%)	Common area	ND	ND	ND	ND	ND	0.07 J	ND	0.04 J

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
20	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
20	Settled surface dust (%)	Residence 1	0.05 J	ND	ND	ND	ND	1 J	ND	ND
20	Settled surface dust (%)	Residence 2	0.9 J	ND	ND	0.6 J	0.09 J	1 J	ND	0.05 J
21	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
21	Air ($\mu\text{g}/\text{m}^3$)	PM10	R	R	R	R	R	R	R	R
21	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	5 J	ND	ND
21	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
21	Settled surface dust (%)	Common area	0.9 J	ND	ND	ND	ND	2 J	ND	ND
21	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
21	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	ND	ND	ND
21	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	1 J	ND	ND
22	Air ($\mu\text{g}/\text{m}^3$)	PM100	13 J	ND	ASN	ND	ND	ND	ND	ND
22	Air ($\mu\text{g}/\text{m}^3$)	PM10	3 J	ND	ASN	ND	ND	ND	ND	ND
22	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
22	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
22	Settled surface dust (%)	Common area	14 J	ND	ND	1 J	0.4 J	ND	ND	ND
22	Settled surface dust (%)	Outdoor	26 J	ND	ND	2 J	0.8 J	0.03 J	0.07 J	ND
22	Settled surface dust (%)	Residence 1	2 J	ND	ND	0.07 J	0.08 J	1 J	ND	ND
22	Settled surface dust (%)	Residence 2	0.6 J	ND	ND	ND	ND	2 J	ND	ND
23	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
23	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
23	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
23	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
23	Settled surface dust (%)	Common area	2 J	ND	ND	0.04 J	0.05 J	0.9 J	ND	ND
23	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
23	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	ND	ND	ND
23	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	1 J	ND	ND
24	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
24	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
24	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
24	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	3 J	ND	ASN	ND	ND	ND	ND	ND
24	Settled surface dust (%)	Common area	0.03 J	ND	ND	ND	ND	ND	ND	ND
24	Settled surface dust (%)	Outdoor	2 J	ND	ND	0.8 J	0.07 J	ND	0.05 J	0.04 J
24	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	ND	ND	ND
24	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	ND	ND	ND

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
25	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	3 J	ND	ND
25	Air ($\mu\text{g}/\text{m}^3$)	PM10	R	R	R	R	R	R	R	R
25	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	4 J	ND	ND
25	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	3 J	ND	ND
25	Settled surface dust (%)	Common area	ND	ND	ND	ND	ND	2 J	ND	ND
25	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
25	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	ND	ND	ND
25	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	2 J	ND	ND
26	Air ($\mu\text{g}/\text{m}^3$)	PM100	8 J	ND	ASN	ND	ND	ND	ND	ND
26	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
26	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
26	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
26	Settled surface dust (%)	Common area	0.7 J	ND	ND	2 J	0.6 J	2 J	0.07 J	ND
26	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
26	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	ND	ND	ND
26	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	0.05 J	ND	ND
27	Air ($\mu\text{g}/\text{m}^3$)	PM100	3 J	ND	ASN	ND	ND	ND	ND	ND
27	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
27	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
27	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
27	Settled surface dust (%)	Common area	0.04 J	ND	ND	0.02 J	ND	0.1 J	ND	ND
27	Settled surface dust (%)	Outdoor	4 J	ND	ND	1 J	0.8 J	0.04 J	0.07 J	ND
27	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	0.6 J	ND	ND
27	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	1 J	ND	ND
28	Air ($\mu\text{g}/\text{m}^3$)	PM100	3 J	ND	ASN	ND	ND	3 J	ND	4 J
28	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	3 J	ND	ND
28	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	5 J	ND	ND
28	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
28	Settled surface dust (%)	Common area	ND	ND	ND	ND	ND	1 J	ND	ND
28	Settled surface dust (%)	Outdoor	8 J	ND	ND	3 J	2 J	0.3 J	0.09 J	ND
28	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	ND	ND	ND
28	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	1 J	ND	ND
29	Air ($\mu\text{g}/\text{m}^3$)	PM100	4 J	ND	ASN	ND	ND	ND	ND	ND
29	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	3 J	ND	ND
29	Air ($\mu\text{g}/\text{m}^3$)	PM4	19 J	ND	ASN	ND	ND	5 J	ND	ND

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
29	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
29	Settled surface dust (%)	Common area	1 J	ND	ND	0.09 J	0.06 J	2 J	ND	ND
29	Settled surface dust (%)	Outdoor	8 J	ND	ND	3 J	2 J	2 J	0.3 J	0.07 J
29	Settled surface dust (%)	Residence 1	0.2 J	ND	ND	ND	ND	1 J	ND	ND
29	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	ND	ND	ND
30	Air ($\mu\text{g}/\text{m}^3$)	PM100	NS	NS	NS	NS	NS	NS	NS	NS
30	Air ($\mu\text{g}/\text{m}^3$)	PM10	3 J	ND	ASN	ND	ND	3 J	ND	ND
30	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	5 J	ND	ND
30	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
30	Settled surface dust (%)	Common area	NS	NS	NS	NS	NS	NS	NS	NS
30	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
30	Settled surface dust (%)	Residence 1	1 J	ND	ND	ND	0.9 J	4 J	0.06 J	0.05 J
30	Settled surface dust (%)	Residence 2	0.6 J	ND	ND	0.4 J	0.4 J	4 J	ND	ND
Results for Individual Comparison Buildings Sampled Above 59th Street (Buildings 31-34)										
31	Air ($\mu\text{g}/\text{m}^3$)	PM100	NS	NS	NS	NS	NS	NS	NS	NS
31	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	3 J	ND	ND
31	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	5 J	ND	ND
31	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	NS	NS	NS	NS	NS	NS	NS	NS
31	Settled surface dust (%)	Common area	1 J	ND	ND	0.03 J	0.05 J	2 J	ND	0.04 J
31	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
31	Settled surface dust (%)	Residence 1	ND	ND	ND	ND	ND	2 J	ND	ND
31	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	ND	ND	ND
32	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	3 J	ND	ND
32	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	3 J	ND	ND
32	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	5 J	ND	ND
32	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	3 J	ND	ND
32	Settled surface dust (%)	Common area	1 J	ND	ND	0.4 J	ND	3J	ND	ND
32	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
32	Settled surface dust (%)	Residence 1	2 J	ND	ND	0.9 J	0.08 J	4 J	0.08 J	0.4 J
32	Settled surface dust (%)	Residence 2	NS	NS	NS	NS	NS	NS	NS	NS
33	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
33	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
33	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
33	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
33	Settled surface dust (%)	Common area	NS	NS	NS	NS	NS	NS	NS	NS

Building Number	Sample Type	Method or Location	Quartz	Cristobalite	Tridymite	Calcite	Portlandite	Gypsum	Mica	Halite
33	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
33	Settled surface dust (%)	Residence 1	NS	NS	NS	NS	NS	NS	NS	NS
33	Settled surface dust (%)	Residence 2	1 J	ND	ND	ND	0.08 J	2 J	ND	ND
34	Air ($\mu\text{g}/\text{m}^3$)	PM100	ND	ND	ASN	ND	ND	ND	ND	ND
34	Air ($\mu\text{g}/\text{m}^3$)	PM10	ND	ND	ASN	ND	ND	ND	ND	ND
34	Air ($\mu\text{g}/\text{m}^3$)	PM4	ND	ND	ASN	ND	ND	ND	ND	ND
34	Air ($\mu\text{g}/\text{m}^3$)	PM2.5	ND	ND	ASN	ND	ND	ND	ND	ND
34	Settled surface dust (%)	Common area	ND	ND	ND	ND	ND	ND	ND	ND
34	Settled surface dust (%)	Outdoor	NS	NS	NS	NS	NS	NS	NS	NS
34	Settled surface dust (%)	Residence 1	NS	NS	NS	NS	NS	NS	NS	NS
34	Settled surface dust (%)	Residence 2	ND	ND	ND	ND	ND	3 J	ND	ND

ASN: Analytical sensitivity not available. Mineral was not detected at any measured location using the associated method, analytical sensitivity is not known.

Detect: Mineral was detected above the analytical sensitivity in at least one of the measured locations of the building using the associated method.

J: Estimated value. Due to inconsistencies during sample collection/analysis, the result is only an estimate of the actual value. The actual value could be higher or lower than the value shown.

ND: Not detected. Mineral was not detected at any measured location using the associated method.

NS: Not sampled. The associated method was not used at any of the measured locations in the building.

R: Result was rejected. Due to inconsistencies during sample collection/analysis, the result values for the sample were rejected.

$\mu\text{g}/\text{m}^3$: microgram per cubic meter of air.

Mineral Analyses in Air

Estimated levels of minerals in air for samples from 30 residential buildings (1–30) in lower Manhattan and 4 comparison residential buildings (31–34) above 59th Street are shown in the following table. The estimated air concentration of each mineral by size fraction is shown for each area sampled. Typically, samples were obtained from an outdoor area, an indoor common area, and two residences. In addition, co-located samples were obtained from some locations. However, due to inconsistencies during sample collection or analysis, the specific sampling location within the building is not noted.

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
Summary of Comparison Areas Above 59th Street										
	PM100		--	--	--	--	--	ND-3 J	--	--
	PM10		--	--	--	--	--	ND-3 J	--	--
	PM4		--	--	--	--	--	ND-5 J	--	--
	PM2.5		--	--	--	--	--	ND-3 J	--	--
Results for Individual Buildings Sampled in Lower Manhattan (Buildings 1–30)										
1	PM100	882	--	--	--	--	--	6 J	--	--
1	PM100	830	--	--	--	--	--	--	--	--
1	PM100	818	--	--	--	--	--	--	--	--
1	PM100	892	--	--	--	--	--	--	--	--
1	PM10	861	--	--	--	--	--	--	--	--
1	PM10	835	--	--	--	--	--	7 J	--	--
1	PM10	838	--	--	--	--	--	14 J	--	--
1	PM10	899	--	--	--	--	--	8 J	--	--
1	PM4	809	--	--	--	--	84 J	10 J	--	--
1	PM4	813	--	--	--	--	--	12 J	--	--
1	PM4	820	--	--	--	6 J	68 J	10 J	--	--
1	PM4	837	--	--	--	--	--	--	--	--
2	PM100	1229	--	--	--	--	--	--	--	--
2	PM100	1162	--	--	--	--	--	--	--	--
2	PM100	766	--	--	--	--	--	--	--	--
2	PM100	1240	--	--	--	--	--	--	--	--
2	PM10	1194	--	--	--	--	--	--	--	--
2	PM10	1168	--	--	--	--	--	--	--	--
2	PM10	1390	--	--	--	--	--	--	--	--
2	PM10	1216	--	--	--	--	--	--	--	--
2	PM4	757	--	--	--	--	--	7J	--	--
2	PM4	717	--	--	--	--	--	--	--	--
2	PM4	849	--	--	--	--	--	--	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
2	PM4	762	--	--	--	--	--	--	--	--
3	PM100	868	--	--	--	--	--	5 J	--	--
3	PM100	821	6 J	15 J	--	5 J	24 J	5 J	13 J	--
3	PM100	756	--	--	--	--	--	5 J	--	--
3	PM100	761	--	--	--	--	--	--	--	--
3	PM10	858	--	--	--	--	--	6 J	--	--
3	PM10	815	5 J	--	--	5J	25 J	5 J	--	--
3	PM10	765	--	--	--	--	--	5 J	--	--
3	PM10	783	--	--	--	--	--	--	--	--
3	PM4	814	5 J	--	--	--	--	6 J	--	--
3	PM4	824	6 J	--	--	6 J	26 J	7 J	--	--
3	PM4	841	--	--	--	--	--	5 J	--	--
3	PM4	823	--	--	--	--	--	--	--	--
4	PM100	1230	--	--	--	--	--	3 J	--	--
4	PM100	1289	4 J	--	--	4 J	16 J	3 J	9 J	5J
4	PM100	1278	--	--	--	--	--	--	--	--
4	PM100	1221	--	--	--	--	--	3 J	--	5J
4	PM10	1218	--	--	--	--	16 J	3 J	--	--
4	PM10	1415	4 J	--	--	3 J	16 J	3 J	--	4J
4	PM10	1294	--	--	--	--	--	3 J	--	--
4	PM10	1201	--	--	--	--	--	--	--	--
4	PM4	751	--	--	--	--	27J	5J	--	--
4	PM4	793	6 J	--	--	6J	28J	5J	14 J	8 J
4	PM4	804	--	--	--	--	--	5 J	--	--
4	PM4	757	--	--	--	--	--	--	--	--
5	PM100	783	--	--	--	14 J	95 J	14 J	--	14 J
5	PM100	786	--	--	--	--	--	--	--	--
5	PM100	804	--	--	--	--	--	--	--	--
5	PM100	800	--	--	--	--	--	--	--	--
5	PM10	780	--	--	--	--	--	--	--	--
5	PM10	797	--	--	--	--	--	--	--	--
5	PM10	846	--	--	--	--	--	14 J	--	--
5	PM10	789	--	--	--	--	--	--	--	--
5	PM4	817	--	--	--	--	--	--	--	--
5	PM4	864	--	--	--	--	--	--	--	--
5	PM4	813	--	--	--	--	--	9 J	--	--
5	PM4	813	--	--	--	--	--	15 J	--	--
6	PM100	1241	--	--	--	--	--	--	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
6	PM100	1212	---	---	---	---	---	---	---	---
6	PM100	1238	---	---	---	---	---	---	---	---
6	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
6	PM10	1226	---	---	---	---	---	---	---	---
6	PM10	1197	---	---	---	---	---	---	---	---
6	PM10	1252	---	---	---	---	---	---	---	---
6	PM10	1254	---	---	---	---	---	---	---	---
6	PM4	775	---	---	---	---	---	---	---	---
6	PM4	762	---	---	---	---	---	---	---	---
6	PM4	775	---	---	---	---	---	---	---	---
6	PM4	772	---	---	---	---	---	---	---	---
7	PM100	1277	---	---	---	---	---	---	---	---
7	PM100	1260	---	---	---	8 J	54 J	10 J	---	---
7	PM100	1243	---	---	---	---	---	---	---	---
7	PM100	1213	---	---	---	---	---	---	---	---
7	PM10	1227	---	---	---	---	---	---	---	---
7	PM10	1225	---	---	---	---	---	11 J	---	---
7	PM10	1240	---	---	---	---	---	---	---	---
7	PM10	1231	---	---	---	---	---	---	---	---
7	PM4	787	---	---	---	---	---	---	---	---
7	PM4	784	---	---	---	---	---	10 J	---	---
7	PM4	765	---	---	---	---	---	11 J	---	---
7	PM4	748	---	---	---	---	---	---	---	---
8	PM100	1213	---	---	---	7 J	---	10 J	---	---
8	PM100	1254	---	---	---	---	---	6 J	---	---
8	PM100	1223	---	---	---	---	---	7 J	---	---
8	PM100	1206	---	---	---	---	---	---	---	---
8	PM100	1175	---	---	---	---	---	---	---	---
8	PM100	1259	---	---	---	---	---	---	---	---
8	PM10	1188	---	---	---	---	---	9 J	---	---
8	PM10	1223	---	---	---	---	---	6 J	---	---
8	PM10	1172	---	---	---	---	---	---	---	---
8	PM10	1256	---	---	---	---	---	---	---	---
8	PM4	757	---	---	---	---	---	12 J	---	---
8	PM4	784	---	---	---	6 J	---	10 J	---	---
8	PM4	738	---	---	---	---	---	---	---	---
8	PM4	777	---	---	---	---	---	10J	43J	19 J
9	PM100	1210	---	---	---	---	---	---	---	---
9	PM100	1218	---	---	---	---	---	3 J	---	---

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
9	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
9	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
9	PM10	1203	--	--	--	--	--	--	--	--
9	PM10	1217	--	--	--	4 J	--	6 J	--	--
9	PM10	1231	--	--	--	--	--	--	--	--
9	PM10	1131	--	--	--	--	--	--	--	--
9	PM4	776	--	--	--	--	--	--	--	--
9	PM4	782	--	--	--	--	--	--	--	--
9	PM4	763	--	--	--	--	--	--	--	--
9	PM4	781	--	--	--	--	--	--	--	--
10	PM100	1201	--	--	--	--	--	--	--	--
10	PM100	1225	--	--	--	--	--	--	--	--
10	PM100	1220	--	--	--	--	--	--	--	--
10	PM100	1226	--	--	--	--	--	--	--	--
10	PM10	1181	--	--	--	--	--	--	--	--
10	PM10	1202	--	--	--	--	--	--	--	--
10	PM10	1227	--	--	--	--	--	--	--	--
10	PM10	1224	--	--	--	--	--	--	--	--
10	PM4	757	--	--	--	--	--	--	--	--
10	PM4	766	--	--	--	--	--	--	--	--
10	PM4	762	--	--	--	8 J	--	--	--	--
10	PM4	767	--	--	--	--	--	--	--	--
11	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
11	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
11	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
11	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
11	PM10	1305	--	--	--	--	--	--	--	--
11	PM10	1301	--	--	--	--	--	--	--	--
11	PM10	1337	--	--	--	--	--	--	--	--
11	PM10	1237	--	--	--	--	--	--	--	--
11	PM4	832	--	--	--	--	--	--	--	--
11	PM4	806	--	--	--	--	--	--	--	--
11	PM4	834	--	--	--	--	--	--	--	--
11	PM4	779	--	--	--	--	--	--	--	--
12	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
12	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
12	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
12	PM100	NS	NS	NS	NS	NS	NS	NS	NS	NS
12	PM10	1412	3 J	--	--	3 J	14 J	3 J	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
12	PM10	1315	3 J	--	--	5 J	18 J	4 J	8 J	5 J
12	PM10	1337	3 J	--	--	3 J	17 J	3 J	--	5 J
12	PM10	1553	R	R	R	R	R	R	R	R
12	PM10	1479	R	R	R	R	R	R	R	R
12	PM4	925	4 J	--	--	4 J	22 J	4 J	--	--
12	PM4	828	5 J	--	--	7 J	28 J	6 J	15 J	7 J
12	PM4	948	R	R	R	R	R	R	R	R
12	PM4	932	R	R	R	R	R	R	R	R
13	PM100	1281	--	--	--	--	--	3 J	--	--
13	PM100	1300	--	--	--	--	--	--	--	--
13	PM100	1298	--	--	--	--	--	--	--	--
13	PM100	1284	5 J	--	--	5 J	16 J	3 J	--	--
13	PM100	1211	--	--	--	--	--	--	--	--
13	PM100	1203	--	--	--	--	--	--	--	--
13	PM100	1184	--	--	--	--	--	--	--	--
13	PM10	1263	--	--	--	--	--	3 J	--	--
13	PM10	1325	4 J	--	--	5 J	16 J	3 J	--	--
13	PM10	1223	--	--	--	--	--	--	--	--
13	PM10	1205	--	--	--	--	--	--	--	--
13	PM4	802	--	--	--	5 J	--	5 J	--	--
13	PM4	818	7 J	--	--	10 J	26 J	5 J	--	--
13	PM4	762	--	--	--	--	--	--	--	--
13	PM4	761	--	--	--	--	--	--	--	--
14	PM100	1151	--	--	--	--	--	--	--	--
14	PM100	1169	--	--	--	--	--	--	--	--
14	PM100	1166	--	--	--	--	--	--	--	--
14	PM100	1142	--	--	--	--	--	--	--	--
14	PM100	1171	--	--	--	--	--	--	--	--
14	PM100	1149	--	--	--	--	--	--	--	--
14	PM10	1134	--	--	--	--	--	--	--	--
14	PM10	1138	--	--	--	--	--	--	--	--
14	PM10	1155	--	--	--	--	--	--	--	--
14	PM10	1179	--	--	--	--	--	--	--	--
14	PM10	1161	--	--	--	--	--	--	--	--
14	PM4	719	--	--	--	--	--	--	--	--
14	PM4	731	--	--	--	--	--	--	--	--
14	PM4	732	--	--	--	--	--	--	--	--
14	PM4	730	--	--	--	--	--	--	--	--
15	PM100	1219	--	--	--	--	--	--	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
15	PM100	1199	8 J	--	--	3 J	18 J	--	--	--
15	PM100	1211	--	--	--	--	--	--	--	--
15	PM100	1156	--	--	--	--	--	--	--	--
15	PM10	1218	--	--	--	--	--	3 J	--	--
15	PM10	1115	R	R	R	R	R	R	R	R
15	PM10	1212	--	--	--	--	--	--	--	--
15	PM10	1225	--	--	--	--	--	--	--	--
15	PM10	1171	--	--	--	--	--	--	--	--
15	PM4	783	--	--	--	--	--	5 J	--	--
15	PM4	778	--	--	--	--	--	--	--	--
15	PM4	766	--	--	--	--	--	--	--	--
15	PM4	751	--	--	--	--	--	--	--	--
16	PM100	1254	--	--	--	--	--	3 J	--	--
16	PM100	1225	4 J	--	--	3 J	17 J	3 J	--	--
16	PM100	1217	--	--	--	--	--	--	--	--
16	PM10	1269	--	--	--	--	--	4 J	--	--
16	PM10	1228	--	--	--	--	--	4 J	--	--
16	PM10	1210	--	--	--	--	--	--	--	--
16	PM4	808	--	--	--	--	--	7 J	--	--
16	PM4	774	--	--	--	--	--	5 J	--	--
16	PM4	769	18 J	--	--	5 J	27 J	7 J	--	--
16	PM4	769	--	--	--	--	--	--	--	--
17	PM10	1306	--	--	--	--	--	4 J	--	--
17	PM10	1469	3 J	--	--	3 J	16 J	3 J	--	4 J
17	PM10	1250	--	--	--	--	--	--	--	--
17	PM10	1259	--	--	--	--	--	3 J	--	--
17	PM10	1293	12 J	--	--	4 J	17 J	6 J	--	5 J
17	PM4	844	--	--	--	--	--	5 J	--	--
17	PM4	816	5 J	--	--	5 J	27 J	6 J	15 J	--
17	PM4	786	--	--	--	--	--	--	--	--
17	PM4	786	--	--	--	--	--	5 J	--	--
17	PM4	803	--	--	--	--	26 J	6 J	--	--
18	PM100	1277	--	--	--	--	--	--	--	--
18	PM100	1247	3 J	--	--	--	--	--	--	--
18	PM100	1241	--	--	--	--	--	--	--	--
18	PM100	1265	--	--	--	--	--	--	--	--
18	PM100	1177	--	--	--	--	--	--	--	--
18	PM10	1234	--	--	--	--	--	--	--	--
18	PM10	1269	--	--	--	--	--	--	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
18	PM10	1258	--	--	--	--	--	--	--	--
18	PM10	1268	--	--	--	--	--	--	--	--
18	PM10	1196	--	--	--	--	--	3 J	--	--
18	PM4	791	--	--	--	--	--	--	--	--
18	PM4	780	--	--	--	--	--	--	--	--
18	PM4	785	5 J	--	--	--	--	--	--	--
18	PM4	778	--	--	--	--	--	--	--	--
18	PM4	735	--	--	--	--	--	5 J	--	--
19	PM100	1275	--	--	--	--	--	--	--	--
19	PM100	1288	--	--	--	--	--	--	--	--
19	PM100	1291	--	--	--	--	--	--	--	--
19	PM100	1215	--	--	--	--	--	--	--	--
19	PM10	1270	--	--	--	--	--	--	--	--
19	PM10	1296	--	--	--	--	--	--	--	--
19	PM10	1286	--	--	--	--	--	--	--	--
19	PM10	1218	R	R	R	R	R	R	R	R
19	PM4	796	--	--	--	--	--	--	--	--
19	PM4	819	--	--	--	--	--	--	--	--
19	PM4	822	--	--	--	--	--	--	--	--
19	PM4	761	R	R	R	R	R	R	R	R
20	PM100	1278	--	--	--	--	--	3 J	--	--
20	PM100	1226	--	--	--	3 J	16 J	3 J	--	--
20	PM100	1412	--	--	--	--	--	3 J	--	--
20	PM100	1417	--	--	--	--	--	3 J	--	--
20	PM100	1366	3 J	--	--	--	--	3 J	--	--
20	PM10	1282	--	--	--	--	--	3 J	--	--
20	PM10	1226	--	--	--	3 J	16 J	--	--	--
20	PM10	1407	--	--	--	--	--	--	--	--
20	PM10	1357	3 J	--	--	3 J	--	4 J	--	--
20	PM4	792	--	--	--	--	--	6 J	--	--
20	PM4	753	5 J	--	--	5 J	29 J	5 J	--	--
20	PM4	891	--	--	--	--	--	--	--	--
20	PM4	842	5 J	--	--	5 J	--	5 J	--	--
21	PM100	1227	--	--	--	--	--	--	--	--
21	PM100	1238	--	--	--	--	--	--	--	--
21	PM100	1203	--	--	--	--	--	--	--	--
21	PM100	1218	--	--	--	--	--	--	--	--
21	PM10	1248	R	R	R	R	R	R	R	R
21	PM10	1256	R	R	R	R	R	R	R	R

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
21	PM10	1212	R	R	R	R	R	R	R	R
21	PM10	1241	R	R	R	R	R	R	R	R
21	PM4	776	--	--	--	--	--	--	--	--
21	PM4	780	--	--	--	--	--	--	--	--
21	PM4	780	--	--	--	--	--	--	--	--
21	PM4	750	--	--	--	--	--	--	--	--
21	PM4	771	--	--	--	--	--	5 J	--	--
21	PM2.5	1236	--	--	--	--	--	--	--	--
21	PM2.5	1249	--	--	--	--	--	--	--	--
21	PM2.5	1211	--	--	--	--	--	--	--	--
21	PM2.5	1238	--	--	--	--	--	--	--	--
22	PM100	1336	5 J	--	--	--	--	--	--	--
22	PM100	1385	13 J	--	--	--	--	--	--	--
22	PM100	1365	7 J	--	--	--	--	--	--	--
22	PM100	1364	--	--	--	--	--	--	--	--
22	PM100	1261	--	--	--	--	--	--	--	--
22	PM10	1346	3 J	--	--	--	--	--	--	--
22	PM10	1369	--	--	--	--	--	--	--	--
22	PM10	1361	--	--	--	--	--	--	--	--
22	PM10	1383	--	--	--	--	--	--	--	--
22	PM10	1271	--	--	--	--	--	--	--	--
22	PM4	870	--	--	--	--	--	--	--	--
22	PM4	872	--	--	--	--	--	--	--	--
22	PM4	863	--	--	--	--	--	--	--	--
22	PM4	787	--	--	--	--	--	--	--	--
22	PM2.5	1343	--	--	--	--	--	--	--	--
22	PM2.5	1334	--	--	--	--	--	--	--	--
22	PM2.5	1354	--	--	--	--	--	--	--	--
22	PM2.5	1252	--	--	--	--	--	--	--	--
23	PM100	1546	--	--	--	--	--	--	--	--
23	PM100	1626	--	--	--	--	--	--	--	--
23	PM100	1554	--	--	--	--	--	--	--	--
23	PM100	1550	--	--	--	--	--	--	--	--
23	PM10	1578	--	--	--	--	--	--	--	--
23	PM10	1596	--	--	--	--	--	--	--	--
23	PM10	1568	--	--	--	--	--	--	--	--
23	PM10	1592	--	--	--	--	--	--	--	--
23	PM10	1612	--	--	--	--	--	--	--	--
23	PM4	991	--	--	--	--	--	--	--	--
23	PM4	1012	--	--	--	--	--	--	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
23	PM4	978	--	--	--	--	--	--	--	--
23	PM4	1014	--	--	--	--	--	--	--	--
23	PM2.5	1548	--	--	--	--	--	--	--	--
23	PM2.5	1009	--	--	--	--	--	--	--	--
23	PM2.5	1544	--	--	--	--	--	--	--	--
23	PM2.5	1584	--	--	--	--	--	--	--	--
24	PM100	1467	--	--	--	--	--	--	--	--
24	PM100	1471	--	--	--	--	--	--	--	--
24	PM100	1424	--	--	--	--	--	--	--	--
24	PM100	1490	--	--	--	--	--	--	--	--
24	PM100	1485	--	--	--	--	--	--	--	--
24	PM10	1475	--	--	--	--	--	--	--	--
24	PM10	1427	--	--	--	--	--	--	--	--
24	PM10	1482	--	--	--	--	--	--	--	--
24	PM10	1481	--	--	--	--	--	--	--	--
24	PM4	920	--	--	--	--	--	--	--	--
24	PM4	891	--	--	--	--	--	--	--	--
24	PM4	880	--	--	--	--	--	--	--	--
24	PM4	929	--	--	--	--	--	--	--	--
24	PM4	920	--	--	--	--	--	--	--	--
24	PM4	935	--	--	--	--	--	--	--	--
24	PM2.5	1467	--	--	--	--	--	--	--	--
24	PM2.5	1411	3 J	--	--	--	--	--	--	--
24	PM2.5	1486	--	--	--	--	--	--	--	--
24	PM2.5	1479	--	--	--	--	--	--	--	--
25	PM100	1454	--	--	--	--	--	3 J	--	--
25	PM100	1437	--	--	--	--	--	--	--	--
25	PM100	1457	--	--	--	--	--	--	--	--
25	PM100	1451	--	--	--	--	--	--	--	--
25	PM10	1456	R	R	R	R	R	R	R	R
25	PM10	1451	R	R	R	R	R	R	R	R
25	PM10	1453	R	R	R	R	R	R	R	R
25	PM10	1458	R	R	R	R	R	R	R	R
25	PM10	1447	R	R	R	R	R	R	R	R
25	PM10	1454	R	R	R	R	R	R	R	R
25	PM4	913	--	--	--	--	--	4 J	--	--
25	PM4	909	--	--	--	--	--	--	--	--
25	PM4	917	--	--	--	--	--	--	--	--
25	PM4	967	--	--	--	--	--	--	--	--
25	PM2.5	1431	--	--	--	--	--	3 J	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
25	PM2.5	1414	--	--	--	--	--	--	--	--
25	PM2.5	1433	--	--	--	--	--	--	--	--
25	PM2.5	1444	--	--	--	--	--	--	--	--
26	PM100	1447	--	--	--	--	--	--	--	--
26	PM100	1445	7 J	--	--	--	--	--	--	--
26	PM100	1424	--	--	--	--	--	--	--	--
26	PM100	1432	--	--	--	--	--	--	--	--
26	PM10	1453	--	--	--	--	--	--	--	--
26	PM10	1462	R	R	R	R	R	R	R	R
26	PM10	1469	--	--	--	--	--	--	--	--
26	PM10	1445	--	--	--	--	--	--	--	--
26	PM10	1429	R	R	R	R	R	R	R	R
26	PM10	1424	R	R	R	R	R	R	R	R
26	PM4	894	--	--	--	--	--	--	--	--
26	PM4	908	--	--	--	--	--	--	--	--
26	PM4	889	--	--	--	--	--	--	--	--
26	PM4	886	--	--	--	--	--	--	--	--
26	PM2.5	1449	--	--	--	--	--	--	--	--
26	PM2.5	1444	--	--	--	--	--	--	--	--
26	PM2.5	1436	--	--	--	--	--	--	--	--
26	PM2.5	1429	--	--	--	--	--	--	--	--
27	PM100	1473	--	--	--	--	--	--	--	--
27	PM100	1450	3 J	--	--	--	--	--	--	--
27	PM100	1469	--	--	--	--	--	--	--	--
27	PM100	1454	--	--	--	--	--	--	--	--
27	PM10	1467	--	--	--	--	--	--	--	--
27	PM10	1457	--	--	--	--	--	--	--	--
27	PM10	1434	--	--	--	--	--	--	--	--
27	PM10	1435	--	--	--	--	--	--	--	--
27	PM4	923	--	--	--	--	--	--	--	--
27	PM4	902	--	--	--	--	--	--	--	--
27	PM4	917	--	--	--	--	--	--	--	--
27	PM4	906	--	--	--	--	--	--	--	--
27	PM4	902	--	--	--	--	--	--	--	--
27	PM2.5	1462	--	--	--	--	--	--	--	--
27	PM2.5	1457	--	--	--	--	--	--	--	--
27	PM2.5	1458	--	--	--	--	--	--	--	--
27	PM2.5	1451	--	--	--	--	--	--	--	--
28	PM100	1427	--	--	--	--	--	3 J	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
28	PM100	1458	--	--	--	--	--	--	--	--
28	PM100	1468	3 J	--	--	--	--	--	--	4 J
28	PM100	1380	--	--	--	--	--	--	--	--
28	PM100	1346	--	--	--	--	--	--	--	--
28	PM100	1337	--	--	--	--	--	--	--	--
28	PM10	1400	--	--	--	--	--	3 J	--	--
28	PM10	1450	--	--	--	--	--	--	--	--
28	PM10	1366	--	--	--	--	--	3 J	--	--
28	PM10	1343	--	--	--	--	--	--	--	--
28	PM4	898	--	--	--	--	--	5 J	--	--
28	PM4	891	--	--	--	--	--	--	--	--
28	PM4	859	--	--	--	--	--	5 J	--	--
28	PM4	810	--	--	--	--	--	--	--	--
28	PM2.5	1396	--	--	--	--	--	--	--	--
28	PM2.5	1371	--	--	--	--	--	--	--	--
28	PM2.5	1319	--	--	--	--	--	--	--	--
28	PM2.5	1451	--	--	--	--	--	--	--	--
29	PM100	1519	--	--	--	--	--	--	--	--
29	PM100	1468	4 J	--	--	--	--	--	--	--
29	PM100	1447	--	--	--	--	--	--	--	--
29	PM10	1527	--	--	--	--	--	--	--	--
29	PM10	1481	--	--	--	--	--	--	--	--
29	PM10	1447	--	--	--	--	--	--	--	--
29	PM10	1212	--	--	--	--	--	3 J	--	--
29	PM4	927	12 J	--	--	--	--	--	--	--
29	PM4	897	19 J	--	--	--	--	--	--	--
29	PM4	887	--	--	--	--	--	5 J	--	--
29	PM4	746	--	--	--	--	--	5 J	--	--
29	PM2.5	1451	--	--	--	--	--	--	--	--
30	PM10	1307	3 J	--	--	--	--	3 J	--	--
30	PM10	1297	--	--	--	--	--	--	--	--
30	PM4	822	--	--	--	--	--	5 J	--	--
30	PM4	781	--	--	--	--	--	--	--	--
30	PM2.5	1307	--	--	--	--	--	--	--	--
Results for Individual Comparison Buildings Sampled Above 59th Street (Buildings 31-34)										
31	PM10	1346	--	--	--	--	--	--	--	--
31	PM10	1328	--	--	--	--	--	3 J	--	--
31	PM10	1347	--	--	--	--	--	--	--	--
31	PM10	1324	--	--	--	--	--	--	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
31	PM10	1371	--	--	--	--	--	--	--	--
31	PM10	1401	--	--	--	--	--	3 J	--	--
31	PM4	828	--	--	--	--	--	--	--	--
31	PM4	819	--	--	--	--	--	--	--	--
31	PM4	852	--	--	--	--	--	--	--	--
31	PM4	867	--	--	--	--	--	5 J	--	--
32	PM100	1318	--	--	--	--	--	3 J	--	--
32	PM100	1336	--	--	--	--	--	--	--	--
32	PM100	1351	--	--	--	--	--	--	--	--
32	PM100	1316	--	--	--	--	--	--	--	--
32	PM10	1312	--	--	--	--	--	3 J	--	--
32	PM10	1337	--	--	--	--	--	--	--	--
32	PM10	1317	--	--	--	--	--	--	--	--
32	PM10	1312	--	--	--	--	--	--	--	--
32	PM4	808	--	--	--	--	--	5 J	--	--
32	PM4	805	--	--	--	--	--	5 J	--	--
32	PM4	776	--	--	--	--	--	--	--	--
32	PM4	828	--	--	--	--	--	--	--	--
32	PM4	826	--	--	--	--	--	--	--	--
32	PM2.5	1311	--	--	--	--	--	3 J	--	--
32	PM2.5	1418	--	--	--	--	--	--	--	--
32	PM2.5	1315	--	--	--	--	--	--	--	--
33	PM100	1338	--	--	--	--	--	--	--	--
33	PM10	1338	--	--	--	--	--	--	--	--
33	PM4	831	--	--	--	--	--	--	--	--
33	PM4	838	--	--	--	--	--	--	--	--
33	PM2.5	1338	--	--	--	--	--	--	--	--
34	PM100	1307	--	--	--	--	--	--	--	--
34	PM100	1315	--	--	--	--	--	--	--	--
34	PM100	1309	--	--	--	--	--	--	--	--
34	PM100	1232	--	--	--	--	--	--	--	--
34	PM10	1318	R	R	R	R	R	R	R	R
34	PM10	1327	--	--	--	--	--	--	--	--
34	PM10	1238	--	--	--	--	--	--	--	--
34	PM4	816	--	--	--	--	--	--	--	--
34	PM4	848	--	--	--	--	--	--	--	--
34	PM4	830	--	--	--	--	--	--	--	--
34	PM4	782	--	--	--	--	--	--	--	--
34	PM4	770	--	--	--	--	--	--	--	--

Building Number	Particle Size Fraction	Sample Volume (L)	Quartz ($\mu\text{g}/\text{m}^3$)	Cristobalite ($\mu\text{g}/\text{m}^3$)	Tridymite ($\mu\text{g}/\text{m}^3$)	Calcite ($\mu\text{g}/\text{m}^3$)	Portlandite ($\mu\text{g}/\text{m}^3$)	Gypsum ($\mu\text{g}/\text{m}^3$)	Mica ($\mu\text{g}/\text{m}^3$)	Halite ($\mu\text{g}/\text{m}^3$)
34	PM2.5	1308	--	--	--	--	--	--	--	--
34	PM2.5	1348	--	--	--	--	--	--	--	--
34	PM2.5	1223	--	--	--	--	--	--	--	--

--: Not detected. Mineral was not detected above the analytical sensitivity in the associated sample.

Detect: Mineral was detected above the analytical sensitivity for the associated sample.

J: Result presented is an estimate. Due to inconsistencies during sample collection/analysis, the result is only an estimate of the actual value. The actual value could be higher or lower than the value shown.

ND: Not detected. Mineral was not detected above the analytical sensitivity in the associated sample.

NS: Not sampled. The associated method was not used at any of the measured locations in the building.

R: Result was rejected. Due to inconsistencies during sample collection/analysis, the result values for the sample were rejected.

$\mu\text{g}/\text{m}^3$: microgram per cubic meter of air.

American Society for Testing and Materials - ASTM D5755

Limitation (As per ASTM document)

- 5.1.1 This test method does not describe procedures or techniques required to evaluate the safety or habitability of buildings with ACM or compliance with federal or state or local regulations or statutes.
- 5.1.2 At present, a single relationship between asbestos containing dust and potential human exposure does not exist.

- Definition

EPA, NYS & NYC does not have any standard for settled dust. The definition for asbestos is any material containing more than 1% as determined using PLM (Polarized Light Microscopy)

Maldonado, Jane

From: Rodenbeck, Sven [svr1@cdc.gov]
Sent: Thursday, May 30, 2002 10:28 AM
To: 'Mitchell.Judy-Ann@epamail.epa.gov'; dianac@dep.nyc.gov; cxjohnso@gw.dec.state.ny.us; njeffery@health.nyc.gov; jleight@health.nyc.gov; rjt03@health.state.ny.us; nkk01@health.state.ny.us; Reed.Larry@epamail.epa.gov; Grevatt.Peter@epamail.epa.gov; Tulis.Dana@epamail.epa.gov; Williams, Robert C. (Bob); Rodenbeck, Sven; marianne.jackson@fema.gov; Habib.Nina@epamail.epa.gov; Basso.Ray@epamail.epa.gov; Pavlou.George@epamail.epa.gov; Maddaloni.Mark@epamail.epa.gov; Callahan.Kathy@epamail.epa.gov; LaPosta.Dore@epamail.epa.gov; jprudhom@health.nyc.gov; michaelgi@dep.nyc.gov; kmckinne@health.nyc.gov; lilan@cityhall.nyc.gov; sbenson@oem.nyc.gov; rlc07@health.state.ny.us; Jones, Steve L. (ATSDR); Block, Arthur; robert.tranter@fema.gov; Fitzpatrick.Robert@epamail.epa.gov; Kruger.Mary@epamail.epa.gov; david.ippolito@osha.gov; garvey-robert@dol.gov; Giardina.Paul@epamail.epa.gov; Girman.John@epamail.epa.gov; Smith.Terry@epamail.epa.gov; Debonis.Michael@epamail.epa.gov; jmiller@health.nyc.gov; Gibb.Herman@epamail.epa.gov; Salkie.Richard@epamail.epa.gov; Rotola.Joe@epamail.epa.gov; spryce@dcas.nyc.gov; Simon.Paul@epamail.epa.gov; Lynes.Carol@epamail.epa.gov; Schaum.John@epamail.epa.gov; Yeh.Alice@epamail.epa.gov; mmm03@health.state.ny.us; sapetron@gw.dec.state.ny.us; Cruz.Auria@epamail.epa.gov; Stradford.Virginia@epamail.epa.gov; amo03@health.state.ny.us; rsierra1@health.nyc.gov; Kushner.Burton@epamail.epa.gov; nelliem@dep.nyc.gov; janem@dep.nyc.gov; Lockaby, Linda N.; lxlucca@gw.dec.state.ny.us; mprice@health.nyc.gov; Higgins.John@epamail.epa.gov; Sprague.Bruce@epamail.epa.gov; valejand@health.nyc.gov
Subject: Example of Community Notification of Results

Folks,

Below is what was discussed in the final NYCDOH/ATSDR Sampling Protocol for the sampling that was conducted last November/December inside residential units.

Sven

VIII. Community Notification of Results

The analytical results along with a public health interpretation will be provided to the community in several different ways. All participants who allowed sampling in their home will be provided with their individual results. Each building owner/operator will be given results of all sampling conducting in the building. Results (without personal identifiers) will also be provided to all occupants of the building. Finally, all results (without personal identifiers) will be provided to residents in lower Manhattan.

In each instance, notification will include a summary of the results; a comparison of the results of samples collected in lower Manhattan with the results of samples collected as NYC background; a public health interpretation of the results; a discussion of the limitations of the data; and recommendations (if needed) that would reduce exposures.

These notifications will be prepared after all of the analytical data has been received. It is anticipated that notification will occur within 6-8 weeks after sampling is begun. However, data and its QA/QC will be reviewed as it is provided by the laboratory. If, results are found that indicate a more immediate notification is necessary (e.g., levels are found that pose a public health hazard), the participants who may be impacted will be notified

as soon as possible. Based on the circumstances, this notification may include just residents in an individual unit, or it may include all residents in the building along with the building owner/operator. If such a notification is necessary, all involved public health agencies will take steps to ensure that it includes specific recommendations/actions that can be quickly implemented to reduce exposures below levels that pose a health hazard.

American Society for Testing and Materials - ASTM D5755

Limitation (As per ASTM document)

- 5.1.1 This test method does not describe procedures or techniques required to evaluate the safety or habitability of buildings with ACM or compliance with federal or state or local regulations or statutes.
- 5.1.2 At present, a single relationship between asbestos containing dust and potential human exposure does not exist.

- Definition

EPA, NYS & NYC does not have any standard for settled dust. The definition for asbestos is any material containing more than 1% as determined using PLM (Polarized Light Microscopy)

DRAFT



Report on Residential Air and Dust Sampling in Lower Manhattan

The Agency for Toxic Substances and Disease Registry (ATSDR), a federal public health agency under the Department of Health and Human Services, was created under Superfund legislation to assist the Environmental Protection Agency, and state and local public health departments in assessing how toxic substances in the environment may affect public health.

The New York City Department of Health requested ATSDR's assistance in designing a sampling plan and in conducting sampling of residential air and dust in lower Manhattan to determine if residents are being exposed to concentrations of materials that may be harmful.

The Purpose of the Sampling

- response to public concern
- determine if residents are being exposed to concentrations of materials that may be harmful
- determine whether areas already cleaned contain materials that may be of public health concern
- provide information to the public on possible public health implications

The Sampling Plan and its Limitations

The sampling plan was designed to obtain samples from locations across the lower Manhattan area. Because of the time urgency associated with the need to obtain results, the plan was not designed to garner samples statistically representative of the area, but rather to give public health officials and citizens relatively quick, overall feedback regarding contaminants present. Thirty residential buildings were sampled in lower Manhattan, the vast majority of which had some degree of clean up.

ATSDR focused on building-related materials that were known to have emanated from the collapse of the World Trade Center towers that might cause health problems. However, our investigation cannot definitively conclude whether the contaminants found were actually from the disaster.

Sample Locations

- A total of 117 air samples were taken from inside and adjacent to the selected residences in various areas of lower Manhattan
- A total of 98 dust samples were taken from apartments, common areas, and outdoor areas of those 30 residential buildings
- Background samples of both dust and air were taken from four buildings north of 59th Street

Air Sample Results

- The air samples from inside the buildings showed no elevated levels of asbestos. Levels were similar to those seen in areas not affected by the World Trade Center collapse.

Dust Sample Results

Asbestos

- Low levels of asbestos were found in settled dust, primarily below Chambers Street, in 10 (17.5 %) of the residential units dust sampled, 5 (19.2 %) of the common area samples and 5 (33 %) of the outdoor areas samples. Only 2 of the 14 indoor samples exceeded the 1% level. ?
- Asbestos was detected in some of the areas previously cleaned.
- No asbestos was detected in the background dust samples taken from north of 59th Street.

*Thought it
outside in
common area*

- Settled dust samples were analyzed using Polarized Light Microscopy or PLM. PLM identifies and distinguishes types of fibers, including asbestos or fibrous glass, by shape and the pattern/color of their appearance. TEM, a more sensitive form of analysis, was conducted as an additional check on all dust samples in which PLM testing did not detect levels of asbestos. 

Fibrous glass and other contaminants

- Fibrous glass was detected in settled dust samples from 23 (40.4%) of the residential unit samples, 11 (42.3%) of the common area samples, and 9 (64.3%) of the outside samples. The percentage of fibers in indoor samples that were fibrous glass ranged from 2% to 35%.
- No fibrous glass was detected in background dust samples.
- Fibrous glass was detected in many of the locations previously cleaned.
- Samples continue to be analyzed for other contaminants, including crystalline silica, mica, gypsum, and calcite, as well as the total amount of dust and fibrous glass in the air.

Health Implications of Findings/Recommendations

- Exposure to fibrous glass is known to cause rashes and upper respiratory irritation. These sampling results suggest that fibrous glass should be considered in choosing the mode and frequency of clean up.
- The negative air data and low levels of asbestos in dust suggest that clean up practices seem to be largely effective in eliminating asbestos exposure.
- Although both the asbestos and fibrous glass were found in dust, both types of particles can become airborne if disturbed. Therefore, ATSDR is recommending that people continue to conduct frequent cleaning with HEPA vacuums and damp cloths/mops to reduce the potential for exposure in accordance with NYC Department of Health guidance.
- ATSDR is recommending additional monitoring of residential units in lower Manhattan.
- ATSDR continues to work with the New York City Department of Health, and other federal and state agencies, to provide information on sampling results to the citizens of New York City and help interpret the possible health effects of contaminants found.

04/03/02 DRAFT: not for public release

Ambient and Indoor Sampling for Public Health Evaluations of Residential Areas Near World Trade Center, New York, New York (November 4 - December 11, 2001)

Results were compared to dust and air levels found in homes located in "non-impacted" areas and to indoor asbestos standards. At each sampled building, attempts were made to sample in a common area, two residences, and an adjacent outdoor location.

Dust:

If PLM was less than 1%*, confirmation by TEM was performed.

If TEM was less than 1%, no further action was taken.

If TEM was greater than 1%, further action was taken.

If PLM was greater than 1%, confirmation by TEM was unnecessary and further action was taken.

Air:

If PCM was less than 0.003** f/cc, no further action was taken.

If PCM was greater than 0.003 f/cc, confirmation by TEM was performed.

If TEM was less than 0.01 f/cc, no further action was taken.

If TEM was greater than 0.01 f/cc (did not occur), further action would have been needed.

If PCM is greater than 0.01*** f/cc, confirmation by TEM was performed.

* A material is considered to be *asbestos-containing material* if it contains more than 1% asbestos using the PLM method.

When asbestos was detected, only Chrysotile asbestos was found.

** 0.003 is the upper range (0.001 - 0.003) of background indoor air fiber concentrations determined in non-impacted areas.

*** Asbestos clearance criteria. Rules of the City of New York, Title 15, Chapter 1.

Results for Asbestos in Air and Settled Dust

Building Number	Location	Asbestos In Dust	Asbestos In Dust	Fibers In Air	Asbestos In Air
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Residential Buildings in Lower Manhattan

Building 1

	PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]
1 Outside	ND	Not Sampled	0.001	NA
1 Common	Not Sampled	Not Sampled	<.001	NA
1 Res 1	ND	Not Sampled	0.006	<.001
1 Res 2	ND	Not Sampled	<.001	NA

Building 1 Notes: PCM results at Res 1 exceeded 0.003 f/cc. Asbestos fibers were not detected in this sample by TEM analysis.

There was not enough material left to analyze the outdoor and residential dust samples by TEM.

Building 2

	PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]
2 Outside	<1	1.2	0.003	NA
2 Common	ND	Not Sampled	0.005	<.001
2 Res 1	ND	Not Sampled	<.001	NA
2 Res 2	ND	Not Sampled	0.002	NA
2 Window Sill	<1	<1	NA	NA
2 Outside X	1.3	NA	Not Sampled	NA

Building 2 Notes: DEP inspected and found asbestos-containing material in the outdoor location which was then professionally abated.

PCM results exceeded 0.003 f/cc in the common area. Asbestos fibers were not detected in this sample by TEM analysis.

There was not enough material left to analyze the indoor dust samples by TEM.

	Building 3									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
3	Outside	Not Sampled	Not Sampled	<.001	NA					
3	Common	Not Sampled	Not Sampled	<.001	NA					
3	Res 1	Not Sampled	Not Sampled	<.001	NA					
3	Res 2	Not Sampled	Not Sampled	<.001	NA					
3	Res 2 X	Not Sampled	Not Sampled	<.001	NA					
	Building 4									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
4	Outside	Not Sampled	Not Sampled	0.001	NA					
4	Common	ND	<1	0.001	NA					
4	Res 1	ND	<1	<.001	NA					
4	Res 2	ND	<1	0.001	NA					
4	Outside X	Not Sampled	Not Sampled	<.001	NA					
4	Common X	Not Sampled	Not Sampled	0.001	NA					
	Building 5									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
5	Outside	3.4	NA	0.002	NA					
5	Common	Not Sampled	Not Sampled	0.002	NA					
5	Res 1	<1	<1	0.002	NA					
5	Res 2	ND	<1	<.001	NA					
5	Outside X	Not Sampled	Not Sampled	0.003	NA					
Building 5 Notes: Upon reinspection DEP found no visible dust in the outdoor area at this location.										
	Building 6									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
6	Outside	Not Sampled	Not Sampled	<.001	NA					
6	Common	ND	<1	<.001	NA					
6	Res 1	ND	ND	<.001	NA					
6	Res 2	ND	ND	<.001	NA					
6	Res 2 X	Not Sampled	Not Sampled	0.002	NA					
	Building 7									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
7	Outside	ND	1.7	<.001	NA					
7	Common	ND	ND	0.001	NA					
7	Res 1	ND	ND	0.001	NA					
7	Res 2	ND	ND	<.001	NA					
7	Window Sill	ND	ND	NA	NA					
Building 7 Notes: DEP reinspected, collected samples, and found no asbestos-containing material.										
	Building 8									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
8	Outside	Not Sampled	Not Sampled	0.001	NA					
8	Common	ND	ND	0.002	NA					
8	Res 1	ND	ND	0.003	NA					
8	Res 2	ND	ND	0.002	NA					
	Building 9									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
9	Outside	Not Sampled	Not Sampled	<.001	NA					
9	Common	ND	ND	0.001	NA					
9	Res 1	ND	<1	0.001	NA					
9	Res 2	ND	<1	0.003	NA					
9	Common X	Not Sampled	Not Sampled	0.001	NA					

	Building 10									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
10	Outside	ND	ND	0.001	NA					
10	Common	ND	1.5	0.002	NA					
10	Res 1	ND	ND	0.001	NA					
10	Res 2	ND	ND	0.001	NA					
Building 10 Notes: The original sample from this location was re-analyzed and found to contain asbestos at levels less than 1% by TEM analysis;										
DOH and DEP inspected the common area based on the original result and found no visible dust at this location.										
	Building 11									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
11	Outside	Not Sampled	Not Sampled	<.001	NA					
11	Common	ND	ND	<.001	NA					
11	Res 1	ND	<1	<.001	NA					
11	Res 2	ND	1.5	<.001	NA					
11	Common X	Not Sampled	Not Sampled	<.001	NA					
Building 11 Notes: Residence 2 was unoccupied when tested and referred to DEP for reinspection. DEP was denied access to reinspect.										
According to the landlord the apartment was cleaned prior to reoccupancy.										
	Building 12									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
12	Outside	Not Sampled	Not Sampled	<.001	NA					
12	Common	ND	ND	<.001	NA					
12	Res 1	ND	ND	0.001	NA					
12	Res 2	ND	ND	<.001	NA					
	Building 13									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
13	Outside	Not Sampled	Not Sampled	0.001	NA					
13	Common	ND	ND	0.001	NA					
13	Res 1	ND	ND	0.003	NA					
13	Res 2	ND	ND	0.002	NA					
	Building 14									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
14	Outside	Not Sampled	Not Sampled	<.001	NA					
14	Common	ND	ND	0.003	NA					
14	Res 1	ND	ND	0.001	NA					
14	Res 2	ND	ND	<.001	NA					
14	Res 1 X	Not Sampled	Not Sampled	<.001	NA					
	Building 15									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
15	Outside	ND	1.9	<.001	NA					
15	Common	ND	ND	0.001	NA					
15	Res 1	ND	<1	<.001	NA					
15	Res 2	ND	ND	<.001	NA					
Building 15 Notes: DEP inspected and found asbestos-containing material which was then professionally abated.										
	Building 16									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
16	Outside	ND	ND	<.001	NA					
16	Common	ND	ND	<.001	NA					
16	Res 1	Not Sampled	Not Sampled	Not Sampled	NA					
16	Res 2	ND	ND	<.001	NA					
16	Res 2 X	ND	NA	Not Sampled	NA					

✓
 changed
 to DEP will
 continue to
 try to reinspect

	Building 17									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
17	Outside	Not Sampled	Not Sampled	<.001	NA					
17	Common	ND	ND	<.001	NA					
17	Res 1	ND	ND	<.001	NA					
17	Res 2	ND	ND	<.001	NA					
	Building 18									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
18	Outside	ND	ND	<.001	NA					
18	Common	ND	ND	<.001	NA					
18	Res 1	ND	ND	0.002	NA					
18	Res 2	ND	ND	0.002	NA					
	Building 19									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
19	Outside	ND	Not Sampled	<.001	NA					
19	Common	ND	ND	overloaded	<.006					
19	Res 1	ND	ND	<.001	NA					
19	Res 2	ND	ND	<.001	NA					
Building 19 Notes: There was not enough material left to analyze the outdoor dust sample by TEM.										
The overloaded air sample was analyzed by TEM and no asbestos fibers were detected.										
	Building 20									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
20	Outside	Not Sampled	Not Sampled	<.001	NA					
20	Common	ND	ND	<.001	NA					
20	Res 1	ND	ND	<.001	NA					
20	Res 2	ND	ND	<.001	NA					
20	Outside X	Not Sampled	Not Sampled	<.001	NA					
	Building 21									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
21	Outside	Not Sampled	Not Sampled	<.001	NA					
21	Common	ND	ND	<.001	NA					
21	Res 1	ND	ND	<.001	NA					
21	Res 2	ND	ND	<.001	NA					
	Building 22									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
22	Outside	ND	ND	<.001	NA					
22	Common	ND	ND	0.001	NA					
22	Res 1	ND	ND	<.001	NA					
22	Res 2	ND	ND	<.001	NA					
22	Res 2 X	Not Sampled	Not Sampled	<.001	NA					
	Building 23									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
23	Outside	Not Sampled	Not Sampled	<.001	NA					
23	Common	ND	ND	<.001	NA					
23	Res 1	ND	ND	<.001	NA					
23	Res 2	ND	ND	<.001	NA					
	Building 24									
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
24	Outside	ND	ND	0.002	NA					

24	Common	ND	<1	0.001	NA					
24	Res 1	ND	ND	0.001	NA					
24	Res 2	ND	ND	0.005	<.001					
24	Res 2 X	Not Sampled	Not Sampled	0.005	<.001					
Building 24 Notes: PCM results exceeded 0.003 f/cc in Residence 2 in two samples;										
Asbestos fibers were not detected in either sample by TEM analysis.										
Building 25										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
25	Outside	Not Sampled	Not Sampled	<.001	NA					
25	Common	ND	ND	<.001	NA					
25	Res 1	ND	ND	<.001	NA					
25	Res 2	ND	ND	0.001	NA					
Building 26										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
26	Outside	Not Sampled	Not Sampled	0.001	NA					
26	Common	ND	ND	0.004	<.001					
26	Res 1	ND	ND	0.001	NA					
26	Res 2	ND	ND	0.012	<.001					
Building 26 Notes: PCM results exceeded 0.003 f/cc in the common area and Residence 2;										
Asbestos fibers were not detected in either sample by TEM analysis.										
Building 27										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
27	Outside	ND	<1	<.001	NA					
27	Common	ND	<1	<.001	NA					
27	Res 1	ND	<1	<.001	NA					
27	Res 2	ND	ND	<.001	NA					
Building 28										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
28	Outside	ND	ND	<.001	NA					
28	Common	ND	ND	0.001	NA					
28	Res 1	ND	Not Sampled	<.001	NA					
28	Res 2	ND	ND	0.002	NA					
Building 28 Notes: There was not enough material left to analyze the Residence 1 dust sample by TEM.										
Building 29										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
29	Outside	ND	ND	<.001	NA					
29	Common	ND	ND	<.001	NA					
29	Res 1	ND	ND	<.001	NA					
29	Res 2	ND	ND	<.001	NA					
Building 30										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
30	Outside	Not Sampled	Not Sampled	Not Sampled	NA					
30	Common	Not Sampled	Not Sampled	Not Sampled	NA					
30	Res 1	ND	ND	<.001	NA					
30	Res 2	ND	ND	<.001	NA					
Comparison Buildings Above 59th Street										
Building 31										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
31	Outside	Not Sampled	Not Sampled	<.001	NA					

31	Common	ND	ND	<.001	NA					
31	Res 1	ND	ND	<.001	NA					
31	Res 2	ND	ND	<.001	NA					
31	Outside X	Not Sampled	Not Sampled	0.001	NA					
Building 32										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
32	Outside	Not Sampled	Not Sampled	<.001	NA					
32	Common	ND	ND	0.002	NA					
32	Res 1	ND	ND	<.001	NA					
32	Res 1 X	Not Sampled	Not Sampled	0.001	NA					
Building 33										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
33	Outside	Not Sampled	Not Sampled	Not Sampled	NA					
33	Common	Not Sampled	Not Sampled	Not Sampled	NA					
33	Res 1	ND	ND	<.001	NA					
Building 34										
		PLM [%]	TEM [%]	PCM [f/cc]	TEM [f/cc]					
34	Outside	Not Sampled	Not Sampled	<.001	NA					
34	Common	ND	ND	<.001	NA					
34	Res 1	ND	Not Sampled	0.002	NA					
34	Res 1 X	Not Sampled	Not Sampled	0.003	NA					
Building 34 Notes: There was not enough material left to analyze the Residence 1 dust sample by TEM.										
Notes										
Definitions of Abbreviations:										
PLM is Polarized Light Microscopy										
% is percent of volume										
TEM is Transmission Electron Microscopy										
PCM is Phase Contrast Microscopy										
f/cc is fibers per cubic centimeter										
Res 1 is Residential Unit 1										
Res 2 is Residential Unit 2										
X is a co-located sample										
ND is not detected										
NA is not analyzed										
ACM is asbestos-containing material										
DEP is the New York City Department of Environmental Protection										
DOH is the New York City Department of Health										
Samples were not taken in some locations because:										
No dust available to collect;										
No consent from building management to do monitoring in outdoor or common areas;										
Unknown, reason was not specified on survey or chain of custody form.										

7.12

Avaltroni, Robert

From: Vincent Coluccio
Sent: Tuesday, April 09, 2002 10:23 AM
To: rcwl@cdc.gov; svrl@cdc.gov; avaltronir@dep.nyc.gov; dianac@dep.nyc.gov; michaelgi@dep.nyc.gov; callahan.kathy@epa.gov; laposta.dore@epa.gov; maddaloni.mark@epa.gov; tulis.dana@epa.gov; Thomas Frieden; Wilfredo Lopez
Cc: Caroline Bragdon; Christopher D'Andrea; Greg Butler; Jessica Leighton; Jim Miller; Jeanine Prudhomme; Kelly McKinney; Nancy Jeffery
Subject: Residential Asbestos Sampling Results; 04/03/02 DRAFT: Not for Public Release

Per my email of last week, we would like to obtain any comments you may have on the attached draft sampling results. Please communicate any comments to me before 3 PM today.

Thank you

Vincent Coluccio, DrPH
 NYC DOH
 Phone: 914 671 4072
 Email: vcolucci@health.nyc.gov
 Fax: 212- 431-2585

Attached is a revised draft spreadsheet of NYCDOH/ATSDR residential sampling results, for asbestos samples obtained November 4 through December 11, 2001.

For your information I have also attached a copy of the Sampling Plan for this study.

Please review this document and provide me with any comments by Monday, April 8. Our plan is to finalize this document for public release next week.

Feel free to contact me with any questions or comments.

Thank You

Vincent Coluccio, DrPH
 NYC DOH
 Phone: 914 671 4072
 Email: vcolucci@health.nyc.gov

Fax: 212- 431-2585

YC ATSDR Samplin Asbestos_FG_public
 Plan.pdf version 4-3.xls

Mike G. spoke to Vincent C.
 4/9



**Department of
Environmental
Protection**

59-17 Junction Boulevard
Corona, New York
11368-5107

**Joel A. Miele Sr., P.E.
Commissioner**

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www.nyc.gov/dep

(718) DEP-HELP

Ambient and Indoor Sampling for Public Health Evaluations of Residential Areas Near World Trade Center - Sampling Protocol

Following the WTC disaster, the New York City Department of Health working with the Agency for Toxic Substances and Disease Registry and the New York State Department of Health conducted indoor and dust sampling in 30 residential buildings in Lower Manhattan. The sampling plan for this investigation is provided below.

Foreword - February 26, 2002

This protocol was used by the New York City Department of Health in collaboration with the U.S. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service Commissioned Corps, and the federal World Trade Center Environmental Assessment Working Group to conduct a limited investigation (November 4 - December 11, 2001) of residential areas near and around the World Trade Center. Prior to implementing the investigation, this protocol was reviewed by members of the federal World Trade Center Environmental Assessment Working Group. Formed on September 15, 2001, the working group is made up of representatives from the U.S. Department of Health and Human Services, the U.S. Environmental Protection Agency, and the U.S. Department of Labor. The purpose of the group is to coordinate public health and occupational sampling and data review among the three federal agencies in support of the New York City Department of Health and the New York State Department of Health. In addition, the protocol was reviewed by representatives of the New York State Department of Health, New York State Department of Environmental Conservation, the New York City Department of Environmental Protection, and the New York City Department of Health. On October 26, 2001, the New York City Department of Health, Institutional Review Board approved the protocol.

Sampling of the residential areas occurred from November 4 through December 11, 2001, and was conducted by U.S. Public Health Service Commissioned Officers detailed to the New York City Department of Health with assistance from the New York City Department of Health. It is anticipated that the final report concerning this limited pilot investigation will be available in May 2002. However, the New York City Department of Health will provide participants in this investigation and the public with relevant public health information as soon as data analysis and interpretation permit. On February 8, 2002, the New York City Department of Health did provide the participants with preliminary results regarding the amount of asbestos detected in air and settled dust. This information, along with the amount of fibrous glass detected in settled dust, was also provided to the general public.

**October 26, 2001, Protocol for
Ambient and Indoor Sampling for Public Health Evaluations of
Residential Areas Near World Trade Center, New York, New York**

I. Introduction

Prior to November 4, 2001, this sampling protocol was developed to assess potential exposures to airborne and settled surface dust that entered residential areas following the collapse of the World Trade Center (WTC) buildings. The collapse of the WTC buildings resulted in a large number of residents being evacuated from their homes. Since the collapse, some residents have not re-occupied their apartments/homes near the WTC. Many of these residents have either visited to assess damage or to clean. Many have re-occupied their homes, and it is anticipated that more residents will soon be moving back. To date, environmental sampling efforts have focused on rescue/recovery areas (occupational); some sampling of commercial buildings to ensure office worker safety; and ambient (outdoor) air sampling for asbestos in a number of residential/commercial areas. Additional sampling is needed to assess possible WTC-related contaminants in residential areas—both indoors and outside.

Surface dust and debris containing asbestos have been found in lower Manhattan. Asbestos has been detected in personal air samples of rescue and recovery workers. In addition, low levels of asbestos have been detected in air samples collected at the WTC perimeter. Crystalline silica quartz has been detected in some of the 30 settled dust samples collected by the Centers for Disease Control and Prevention's National Institute of Occupational Safety and Health (NIOSH). Although most samples contained less than 5%, some samples contained from 15-20% crystalline silica quartz. Of the twelve personal air samples from the work site that have been analyzed for respirable crystalline silica, no detectable levels were found.

Dust, bulk, and air samples (mostly on or near the work site), as well as surface runoff water, river sediment, and river water have been analyzed for other contaminants, including metals, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), dioxins and polychlorinated biphenyls (PCBs). The low levels of these contaminants that have been found do not indicate an immediate need to conduct widespread environmental testing for them.

Materials in airborne dust that may be of more immediate health concern—especially to residents who are returning to lower Manhattan—are those that can cause eye, nose, and throat irritation. Materials that can be inhaled or respired from airborne dust may cause respiratory irritation and exacerbation of pre-existing problems such as asthma, emphysema, and cardiopulmonary disease. Analysis of WTC-related residential surface and airborne dust, both indoors and outdoors, is to 1) respond to public concerns, 2) determine if residents are being exposed to concentrations of materials that may be of public health concern; 3) determine whether areas already cleaned (inside and outside environments) contain materials that may be of public health

concern; and 4) provide information to the public on the potential health implications (or lack of implications) of the sample results.

During October 2001, information from residents supported the need to further assess potential indoor and outdoor environmental health issues. Burning throats have been reported to be a common problem in the recently re-occupied residential areas. Residents in south Battery Park City, whose windows were open at the time of the WTC collapse, have settled dust in their homes. Some have disposed of furniture, stereo equipment, etc., because they were covered with “ash and dust.” Homes in part of the Tribeca zone (Chambers Street to Murray Street, west of Broadway) are not yet occupied, but were reported to have roofs covered with hand-sized chunks of insulation-like material that contain small pieces of mica-like material. In addition, the mica-like material has clogged roof drains and resulted in standing pools of water on residential roof tops.

II. Sampling Objective

The **overall objective** of this sampling is to provide results upon which public health agencies can further determine the potential for environmental exposures to WTC collapse-related materials and possible health implications of the exposures. Sampling will characterize ambient and indoor airborne and potentially airborne particles (surface dust) in residential areas of lower Manhattan from the collapse of WTC. Specifically, the objective is:

Characterize the make-up and size distribution of settled dust and airborne breathing zone dust in residential areas—both indoors and outside—near the WTC. This information will be used to further determine if materials are present in air at levels of public health concern; and if materials are present in settled surface dust that can be re-entrained and result in continued exposures.

Sample locations will be selected in a concentric circle pattern, starting close to the WTC. Section V, Residence Selection/Sampling rationale, of this protocol describes this approach.

Note: The sampling objective/approach is focused on contaminants that emanated from the collapse of the WTC towers and that might cause health problems. However, this investigation will not be able to conclude if contaminants/materials are actually from the disaster. The contaminants that have been selected for testing might be present in some areas from other sources. Examples include: cooking on a stove top can increase indoor airborne particulate matter; vehicle exhaust can increase outdoor airborne particulate matter; recent home renovation can result in an increase in levels of gypsum, fiberglass, etc. in the air and surface dust.

III. Data and Quality Assurance

Co-located samples will be collected in 10% of the air samples. While not a true duplicate, evaluation of the results will provide some information on the quality of the sampling technique. Generally, analysis of duplicate samples should be within +/- 25% of each other.

At least two field blanks (or 10% of samples submitted, whichever is greater) per air sample method per sample team will be submitted with the air samples collected each day. Blank cassettes should be opened at the same time as the sample cassettes are opened (just prior to sampling). Blank cassettes will be recapped and stored in a clean area (e.g., closed bag or box) with the covers from the sampling cassettes during the sampling period. Each air sampling pump will be calibrated with a representative sampling device in-line before and after sample collection. Sample flow rates will be documented in the sampling log. The average of pre- and post-calibration flow rates will be used as the sample flow rate, for sample volume calculations.

Dust samples will be collected using the U.S. Environmental Protection Agency (EPA) Environmental Response Team (ERT) indoor dust sampling standard operating procedure (SOP). Duplicate samples are not feasible with indoor surface dust sample collection. Co-located samples (samples collected from adjacent areas of the floor) will be collected in 10% of the indoor surface dust sample locations. While not a true duplicate, evaluation of the results will provide some information on the variability of contaminants in the dust.

Samples should not be packaged in untreated polystyrene—electrostatic forces may cause fiber loss from some sample filters.

Chain of custody will be established and maintained throughout sample collection, transport, and analysis of the samples. Laboratory analysis shall follow all method-required quality assurance and quality control procedures.

All samples collected, unless analyzed with destructive methods, will be archived until further notice.

IV. Sampling Parameters

<u>Parameter</u>	<u>Sample Type</u>	<u>Indoor/Outdoor</u>	<u>Rationale for Selection</u>
Asbestos	breathing ht., time-weighted air	I/O	Known use in building construction, evidence of presence in early air sampling and in settled dust, known inhalation carcinogen
Inhalable (<100			

V. Residence Selection/Sampling Rationale

The selection of residential sampling locations will be decided upon by New York City Department of Health (NYCDOH). The general NYCDOH approach is described as follows: A total of approximately 60 residential units will be sampled (a **unit** is an individual apartment in a multi-apartment building). A series of three concentric circles is being drawn around the WTC location. These circles will be divided by direction or zone from the WTC (north, south and west, and east). From five to seven of the multi-residential buildings will be selected for testing from within each zone.

Testing locations will mainly focus on occupied residences. However, approximately five unoccupied units nearest the WTC will be targeted for testing. In addition, approximately five units will be selected outside of the concentric circles, that were not impacted by the WTC collapse, to serve as background sample locations.

Sampling personnel will document the rationale for selecting buildings and residential units for sampling. They will also document sample locations, conditions during sampling, and possible interfering factors (e.g., traffic, construction). In addition, unit occupants and building owner/operators will be requested to provide information that will better assist in evaluating the results. *Appendix A* of this plan contains the information needed/requested.

VI. Sampling/Analysis Approach

1. Indoor

Air and surface dust sampling will focus on both a common entryway area into the building (e.g., lobbies, front entryways) and on a selected number of apartments/units in the building. Attempts will be made to select apartments/units where dust is visible as well as units where dust is not visible. Selecting entryways and common areas should be representative of worst case conditions for contaminant/material track-in from outdoors. Selecting two apartments/units in the same building—with and without visible dust—should provide information on the ranges of contaminants found in indoor living spaces.

If the building is unoccupied and no central HVAC system is present, aggressive (leaf blower, high-power fan) indoor air sampling should be conducted. If the building is occupied, air sampling should be conducted with the building/unit heating, ventilation, and air conditioning (HVAC) system's fan in continuous operation. After sampling is completed, filters for the HVAC system, if applicable, should be inspected. If dust is present, recommend filter replacement.

Indoor air sampling for asbestos will be conducted and analyzed using NIOSH methods 7400 and 7402. Respirable crystalline silica will be sampled and analyzed using NIOSH method 7500. Air sampling for inhalable and thoracic size particles will be conducted using EPA method IP-10A. The respirable silica sample will be used to analyze the respirable fraction of the dust. The relative amounts (percent weight) of each fraction present will be determined. Each fraction will be analyzed for silica, gypsum, mica, and calcite using X-ray diffraction (XRD) analysis. Fibrous glass will be analyzed using scanning electron microscopy (SEM).

Indoor floor dust samples will be collected using the EPA ERT SOP for household dust collection. As much dust as possible will be collected; the area vacuumed will be measured and reported. Samples will be analyzed for crystalline silica, gypsum, mica, and calcite using XRD analysis. Asbestos and fibrous glass will be analyzed using New York State Method 198.1 (polarized light microscopy [PLM]); if <1% asbestos is found, New York State Method 198.4 (transmission electron microscopy [TEM]) analysis will be conducted. The pH of the dust will be tested using EPA SW846 Method 9045C.

2. Outdoor

Outdoor air and settled dust sampling will occur in areas adjacent to the residential building being tested indoors. Sampling will occur concurrently with indoor sampling.

Ambient air sampling will be conducted at breathing height. Air sampling for asbestos will be conducted and analyzed using NIOSH methods 7400 and 7402. Respirable crystalline silica will be sampled and analyzed using NIOSH method 7500. Air sampling for inhalable and thoracic size particles will be conducted using EPA method IP-10A. The respirable silica sample will be used to analyze the respirable fraction of the dust. The relative amounts (percent weight) of each fraction present will be determined. Each fraction will be analyzed for silica, gypsum, mica, and calcite using XRD analysis, and for fibrous glass using SEM.

Settled surface dust samples will be collected by scooping visible dust into a glass container. A minimum of 25-30 grams of sample is required. The area of the surface sampled (e.g., 100 cm²) will be measured and documented. Samples will be analyzed for crystalline silica, gypsum, mica, and calcite using XRD analysis, and for asbestos and fibrous glass using New York State method 198.1 (PLM). If PLM shows less than <1% asbestos, New York State Method 198.4 (transmission electron microscopy [TEM]) analysis will be conducted. The pH of the dust will be tested using EPA SW846 Method 9045C.

*** I: indoor; O: outdoor

VII. Interference from existing building materials

It is anticipated that some of the contaminants/materials found in this sampling effort will be un-related to the WTC event. Attempts will be made during sample collection to note other possible sources of contaminants (Section VIII, Information Needs for Samples/Sample Locations).

To better determine if contaminants/materials found are within area background levels, approximately five residential units outside of the concentric circle zones will be selected for testing (indoor air and surface dust, outdoor air and surface dust). Contaminant levels found inside and outside of the background homes, along with specific sample location information, will be considered when data interpretation is conducted.

VIII. Community Notification of Results

The analytical results along with a public health interpretation will be provided to the community in several different ways. All participants who allowed sampling in their home will be provided with their individual results. Each building owner/operator will be given results of all sampling conducting in the building. Results (without personal identifiers) will also be provided to all occupants of the building. Finally, all results (without personal identifiers) will be provided to residents in lower Manhattan.

In each instance, notification will include a summary of the results; a comparison of the results of samples collected in lower Manhattan with the results of samples collected as NYC background; a public health interpretation of the results; a discussion of the limitations of the data; and recommendations (if needed) that would reduce exposures.

These notifications will be prepared after all of the analytical data has been received. It is anticipated that notification will occur within *6-8 weeks* after sampling is begun. However, data and its QA/QC will be reviewed as it is provided by the laboratory. If, results are found that indicate a more immediate notification is necessary (e.g., levels are found that pose a public health hazard), the participants who may be impacted will be notified as soon as possible. Based on the circumstances, this notification may include just residents in an individual unit, or it may include all residents in the building along with the building owner/operator. If such a notification is necessary, all involved public health agencies will take steps to ensure that it includes specific recommendations/actions that can be quickly implemented to reduce exposures below levels that pose a health hazard.

IX. Screening Values/Data Interpretation/Recommended Actions

Screening levels and actions are outlined in *Appendix B*.

Data will be evaluated by local, state and federal public health agencies. Evaluations will include:

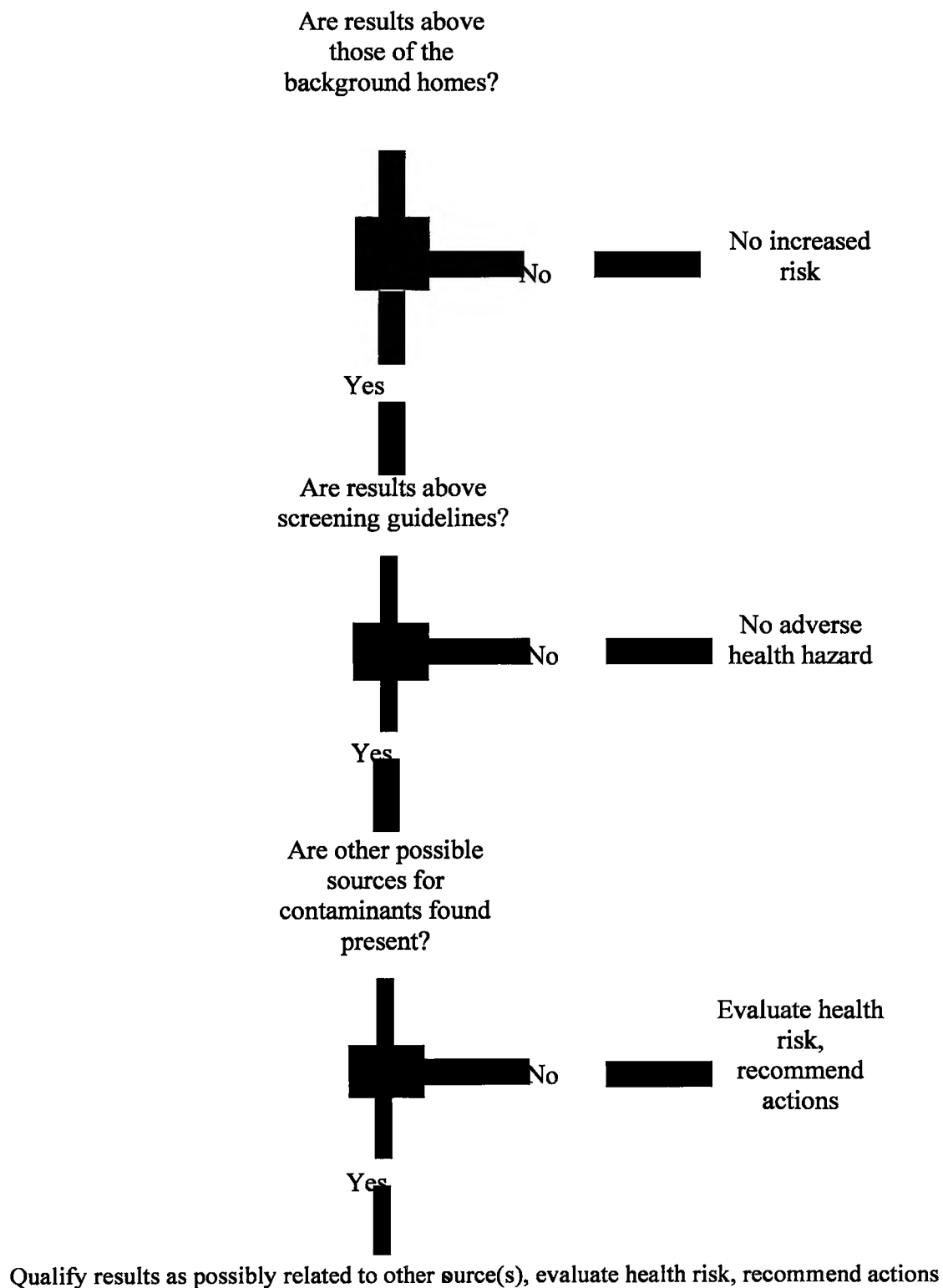
- 1) Indoor sample results will be compared to the results found in the background homes and evaluated on a residence-by- residence basis (for the individual occupants)
- 2) All indoor data will be compared to the results found in the background homes and evaluated to determine any public health implications for residents near the WTC
- 3) All outdoor data will be compared to the results found in the background homes and evaluated to determine any public health implications for those living near the WTC
- 4) The relationship between materials found in indoor and outdoor samples will be evaluated.

For 1 through 3, above, sample results will first be compared to the results from background homes. If results are less than or within the levels found in background locations, then the health interpretation will stress that there is no indication that the resident(s) in the area tested are at any increased risk compared to those in communities further away from the WTC.

If sample results are higher than those of the background homes, the results will be compared to screening guidelines. These screening levels are outlined in the next Section. If values are below screening guidelines, the health interpretation will stress that the levels of contaminants found are below those of public health concern. If values exceed the screening guidelines, then sample collection information (Appendix A) will be reviewed in detail to determine if a possible source or contributing source (e.g., remodeling activities, road construction) of the contaminant(s) is possible. If a possible source or contributing source is found, this information will be included in the interpretation of the results. If the possible source is controllable (e.g., sweeping with a broom), recommendations will be made that will reduce levels of contaminants. If no other source of the contaminant(s) is indicated and sample collection information indicates the presence of variables associated with WTC-related dust (e.g., visible settled dust, windows open during WTC collapse), this information will be included in the interpretation of the results. Recommendations to clean (or re-clean) areas to reduce exposures will be made. A public health implications statement will be provided with each set of results.

If levels of contaminants are found outdoors that exceed those of the background homes and the screening guidelines, recommendations will be made to take steps that eliminate transporting the contaminants indoors (e.g., reduce contaminant track in by removing or changing shoes prior to entering residence, use higher efficiency filters on HVAC systems, keep windows closed). In addition, a public health implications statement will be provided for outdoor results.

Figure 1 - Follow Chart of How Data Evaluations Will be Conducted



none of these air samples were analyzed by TEM, it is not known if they were asbestos fibers. For this analysis of a worst-case exposure, it will be assumed they are asbestos. Four of these samples were taken in common areas during normal daily activity. All other air samples, including the highest, 0.003 f/cc, were taken in residences that were aggressively sampled. Using the IRIS slope factor, no appreciable increase in cancer risk is seen when considering a 1-year continuous exposure at the highest fiber level cited (1×10^{-5} excess cancer risk).

If the highest measured PCM levels are assumed to be all asbestos fibers (a worst-case assumption) and were representative of long-term conditions (another worst-case assumption), the cumulative exposure for a continuous 30-year residence would result in a greater risk estimate for lung cancer and mesothelioma. Therefore these data cannot rule out the potential for long-term risk. However, the highest airborne level measured during this study is not necessarily representative of long-term exposure nor is the highest level necessarily all asbestos fibers. As presented in the discussion section of this report, it is expected that the ongoing cleaning of lower Manhattan should reduce levels of these materials over time, thus reducing long-term risk. Therefore cleaning should be continued and levels of asbestos monitored, until the data demonstrate long-term risk of lung cancer and mesothelioma are minimal.

8. Multiple Material Exposures

Each of the materials discussed previously may exist singly or in combination with other materials found in lower Manhattan. The combinations of materials found in this investigation are described in the discussion of results. When exposures to multiple materials occur together, there is some potential that the agents may interact with respect to their adverse effects. Agents may be additive if they impact an organ system similarly. Synergistic and antagonistic effects may also be seen if the agents either potentiate or disrupt the effects of other agents.

a. Irritant Effects

The effects of the alkaline minerals are most likely additive, although it should be noted that not all of the materials are equally caustic. Therefore, cumulative effects on pH would be the best measure of irritant effects based on the caustic nature of the dust. There may also be potentially additive or synergistic effects with the irritant effects of the SVF. The ability of either caustic action or the mechanical action of the fibers or minerals to degrade the protective properties of skin and mucus membranes may make tissue more susceptible to irritant effects. Additionally, because both types of actions may trigger localized immune responses, these irritants may potentiate each other.

b. Noncancer Pulmonary Effects

Several of the minerals detected contribute to fibrotic lung damage and may result in several diseases that reduce lung function including silicosis, asbestosis, other mineral fibroses, emphysema, and other respiratory disorders. The mechanisms and pathology of

these conditions are similar, and the effects of these agents may be considered at least additive. However, each material has a different toxicity based on the mineral properties of that material. Less biopersistent materials, such as SVF, have the least long-term toxicity, and more biopersistent material, such as asbestos, have greater long-term toxicity. In general, the order of toxicity may be SVF < mica < silica < asbestos, based on solubility and availability for clearance. No factors currently exist to combine risk estimates for these different materials.

CONCLUSIONS

On the basis of the analytical results of samples taken between November 4 through December 11, 2001, and information collected during the sampling effort, the New York City Department of Health and Mental Hygiene and the U.S. Agency for Toxic Substances and Disease Registry make the following conclusions (not in order of importance).

- Total fiber counts of air samples taken in lower Manhattan were similar to the comparison areas above 59th Street sampled during this investigation. The six lower Manhattan areas that had elevated total fiber counts were re-examined by transmission electron microscopy (TEM) and scanning electron microscopy (SEM). The TEM and SEM results indicated that neither asbestos nor SVF contributed to the elevated fiber counts.
- Low levels of asbestos were found in some settled surface dust, primarily below Chambers Street. Many of the lower Manhattan locations sampled had been previously cleaned prior to this investigation. No asbestos was detected in the comparison indoor dust samples taken north of 59th Street. The City of New York has conducted follow-up activities at the locations where asbestos was detected in settled surface dust. Only two follow-up locations, outdoor areas, required professional asbestos abatement. Following-up activity at the other locations did not find any asbestos containing materials.
- When compared with the results obtained from the comparison sampling locations, the lower Manhattan residential areas sampled by this investigation tended to have a greater percentage of SVF (primarily fiberglass), mineral components of concrete (quartz, calcite, and portlandite), and mineral components of building wallboard (gypsum, mica, and halite) in settled surface dust. However, the frequency of detections and prevalence patterns of these minerals are similar in both residential areas.
- Exposure to significant amounts of synthetic vitreous fibers (SVF), mineral components of concrete (quartz, calcite, and portlandite), and mineral components of building wallboard (gypsum) may cause skin rashes, eye irritation, and upper respiratory irritation, all of which have been voiced as concerns by citizens and first responders. If the reported irritant effects are associated with World Trade Center related materials, these effects will subside once exposure to SVF, mineral components of concrete, and mineral components of building wallboard end. Some

people with pre-existing heart or lung disease (e.g., asthma) or a previous history of very high levels of exposures (occupational) to SVF, mineral components of concrete, and mineral components may be more sensitive to the irritant effects of SVF, mineral components of concrete, and mineral components of building wallboard.

- Sometimes mineral components of concrete (calcite and portlandite) and mineral components of building wallboard (gypsum, mica, and halite) were detected in air samples at higher estimated levels in lower Manhattan residential areas than in samples taken at comparison residential areas above 59th Street. These detected mineral levels are orders of magnitude below occupational standards. Although the occupational standards do not account for sensitive individuals or extended periods of exposure, they provide a comparison to an established health guidance value. The levels of minerals seen in airborne dust do not pose potential health hazards even for a continuous year of exposure at the highest levels detected.
- Some settled surface dust could become airborne if disturbed. Therefore, people could potentially inhale the asbestos, SVF, mineral components of concrete (quartz, calcite, and portlandite), and mineral components of building wallboard (gypsum, mica, and halite) found in settled surface dust of some lower Manhattan residences. Because we did not determine the weight of dust present in the areas sampled, it is not possible to determine whether any particular residence had an elevated dust loading. Appropriate continued frequent cleaning should minimize exposures.
- Several worst-case assumptions were made in order to assess the potential long-term public health risks of airborne asbestos and quartz. Some of the assumptions were that no cleaning of indoor spaces has occurred or will occur, all fibers found in air were asbestos fibers, and the highest levels detected last fall in air represent long-term air levels. Using these worst-case assumptions, prolonged exposure (decades) to airborne asbestos and quartz *may* increase the long-term, theoretical risk of people developing lung cancer and other adverse lung health effects (more than 1 additional case in 10,000 people exposed). For individuals who conduct frequent cleaning of their residences, as recommended in this report, or participate in the U.S. Environmental Protection Agency cleaning/sampling program, it is unlikely that their exposure would resemble these worst-case conditions.
- A review of the building sampling results from this investigation indicates that there is not a consistent spatial distribution pattern of asbestos, SVF, mineral components of concrete, and mineral components of wallboard in air and settled surface dust. This indicates that the materials are heterogeneously distributed. There are many factors that may contribute to the heterogeneous distribution, including whether the area was cleaned (indoors and outdoors), cleaning method, date since last cleaning, and how much dust was initially in the area. It is not clear which factors contributed to this trend.

- Results from this investigation do not necessarily reflect conditions that would be found in other buildings, at other times just following the collapse, or after the sampling period. The measurements reflect conditions present at the time of the sampling (November 4–December 12, 2001) in the buildings and areas sampled. The limited number of results obtained from the comparison areas above 59th Street may or may not reflect the New York City-specific background levels of asbestos, SVF, mineral components of concrete (quartz, calcite, and portlandite), and mineral components of building wallboard (gypsum, mica, and halite).

RECOMMENDATIONS

On the basis of the conclusions of this investigation, the New York City Department of Health and Mental Hygiene and the U.S. Agency for Toxic Substances and Disease Registry make the following recommendations.

- Because more asbestos, synthetic vitreous fibers (e.g., fiberglass), mineral components of concrete (quartz, calcite, and portlandite), and mineral components of building wallboard (gypsum, mica, and halite) were found in settled surface dust in lower Manhattan residential areas when compared to comparison residential areas above 59th Street, the New York City Department of Health and Mental Hygiene and the U.S. Agency for Toxic Substances and Disease Registry are recommending that people continue to conduct frequent cleaning with HEPA vacuums and damp cloths/mops to reduce the potential for exposure.
- To ensure that the recommended frequent cleaning is effective and to ensure that the health of people of New York City is protected, the New York City Department of Health and Mental Hygiene and the U.S. Agency for Toxic Substances and Disease Registry are recommending additional monitoring of residential areas in lower Manhattan. In addition, an investigation should be conducted to better define background levels specific to the city of New York for asbestos, synthetic vitreous fibers, mineral components of concrete (quartz, calcite, and portlandite), and mineral components of building wallboard (gypsum, mica, and halite).
- Lower Manhattan residents concerned about possible World Trade Center-related dust in their residential areas can request cleaning and/or testing from the U.S. Environmental Protection Agency (EPA) by logging on to the agency's World Trade Center Web page at www.epa.gov/wtc or by calling the EPA hotline at 1-877-796-5471.

PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan (PHAP) for the World Trade Center response contains a description of actions to be taken by the New York City Department of Health and Mental Hygiene (NYC DOHMH), the U.S. Agency for Toxic Substances and Disease Registry (ATSDR), and/or other government agencies. The purpose of the PHAP is to ensure that this investigation not only identifies potential public health hazards, but also provides a plan of action designed to mitigate and prevent possible adverse human health effects resulting from exposure to hazardous substances in the environment.

A. Public Health Actions Taken

Shortly after the collapse of the World Trade Center towers, NYC DOHMH staff, along with other governmental and private organizations, provided respirators and fit checking for people participating in the recovery operations.

Beginning September 13, 2001, NYC DOHMH staff coordinated daily conference calls with the various governmental and private organizations that were conducting environmental sampling at and around the World Trade Center. These coordination calls ended in January 2002.

On September 15, 2001, the U.S. Department of Health and Human Services, the U.S. Environmental Protection Agency, and the U.S. Department of Labor formed the World Trade Center Environmental Assessment Working Group. The purpose of the group is to coordinate public health and occupational sampling and data review among the three federal agencies in support of the New York City Department of Health and Mental Hygiene and the New York State Department of Health. Other governmental (e.g., New York State Department of Health, New York State Department of Environmental Conservation, New York City Department of Health and Mental Hygiene, and the New York City Department of Environmental Protection) and private organizations (unions, research institutions, companies) participated on the Working Group.

Shortly after September 11, 2001, and through June of 2002, the U.S. Environmental Protection Agency (EPA), the Occupational Safety and Health Administration, the New York State Department of Environmental Conservation, the New York State Department of Health, and the New York City Department of Environmental Protection conducted frequent ambient environmental and occupational monitoring of many different types specifically for the World Trade Center response.

From September 18 through October 4, 2001, the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, conducted occupational sampling and evaluation of the conditions at the World Trade Center.

From November 4 through December 11, 2001, NYC DOHMH and ATSDR, with assistance from the U.S. Public Health Service Commissioned Corps, conducted limited sampling of residential areas in lower Manhattan.

On February 4, 2002, NYC DOHMH and ATSDR provided the public with the preliminary findings (asbestos air and dust and synthetic vitreous fibers dust sampling results) of the limited residential sampling investigation conducted in November and December of 2001. Various public meetings were conducted to provide the public with the most relevant information.

On February 13, 2002, EPA formed the Indoor Air Task Force to help address the remaining indoor air quality issues in lower Manhattan.

On March 8, 2002, New York City created the lower Manhattan Air Quality Task Force.

On May 8, 2002, EPA and its federal, state, and city partners announced a comprehensive plan to ensure that residences impacted by the collapse of the World Trade Center have been properly cleaned.

On June 1, 2002, lower Manhattan residents concerned about possible World Trade Center-related dust in their residential areas could begin to request cleaning and/or testing from EPA by logging on to the agency's World Trade Center Web page at www.epa.gov/wtc or by calling the EPA hotline at 1-877-796-5471.

B. Public Health Actions Planned

During the summer of 2002, EPA and its federal, state, and city partners will conduct additional sampling of settled surface dust and air of residential areas not impacted by the collapse of the World Trade Center towers. The purpose of this investigation is to better define the New York City-specific background levels of asbestos, synthetic vitreous fibers, and quartz. Mineral components of concrete (calcite and portlandite) and mineral components of building wallboard (gypsum, mica, and halite) will also be investigated.

During the summer of 2002, EPA and its federal, state, and city partners will conduct an investigation to determine the effectiveness of various cleaning methods to remove World Trade Center-related material.

In late summer/early fall 2002, EPA will begin to conduct cleaning and/or testing of residential areas requested by lower Manhattan residents.

The New York City Department of Health and Mental Hygiene and the U.S. Agency for Toxic Substances and Disease Registry will establish a unified World Trade Center Exposure Registry of people who may have been exposed to harmful substances resulting from the collapse of the World Trade Center towers.

The New York City Department of Health and Mental Hygiene and the U.S. Agency for Toxic Substances and Disease Registry will continue to work with other federal, state, and local agencies to provide information on the sampling results to the citizens of New York and to help interpret the possible health effects of contaminants found.

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World Trade Center Environmental Assessment Working Group

Formed on September 15, 2001, the World Trade Center Environmental Assessment Working Group is made up of representatives from the U.S. Department of Health and Human Services, the U.S. Environmental Protection Agency, and the U.S. Department of Labor. Other governmental (e.g., New York State Department of Health, New York State Department of Environmental Conservation, New York City Department of Health and Mental Hygiene and New York City Department of Environmental Protection) and private organizations (unions, research institutions, companies) participated on the Working Group. The purpose of the group is to coordinate public health and occupational sampling and data review among the three federal agencies in support of the New York City Department of Health and Mental Hygiene and the New York State Department of Health.

TABLES

Table 1 General Information on the World Trade Center Towers		
Height	Tower One: 1,368 feet	Tower Two: 1,362 feet
Weight	1.5 million tons	
Statistics	110 floors 6 basements (with 2 subway stations and PATH train station) 1 underground mall 43,600 windows 97 passenger elevators and 6 freight elevators 300 computer mainframes Air conditioning had 60,000 tons of cooling capacity	
Rentable Space	43,200 square feet per floor	10,000,000 total square feet
Owners and Operators	Port Authority of New York and New Jersey	
Groundbreaking	August 5, 1966	
Opening Ceremony	April 4, 1973 (Parts were opened between 1970–1973)	
Construction Materials	Steel: 200,000 tons	
	Concrete: 425,000 cubic yards	
	Glass: 600,000 square feet	
	Electric cables: 12,000 miles	

Table 2 2000 Census Block Level Population		
Distance From WTC	Total Population	Housing Units
One-Quarter Mile	6,965	4,617
One-Half Mile	17,596	10,768
Three-Quarter Mile	29,667	16,482
The 16-acre site of the World Trade Center was buffered, and an aerial proportion technique was used to estimate the number of persons living in the area.		

Table 3 Number of Buildings and Areas Within Buildings Sampled for Settled Surface Dust: Analyzed for Asbestos by PLM^a and TEM^b, SVF^c by PLM, and Minerals by XRD^d Due to available sample size and analytical objectives, some samples were not analyzed by each method.		
	Lower Manhattan	Above 59th Street
Buildings	29	4
Residential Units	57	5
Common Areas	26	3
Outdoors	14	0

Table 4 Number of Buildings and Areas Within Buildings Sampled for Fibers in Air: Analyzed for Total Fibers by PCM^e, Asbestos by TEM, and SVF by SEM^f						
	Lower Manhattan			Above 59th Street		
	Total Fibers (PCM)	Asbestos (TEM)	SVF (SEM)	Total Fibers (PCM)	Asbestos (TEM)	SVF (SEM)
Buildings	30	5	4	4	0	4
Residential Units	59	3	3	5	0	5
Common Areas	29	3	2	3	0	1
Outdoors	29	0	0	3	0	3

Table 5 Number of Locations Sampled for Minerals in Airborne Dust, Analyzed by XRD for Minerals								
	Lower Manhattan				Above 59th Street			
	PM100	PM10	PM4	PM2.5	PM100	PM10	PM4	PM2.5
Buildings	26	28	30	10	3	4	4	3
Residential Units	47	52	57	18	3	5	5	2
Common Areas	26	27	29	8	2	2	3	2
Outdoors	26	26	29	8	2	3	3	2

Notes:

- a. PLM = polarized light microscopy
- b. TEM = transmission electron microscopy
- c. SVF = synthetic vitreous fibers
- d. XRD = x-ray diffraction
- e. PCM = phase contrast microscopy
- f. SEM = scanning electron microscopy

Settled surface dust and air samples could not always be obtained together from the same sampling location.

Table 6 Summary of Locations With Asbestos or Synthetic Vitreous Fibers (SVF) in Settled Surface Dust Sampling locations that had either asbestos in the dust by PLM or TEM analysis or SVF in the settled surface dust by PLM analysis. Ranges of asbestos and SVF values for each type of location are included.					
Sampling Locations: Lower Manhattan	Total Number of Locations Sampled ^a	Number of Locations with Asbestos in Settled Surface Dust (% of locations detected) ^b	Range of Asbestos Found ^c	Number of Locations with SVF in Settled Surface Dust (% of locations detected) ^d	Range of SVF Found ^e
Outdoor	Asbestos (PLM) = 14 Asbestos (TEM) = 12 SVF (PLM) = 14	6 (43%)	<1%–3.4 %	11 (79%)	1%–72%
Common	Asbestos (PLM) = 26 Asbestos (TEM) = 25 SVF (PLM) = 26	5 (19%)	<1%–1.5%	14 (54%)	5%–27%
Residential	Asbestos (PLM) = 57 Asbestos (TEM) = 52 SVF (PLM) = 57	10 (18%)	<1%–1.5%	26 (46%)	2%–35% ^f
Whole Building	Asbestos (PLM) = 29 Asbestos (TEM) = 29 SVF (PLM) = 29	12 (41%)	<1%–3.4%	21 (72%)	2%–72%
Sampling Locations: Comparison Buildings	Total Number of Locations Sampled ^a	Number of Locations With Asbestos in Settled Surface Dust (% of locations detected) ^b	Range of Asbestos Found ^c	Number of Locations With SVF in Settled Surface Dust (% of locations detected) ^d	Range of SVF Found ^e
Common	Asbestos (PLM) = 3 Asbestos (TEM) = 3 SVF (PLM) = 3	0 (0%)	None Detected by PLM or TEM	0 (0%)	None Detected by PLM
Residential	Asbestos (PLM) = 5 Asbestos (TEM) = 4 SVF (PLM) = 5	0 (0%)	None Detected by PLM or TEM	0 (0%)	None Detected by PLM
Notes: a. All dust samples were initially analyzed by polarized light microscopy (PLM). Transmission electron microscopy (TEM) analysis was performed to confirm the absence of asbestos if not detected by PLM analysis. b. The number of locations containing asbestos in dust reflects locations with asbestos detected by either PLM or TEM (reported as <1% or more). The percentage of locations with asbestos detected is calculated from the total number of dust samples. c. The range represents the highest value detected at a location (PLM or TEM). d. The percentage of locations with synthetic vitreous fibers (SVF) detected is calculated from the number of SVF PLM samples. e. Some locations had an additional co-located sample obtained, the range shown considers the highest measured value for each sampling location. f. One residential unit had an extra settled surface dust sample (taken from a window sill), which contained 40% SVF by PLM.					

Table 7 Summary of Mineral Components of Settled Surface Dust by Sampling Location									
Outdoor Settled Surface Dust of Lower Manhattan						Outdoor samples were not taken from comparison areas above 59th Street because no settled surface dust was visible.			
	Number of Occurrences, 14 samples total ^f	Minimum Detected (% by weight)	Maximum Detected (% by weight)	Average of Detections (% by weight)	Number Above Comparison ^b				
Quartz	14 (100%)	1 J ^d	27 J	12 J	NA ^c				
Calcite	13 (93%)	0.8 J	19 J	6 J	NA				
Portlandite	12 (86%)	0.07 J	6 J	2 J	NA				
Gypsum	11 (79%)	0.03 J	27 J	6 J	NA				
Mica	9 (64%)	0.05 J	0.3 J	0.1 J	NA				
Halite	7 (50%)	<0.03 J	0.1 J	0.05 J	NA				
Common Area Settled Surface Dust of Lower Manhattan						Common Areas of Comparison Areas Above 59th Street			
	Number of Occurrences, 26 samples total ^a	Minimum Detected (% by weight)	Maximum Detected (% by weight)	Average of Detections (% by weight)	Number Above Comparison ^b	Number of Occurrences, 3 samples total ^a	Minimum Detected (% by weight)	Maximum Detected (% by weight)	Average of Detected Values (% by weight)
Quartz	21 (81%)	0.03 J	25 J	5 J	6 (23%)	2 (67%)	1 J	1 J	NA
Calcite	15 (58%)	0.02 J	10 J	3 J	9 (35%)	2 (67%)	0.03 J	0.4 J	NA
Portlandite	13 (50%)	0.04 J	4 J	2 J	9 (35%)	1 (33%)	0.05 J	0.05 J	NA
Gypsum	23 (88%)	0.07 J	20 J	5 J	6 (23%)	2 (67%)	2 J	3 J	NA
Mica	5 (19%)	0.06 J	0.6 J	0.2 J	5 (19%)	0 (0%)	ND	ND	NA
Halite	4 (15%)	0.04 J	0.06 J	0.05 J	1 (4%)	1 (33%)	0.04 J	0.04 J	NA
Residential Units Settled Surface Dust of Lower Manhattan						Residential Units of Comparison Areas Above 59th Street			
	Number of Occurrences, 57 samples total ^f	Minimum Detected (% by weight)	Maximum Detected (% by weight)	Average of Detections (% by weight)	Number Above Comparison ^b	Number of Occurrences, 5 samples total ^a	Minimum Detected (% by weight)	Maximum Detected (% by weight)	Average of Detected Values (% by weight)
Quartz	30 (53%)	0.05 J	31 J	9 J	15 (26%)	2 (40%)	1 J	2 J	NA
Calcite	20 (35%)	0.02 J	21 J	8 J	13 (23%)	1 (20%)	0.9 J	0.9 J	NA
Portlandite	21 (37%)	0.05 J	8 J	2 J	17 (30%)	2 (40%)	0.08 J	0.08 J	NA
Gypsum	45 (79%)	0.05 J	30 J	4 J	9 (16%)	4 (80%)	2 J	4 J	3 J
Mica	5 (9%)	0.03 J	0.3 J	0.1 J	1 (2%)	1 (20%)	0.08 J	0.08 J	NA
Halite	6 (11%)	0.03 J	0.1 J	0.06 J	0 (0%)	1 (20%)	0.4 J	0.4 J	NA
a. Shows the number of samples where the mineral was detected and the percentage based on the number of samples obtained from this area. b. Shows the number of results, and the percentage of samples obtained from this area, that had estimated values greater than the maximum levels found at locations above 59th Street. c. NA = not applicable. d. J = estimated.									

Table 8
Summary of Results for Locations With Airborne Fiber Levels
Higher Than Levels in Comparison Areas Above 59th Street.

Air samples were collected and analyzed by phase contrast microscopy for total fibers (NIOSH 7400). All samples with fiber counts higher than the comparison areas above 59th Street were re-analyzed to determine if those fibers were asbestos, synthetic vitreous fibers (SVF), or other material.

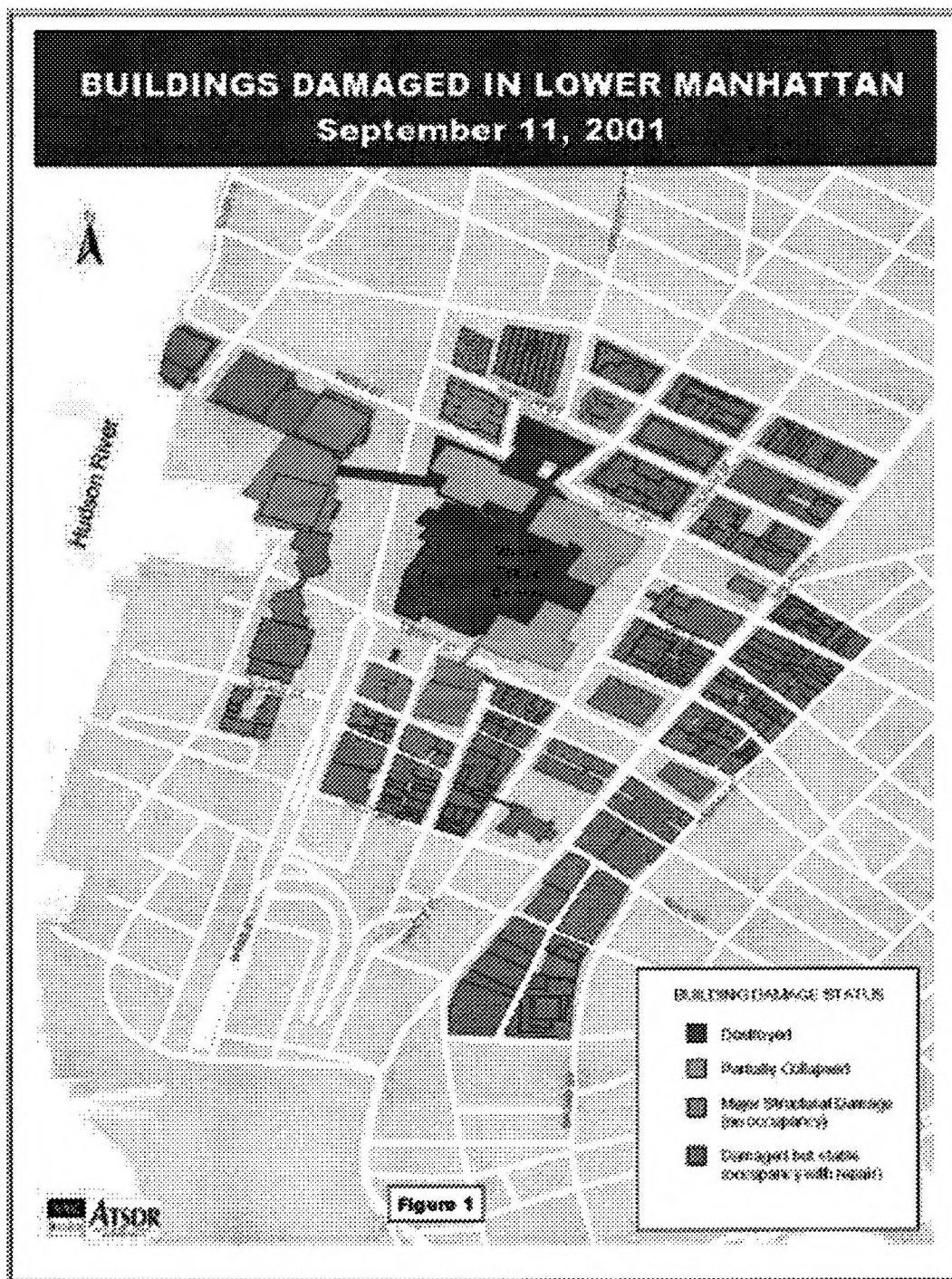
Building (Area)	Aggressive Sampling ^a	Fibers in Air by PCM (f/cc) ^b	Asbestos in Dust by PLM or TEM ^c	Asbestos in Air by TEM (f/cc) ^b	SVF in Dust by PLM	SVF in Air by SEM (f/cc) ^b
1 (Residence)	No	0.006	ND ^g	<0.001 ^d	20%	0.000162
2 (Common)	No	0.005	ND ^g	<0.001 ^d	27%	0.000255
19 (Common)	No	Overloaded ^e	ND ^g	<0.006 ^f	ND	Not analyzed
24 (Residence)	No	0.005	ND ^g	<0.001 ^d	10%	0.000037
26 (Common)	No	0.004	ND ^g	<0.001 ^d	5%	<0.00004
26 (Residence)	No	0.012	ND ^g	<0.001 ^d	ND	<0.00004
a. Aggressive sampling refers to a technique used in some residential units where the vacuum exhaust (used for settled dust sample collection) was used to stir up the settled surface dust before the air sampling began. b. f/cc = fibers in each cubic centimeter (cc) of air as determined using phase contrast microscopy (PCM), transmission electron microscopy (TEM), or scanning electron microscopy (SEM) methods. This is calculated from the number of fibers seen on the air filter and the volume of air pulled through the filter measured in cubic centimeters of air. c. Value shown represents the highest of polarized light microscopy (PLM) or TEM results for this area. d. The TEM method employed here, National Institute of Occupational Safety and Health (NIOSH) 7402, counts fibers of the same size as those detected by PCM analysis. Fibers reported here are greater than or equal to 5 microns in length and 0.25 microns in width. e. A building renovation project was occurring near the area of this sampling equipment. Construction dust and building insulation material may have influenced this sample. f. Sample processing of the overloaded filter involved transferring the material to a new filter; this process provides less analytical sensitivity, resulting in a higher detection limit. g. ND = not detected.						

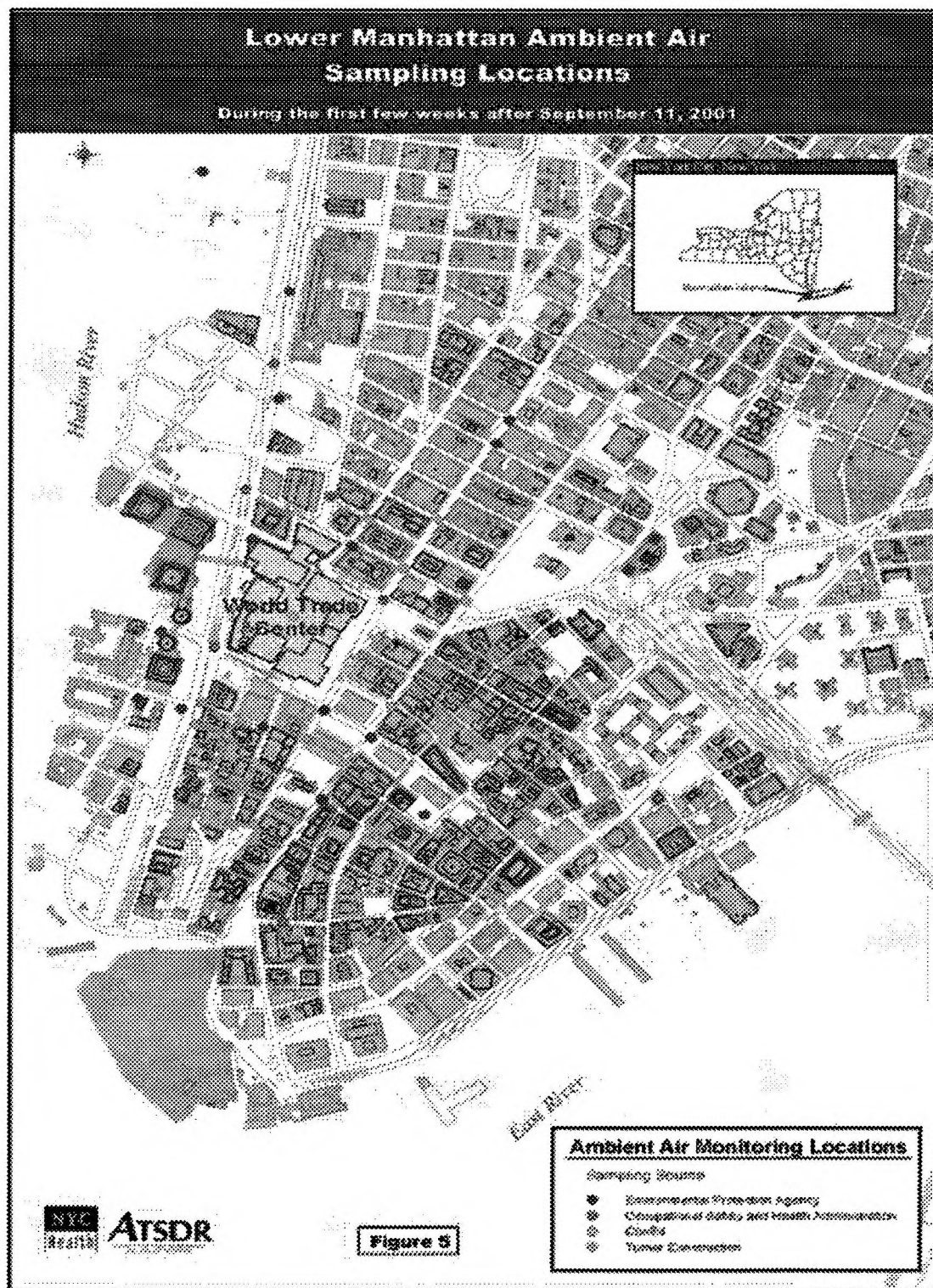
Table 9 Summary of Airborne Fibers at Locations Where Asbestos Was Detected in Settled Surface Dust					
Outdoor Areas in Lower Manhattan					
Building	Area	Asbestos in Dust (PLM or TEM) ^a	SVF in Dust (PLM) ^b	Aggressive Sampling ^c	Fibers in Air (PCM) ^d
1	Outdoor	<1%	22%	No	0.001 f/cc
2 ^e	Outdoor	1.3%	28%	No	0.003 f/cc
5	Outdoor	3.4%	25%	No	0.002 f/cc
7	Outdoor	1.7%	35%	No	<0.001 f/cc
15	Outdoor	1.9%	72%	No	<0.001 f/cc
27	Outdoor	<1%	15%	No	<0.001 f/cc
Common Areas in Lower Manhattan					
Building	Area	Asbestos in Dust (PLM or TEM) ^a	SVF in Dust (PLM) ^b	Aggressive Sampling ^c	Fibers in Air (PCM) ^d
4	Common	<1%	15%	No	0.001 f/cc
6	Common	<1%	10%	No	<0.001 f/cc
10	Common	1.5%	20%	No	0.002 f/cc
24	Common	<1%	5%	No	0.001 f/cc
27	Common	<1%	10%	No	<0.001 f/cc
Residential Units in Lower Manhattan					
Building	Area	Asbestos in Dust (PLM or TEM) ^a	SVF in Dust (PLM) ^b	Aggressive Sampling ^c	Fibers in Air (PCM) ^d
4	Residence 1	<1%	2%	Yes	<0.001 f/cc
4	Residence 2	<1%	5%	Yes	0.001 f/cc
5	Residence 1	<1%	10%	Yes	0.002 f/cc
5	Residence 2	<1%	20%	Yes	<0.001 f/cc
9	Residence 1	<1%	2%	Yes	0.001 f/cc
9	Residence 2	<1%	5%	Yes	0.003 f/cc
11	Residence 1	<1%	ND	Yes	<0.001 f/cc
11	Residence 2	1.5%	ND	Yes	<0.001 f/cc
15	Residence 1	<1%	ND	Yes	<0.001 f/cc
27	Residence 1	<1%	10%	No	<0.001 f/cc
a. Value shown is highest of the reported polarized light microscopy (PLM) and transmission electron microscopy (TEM) results for this area. b. SVF = synthetic vitreous fibers. Measured by PLM analysis. c. Aggressive sampling refers to a technique used in some residential units where the vacuum exhaust (used for settled dust sample collection) was used to stir up the settled surface dust before the air sampling began. d. f/cc = the fibers in each cubic centimeter (cc) of air. This is calculated from the number of fibers seen on the air filter and the volume of air pulled through the filter measured in cubic centimeters. e. Building 2 also had a co-located dust sample; values represent the highest measured result.					

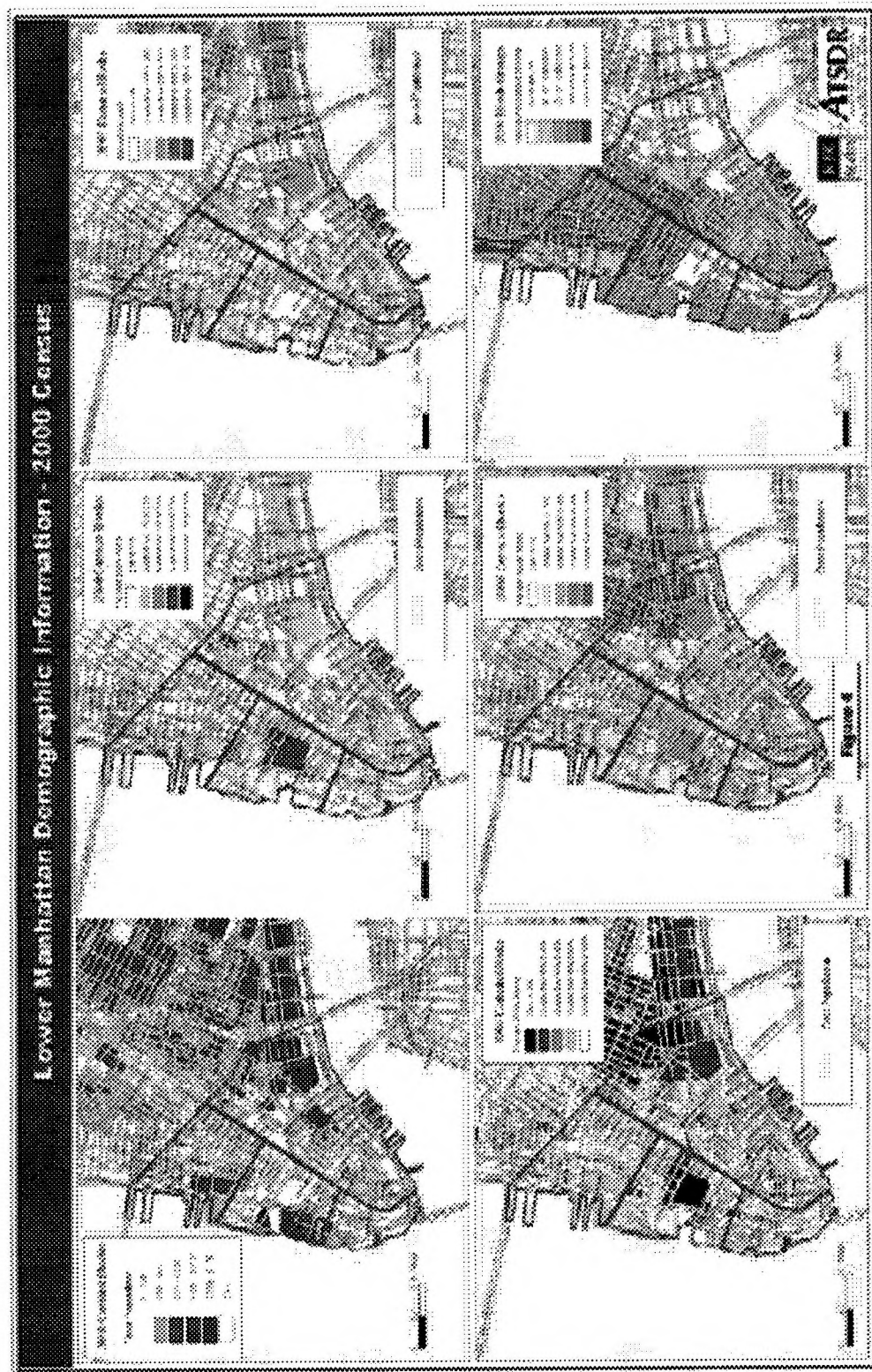
Table 10 Summary of Airborne Fibers at Locations Where Only Synthetic Vitreous Fibers (SVF) Were Detected in Settled Surface Dust					
Outdoor Areas in Lower Manhattan					
Building	Area	Asbestos in Dust (PLM or TEM) ^a	SVF in Dust (PLM) ^b	Aggressive Sampling ^c	Fibers in Air (PCM) ^d
18	Outdoor	ND ^f	30%	No	<0.001 f/cc
24	Outdoor	ND ^f	55%	No	0.002 f/cc
28	Outdoor	ND ^f	15%	No	<0.001 f/cc
Common Areas in Lower Manhattan					
Building	Area	Asbestos in Dust (PLM or TEM) ^a	SVF in Dust (PLM) ^b	Aggressive Sampling ^c	Fibers in Air (PCM) ^d
2	Common	ND ^f	27%	No	0.005 f/cc ^e
7	Common	ND ^f	5%	No	0.001 f/cc
14	Common	ND ^f	5%	No	0.003 f/cc
25	Common	ND ^f	5%	No	<0.001 f/cc
26	Common	ND ^f	5%	No	0.004 f/cc ^e
28	Common	ND ^f	10%	No	0.001 f/cc
Residential Units in Lower Manhattan					
Building	Area	Asbestos in Dust (PLM or TEM) ^a	SVF in Dust (PLM) ^b	Aggressive Sampling ^c	Fibers in Air (PCM) ^d
1	Residence 1	ND ^f	20%	No	0.006 f/cc ^e
1	Residence 2	ND ^f	20%	Yes	<0.001 f/cc
2	Residence 1	ND ^f	25%	No	<0.001 f/cc
2	Residence 2	ND ^f	20%	Yes	0.002 f/cc
6	Residence 1	ND ^f	15%	Yes	<0.001 f/cc
6	Residence 2	ND ^f	15%	Yes	<0.001 f/cc
7	Residence 2	ND ^f	5%	No	<0.001 f/cc
10	Residence 1	ND ^f	15%	Yes	0.001 f/cc
10	Residence 2	ND ^f	10%	Yes	0.001 f/cc
12	Residence 1	ND ^f	5%	No	0.001 f/cc
12	Residence 2	ND ^f	5%	Yes	<0.001 f/cc
13	Residence 1	ND ^f	10%	Yes	0.003 f/cc
15	Residence 2	ND ^f	5%	Yes	<0.001 f/cc
18	Residence 1	ND ^f	30%	No	0.002 f/cc
18	Residence 2	ND ^f	35%	No	0.002 f/cc
24	Residence 2	ND ^f	10%	No	0.005 f/cc ^e
25	Residence 1	ND ^f	5%	No	<0.001 f/cc
27	Residence 2	ND ^f	10%	No	<0.001 f/cc
a. Value shown is highest of the reported polarized light microscopy (PLM) and transmission electron microscopy (TEM) results for this area. b. SVF = synthetic vitreous fibers. Measured by PLM analysis. c. Aggressive sampling refers to a technique used in some residential units where the vacuum exhaust (used for settled dust sample collection) was used to stir up the settled surface dust before the air sampling began. d. f/cc = the fibers in each cubic centimeter (cc) of air. This is calculated from the number of fibers seen on the air filter and the volume of air pulled through the filter measured in cubic centimeters. e. Scanning electron microscopy (SEM) and TEM results for these air samples are available and shown on Table 8. f. ND = not detected.					

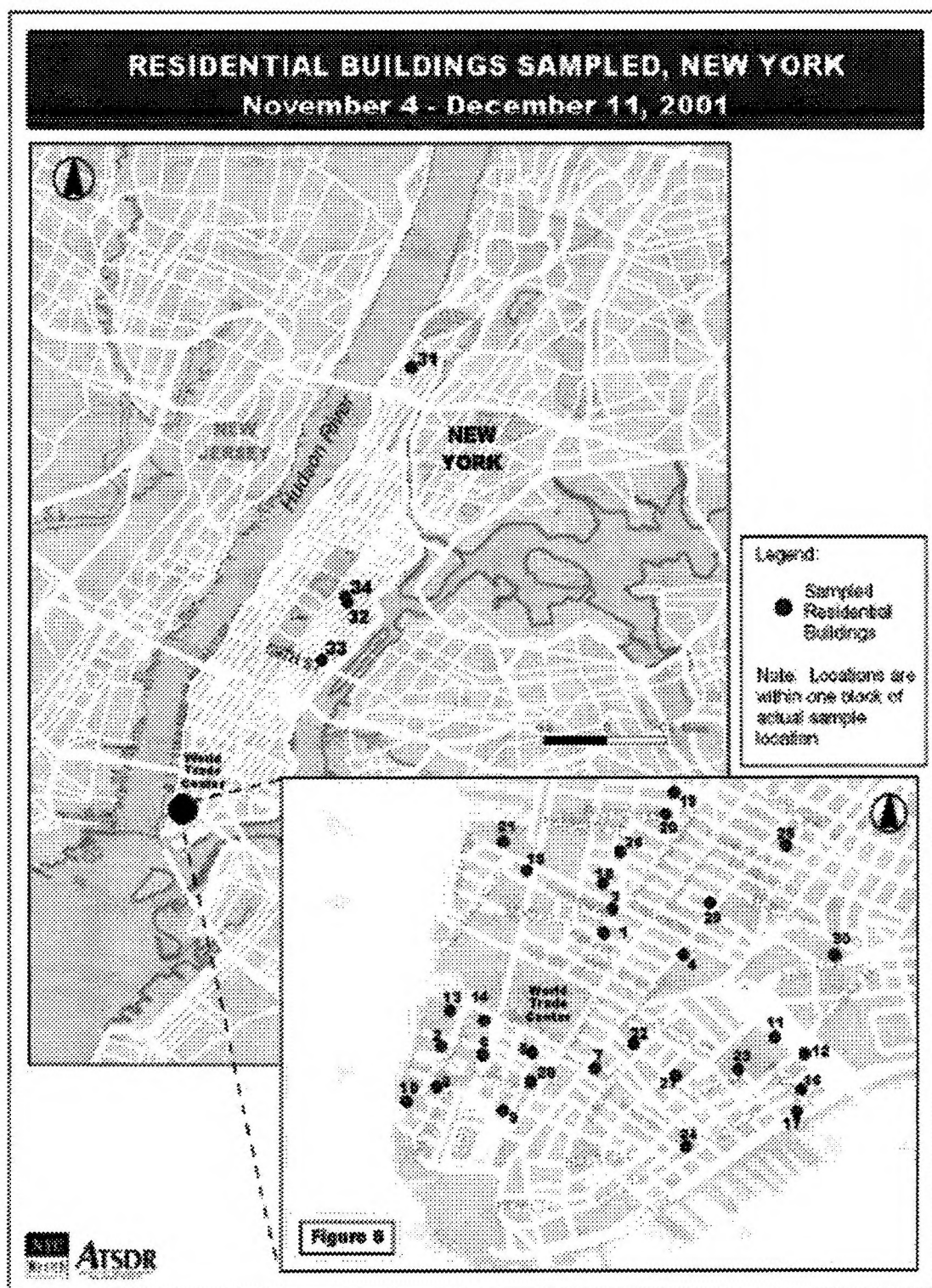
Table 11 Summary of Minerals in Indoor and Outdoor Air From Lower Manhattan and Comparison Buildings Above 59th Street ^{a, b, c}														
	<i>Air Samples from Lower Manhattan</i>							<i>Air Samples From Comparison Buildings</i>						
	Number of Samples	Quartz	Calcite	Portlandite	Gypsum	Mica	Halite	Number of Samples	Quartz	Calcite	Portlandite	Gypsum	Mica	Halite
PM 100														
Number (Frequency detected %)	101	14 (14%) ^d	9 (9%)	8 (8%)	24 (24%)	2 (2%)	4 (4%)	7	ND ^f	ND	ND	1 (14%)	ND	ND
Air Concentration (µg/m ³)		3–13 J ^e	3–14 J	16–95 J	3–14 J	9–13 J	4–14 J					3 J		
PM 10														
Number (Frequency detected %)	105	11 (10%)	10 (10%)	10 (10%)	33 (31%)	1 (1%)	5 (5%)	10	ND	ND	ND	3 (30%)	ND	ND
Air Concentration (µg/m ³)		3–12 J ^e	3–5 J	14–25 J	3–14 J	8 J	4–5 J					3 J		
PM 4														
Number (Frequency detected %)	114	13 (11%)	13 (11%)	12 (11%)	40 (35%)	4 (4%)	3 (3%)	11	ND	ND	ND	3 (27%)	ND	ND
Air Concentration (µg/m ³)		4–19 J	4–10 J	21–84 J	4–15 J	14–43 J	7–19 J					5 J		
PM 2.5														
Number (Frequency detected %)	34	1 (3%)	ND	ND	1 (3%)	ND	ND	6	ND	ND	ND	1 (17%)	ND	ND
Air Concentration (µg/m ³)		3 J			3 J							3 J		
Range of Detection Limits (µg/m³)														
PM 100		2–5 J	2–5 J	12–26 J	2–5 J	7–15 J	4–8 J		2–5 J	2–5 J	12–26 J	2–5 J	7–15 J	4–8 J
PM 10		2–5 J	2–5 J	12–26 J	2–5 J	7–15 J	4–8 J		2–5 J	2–5 J	12–26 J	2–5 J	7–15 J	4–8 J
PM 4		4–6 J	4–6 J	20–30 J	4–6 J	11–17 J	6–9 J		4–6 J	4–6 J	20–30 J	4–6 J	11–17 J	6–9 J
PM 2.5		2–4 J	2–4 J	13–20 J	2–4 J	7–11 J	4–6 J		2–4 J	2–4 J	13–20 J	2–4 J	7–11 J	4–6 J
a. Where two samples were co-located—the greatest value of the two was included in this summary. Each location is only represented once in this table. b. Concentrations shown are estimated values, indicated by “J.” c. Air samples from all locations, indoor and outdoor, are pooled in this table due to uncertainties in the data. d. Cristobalite, a different crystalline form of silica, was found in one Lower Manhattan air sample at 15 micrograms per cubic meter of air (µg/m ³) J in the PM 100 fraction. e. J = estimated. f. ND = not detected.														

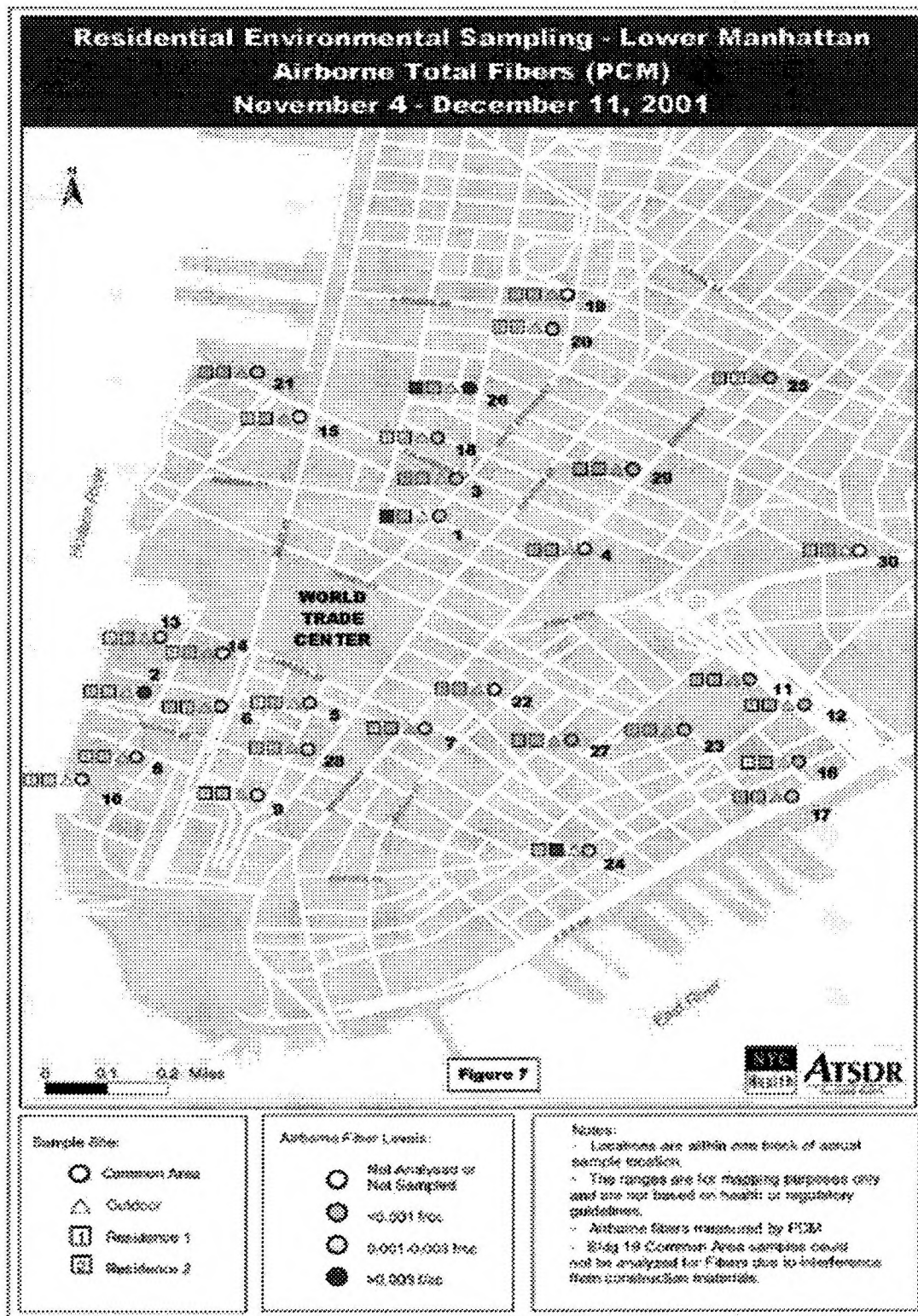
Table 12 Highest Amount of Materials Measured in the Indoor Settled Dust of Each Building				
Building Number	Quartz (%)^{a, d, e}	Gypsum (%)^{a, d, e}	Asbestos (%)^{b, f}	SVF (%)^{e, f}
Comparison Locations 31-34	2 J	4 J	Non-Detect	Non-Detect
1	31 J	30 J	Non-Detect	20
2	23 J	14 J	Non-Detect	27
3	Not Sampled	Not Sampled	Not Sampled	Not Sampled
4	14 J	9 J	<1	15
5	11 J	9 J	<1	20
6	27 J	20 J	<1	15
7	21 J	15 J	Non-Detect	5
8	28 J	17 J	Non-Detect	Non-Detect
9	25 J	16 J	<1	7
10	3 J	0.8J	1.5	20
11	2 J	2 J	1.5	Non-Detect
12	4 J	1 J	Non-Detect	5
13	0.05 J	1 J	Non-Detect	10
14	0.03 J	2 J	Non-Detect	5
15	0.4 J	1 J	<1	5
16	Non-Detect	0.9 J	Non-Detect	Non-Detect
17	2 J	2 J	Non-Detect	2
18	0.9 J	1 J	Non-Detect	35
19	1 J	2 J	Non-Detect	Non-Detect
20	0.9 J	1 J	Non-Detect	Non-Detect
21	0.9 J	2 J	Non-Detect	Non-Detect
22	14 J	2 J	Non-Detect	3
23	2 J	1 J	Non-Detect	Non-Detect
24	0.03 J	Non-Detect	<1	10
25	Non-Detect	2 J	Non-Detect	5
26	0.7 J	2 J	Non-Detect	5
27	0.04 J	1 J	<1	10
28	Non-Detect	1 J	Non-Detect	10
29	1 J	2 J	Non-Detect	Non-Detect
30	1 J	4 J	Non-Detect	Non-Detect
a. Minerals were measured by XRD. Quartz is considered representative of the relative presence of portlandite and calcite (all are associated with concrete). b. Asbestos value represents the highest of the PLM and TEM result for each location. c. SVF is synthetic vitreous fiber and was measured by PLM. d. Results shown are estimated values, indicated by "J." e. % = weight of mineral per weight of dust. f. % = roughly area of fibers per area of dust.				

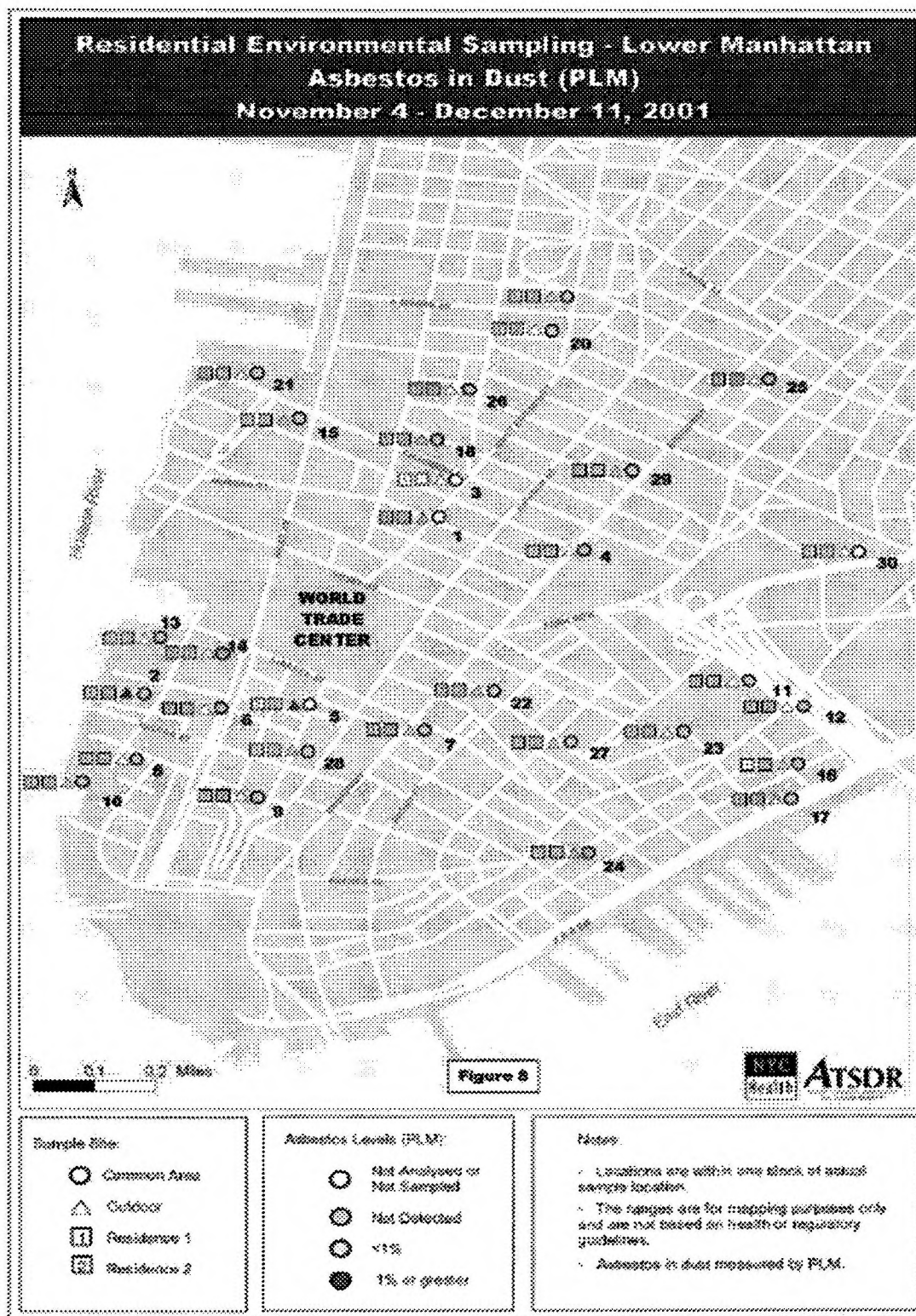


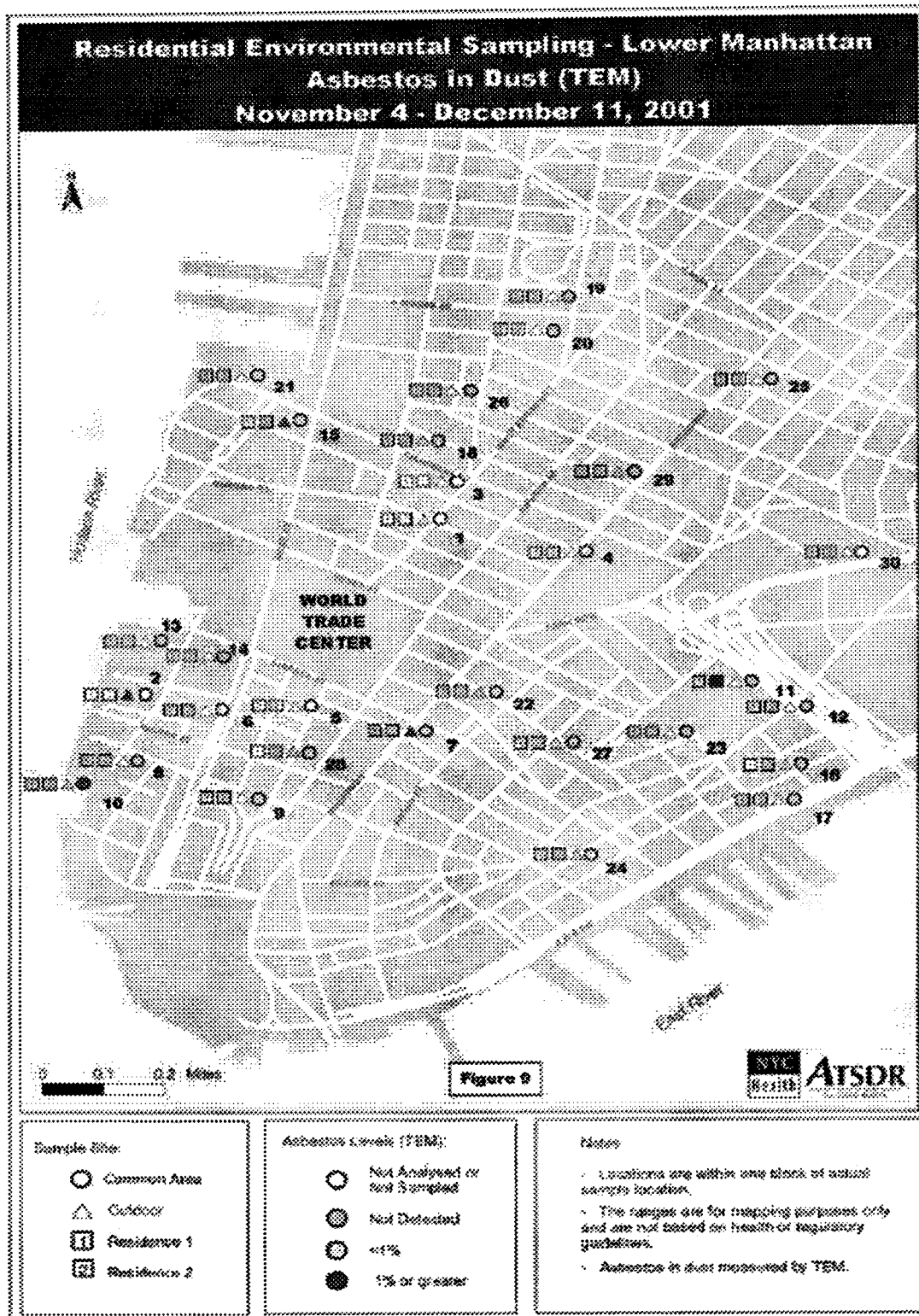


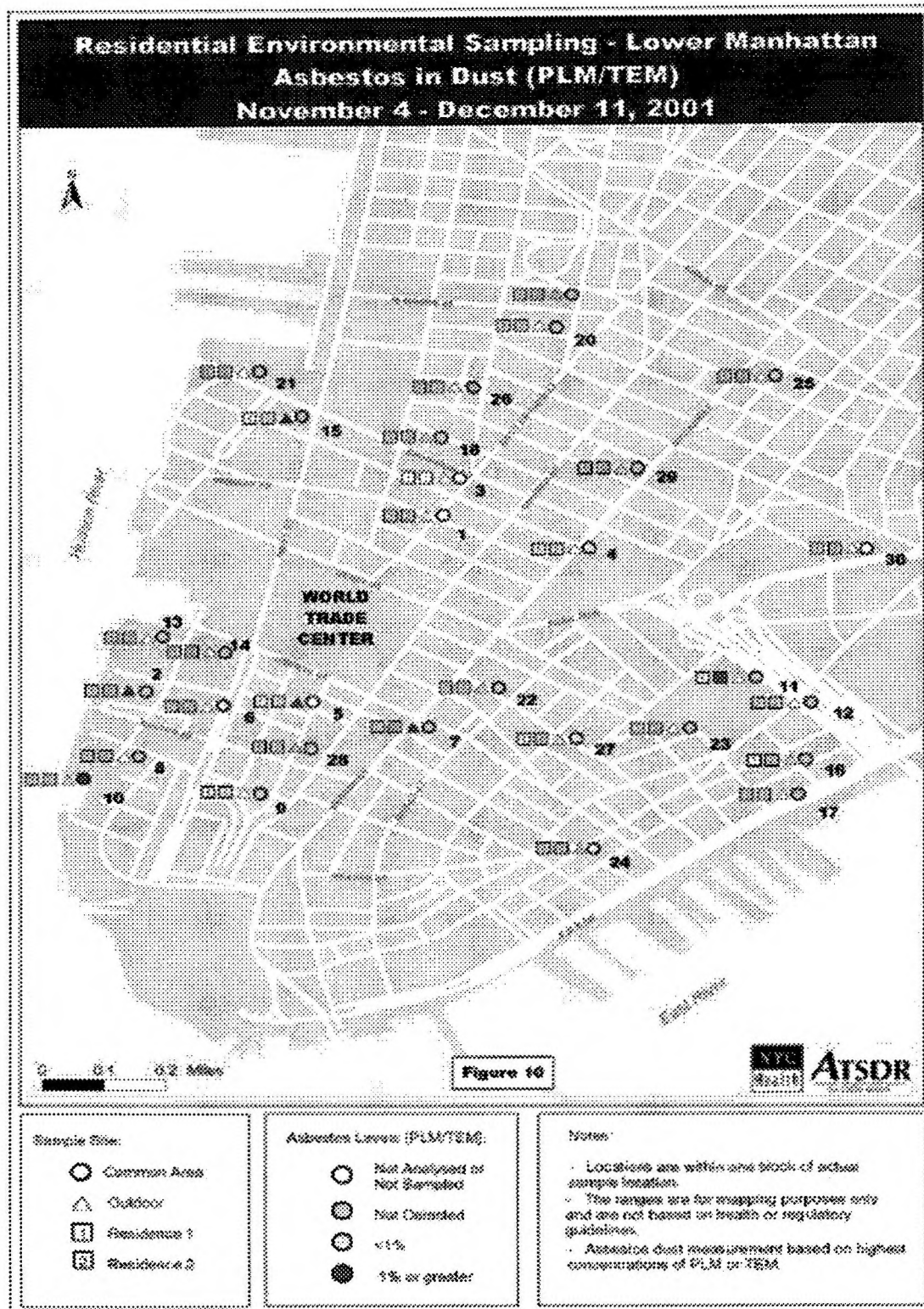


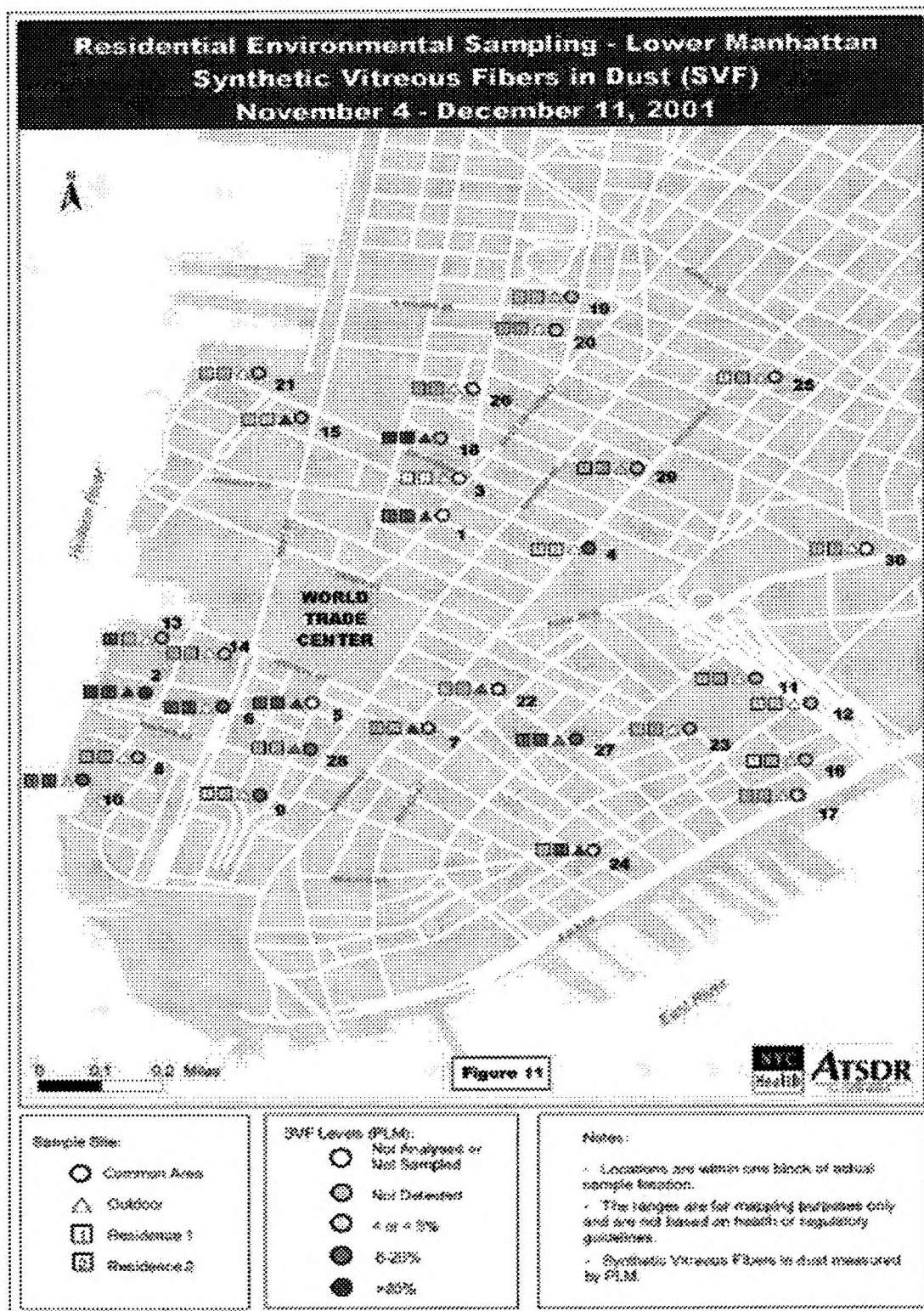


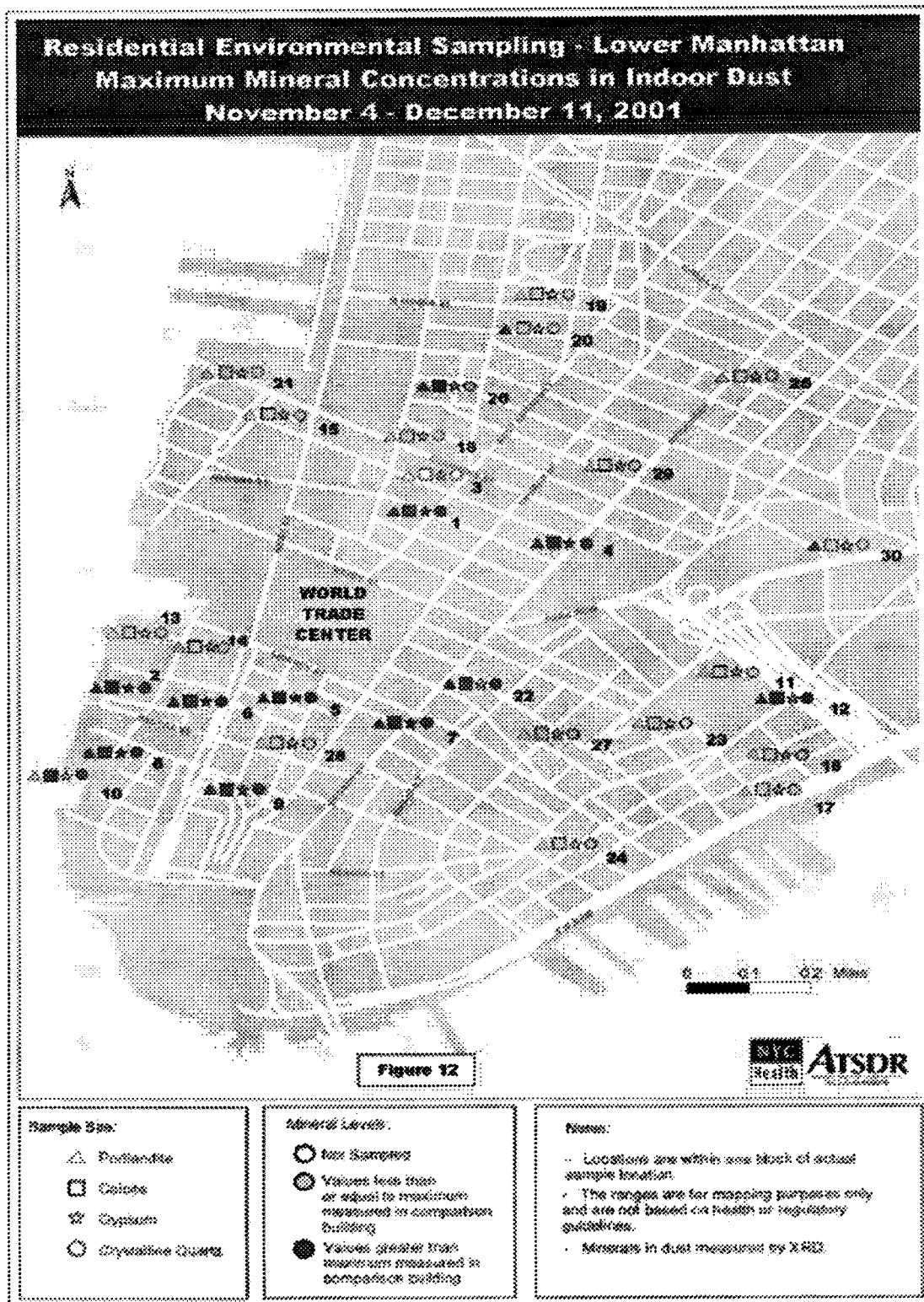


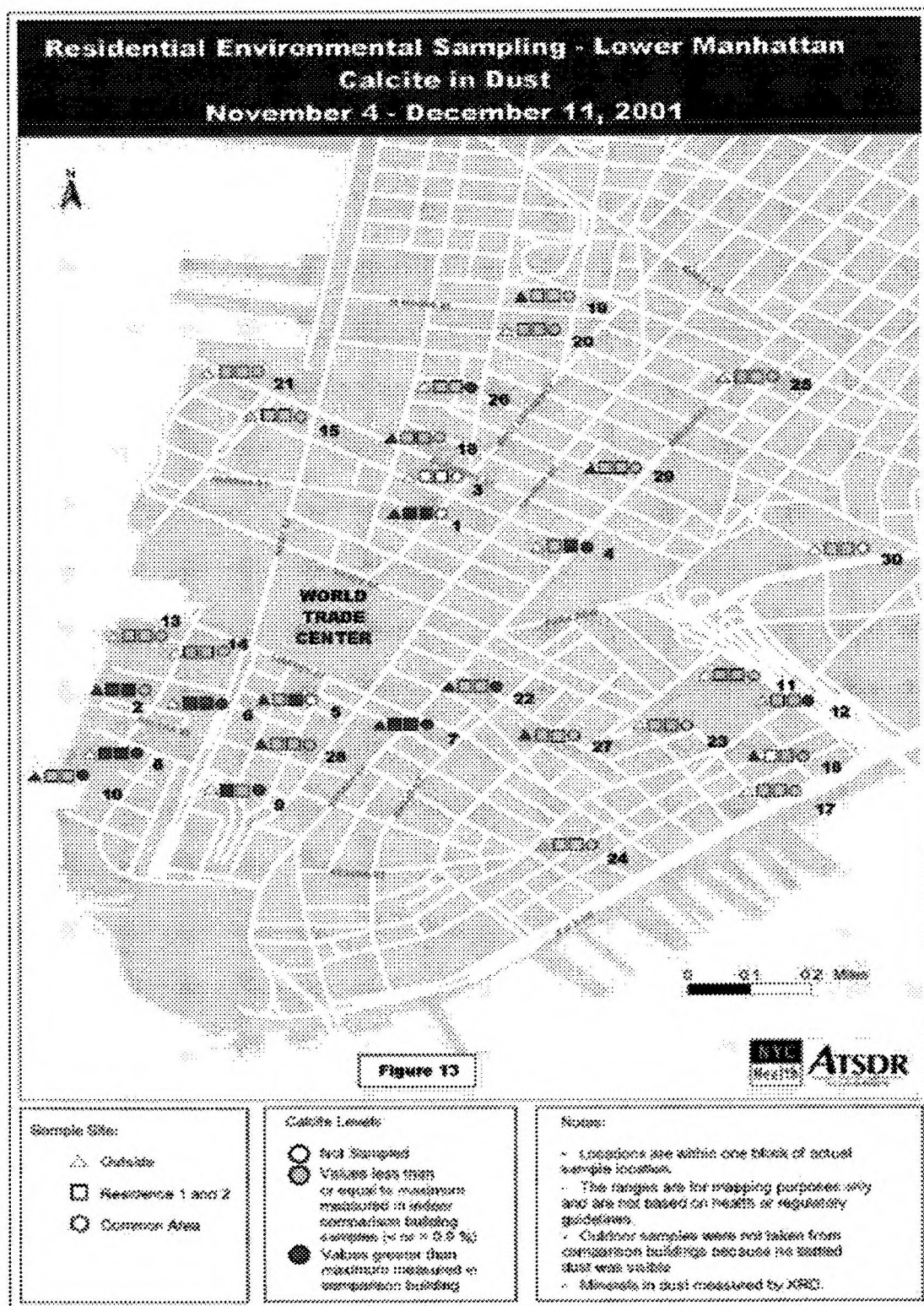


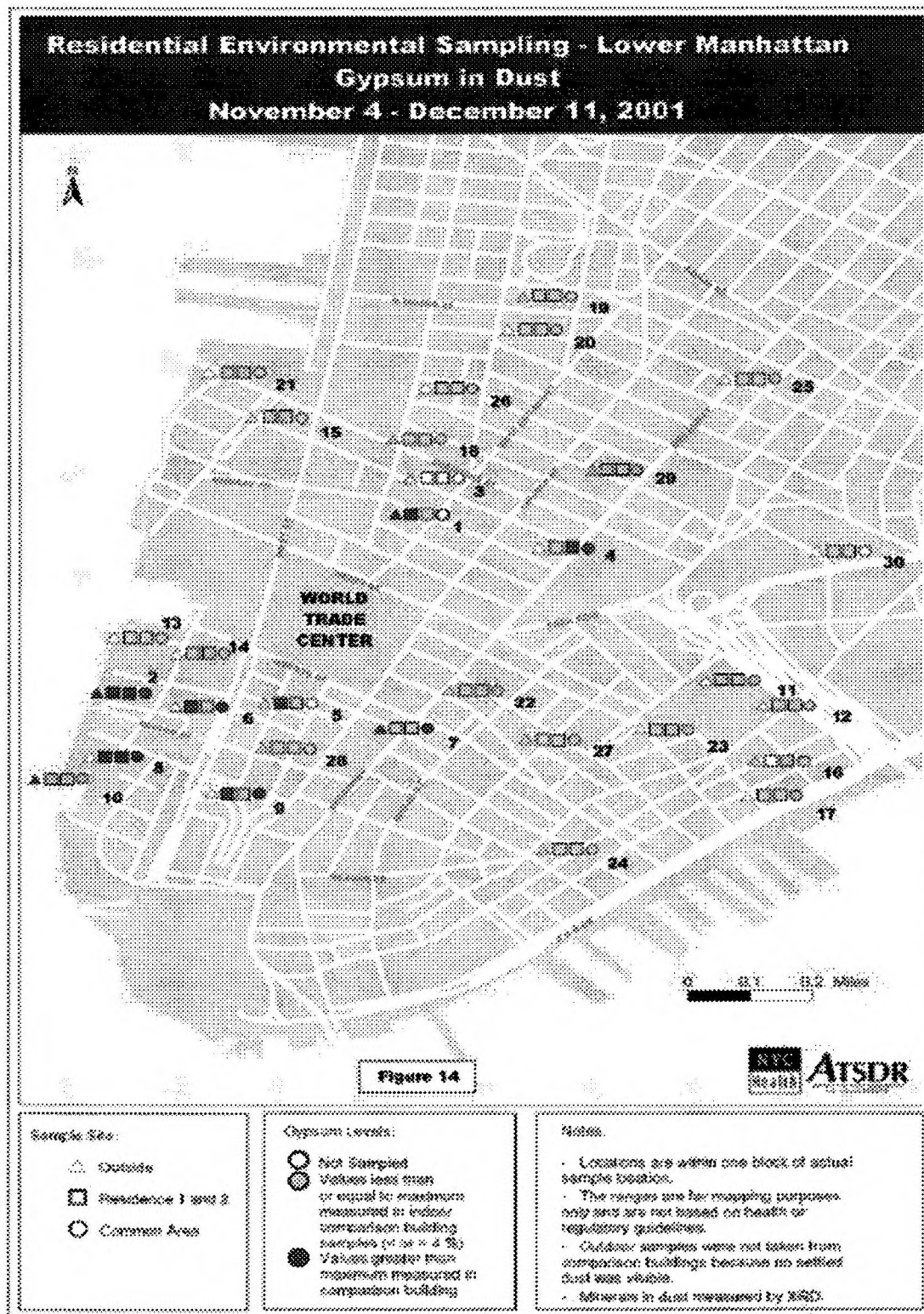


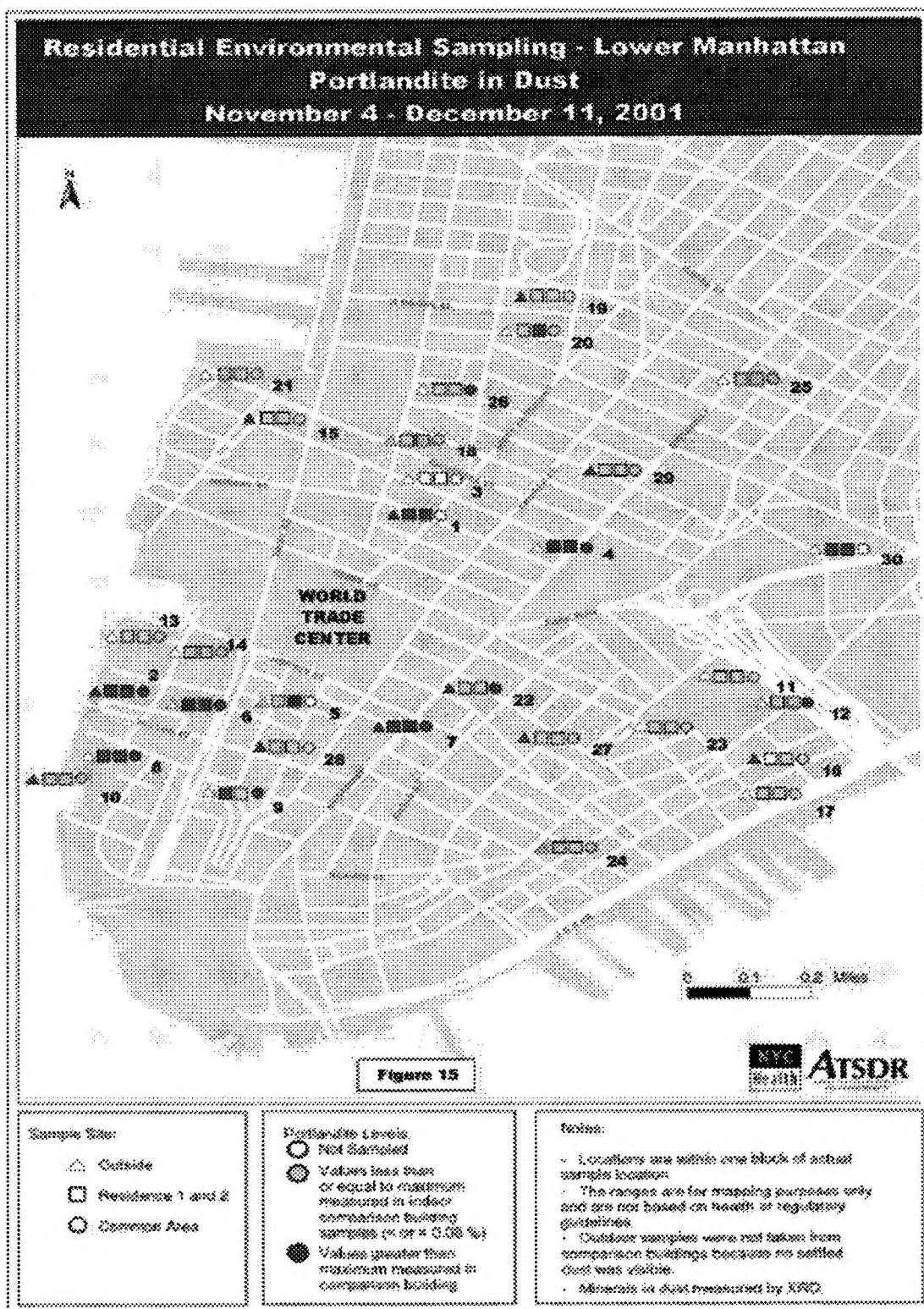


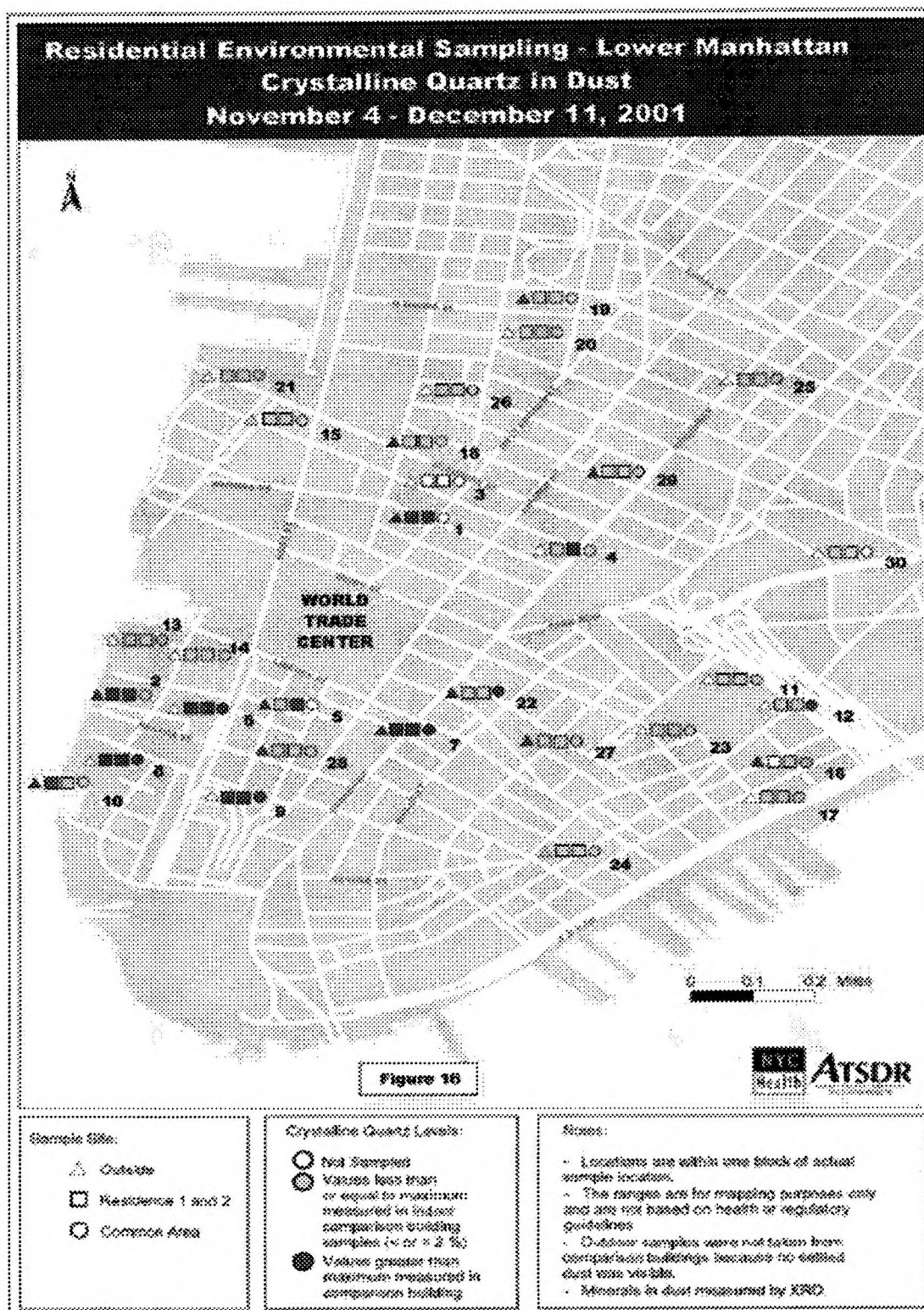


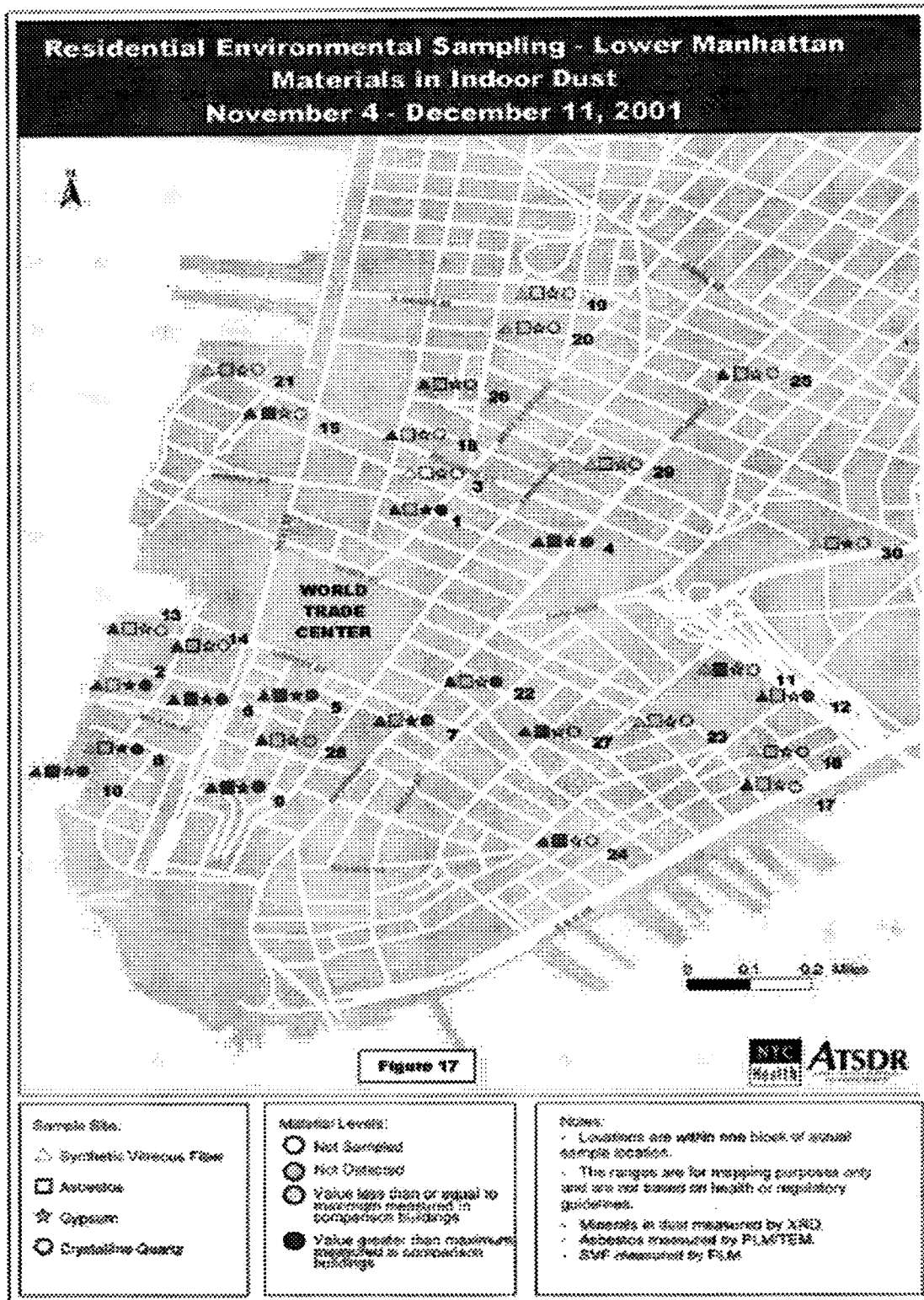












SAMPLING EVENT PHOTOGRAPHS



Photo 1. Residential Vacuum Sample

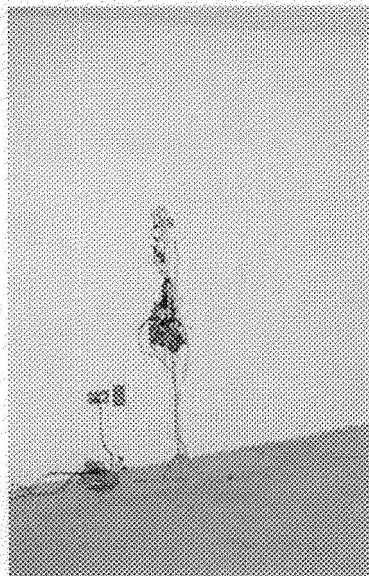


Photo 2. Residential Air Sampling

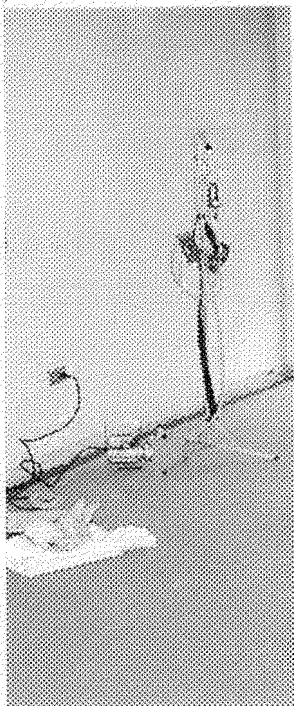


Photo 3. Residential Air Sampling

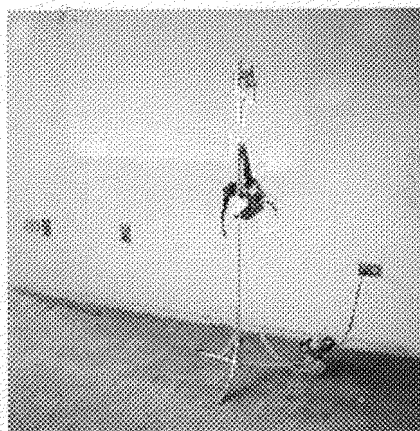


Photo 4. Residential Air Sampling

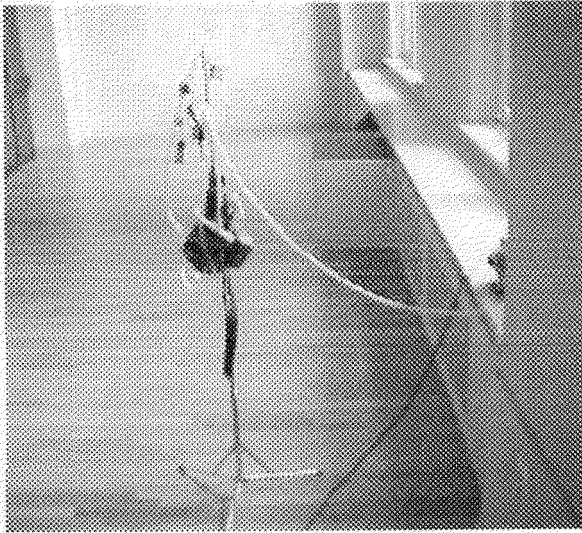


Photo 5. Residential Air Sampling

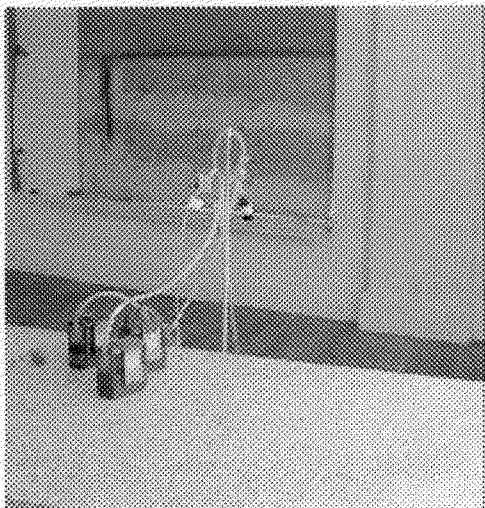


Photo 6. Residential Air Sampling

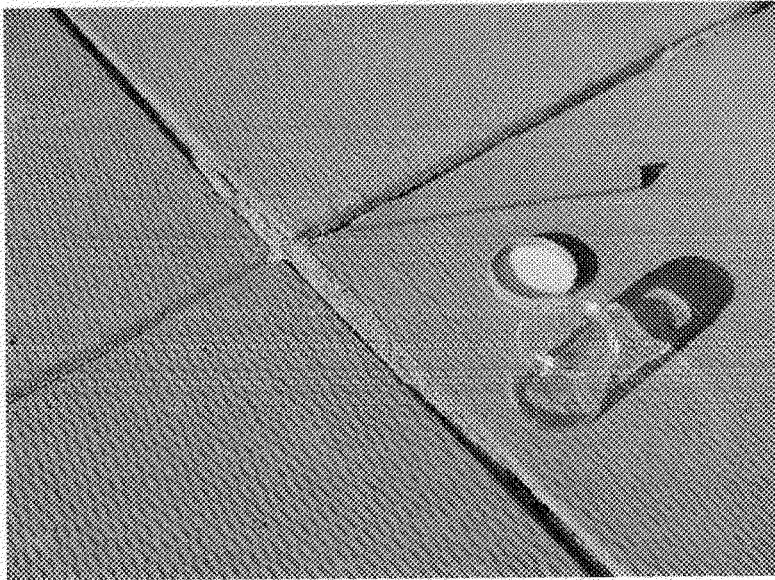


Photo 7. Outside Bulk Sampling



Photo 8. Sampling Head

APPENDICES

Appendix A. Particulate Matter Quality Assurance/Quality Control Discussion

General Notes on Quality Assurance/Quality Control Procedures

Quality assurance/quality control (QA/QC) procedures are used to ensure the precision, accuracy, completeness, representativeness, comparability, and method detection limit of the results. The co-located samples and blanks are a primary means of assessing each of the data quality indicators. Comparing the results of two co-located samples provides information on the precision of the results as a whole. Comparing sample results to their associated blanks can help identify some potential errors in accuracy. Comparing the results received to those expected and necessary to draw conclusions about the data can help in understanding the completeness and reliability of the results. Comparability can be assessed by looking at the results taken from different sampling locations of the same building—or from different buildings for the same type of location. The reviews are generally qualitative and provide a qualitative assessment of how well the data actually represents the sampled location.

The method detection limit is a more quantitative review. It is accomplished by calculating the lowest result the analytical method can accurately identify. It is based on an analysis of the blank samples and is specific for the sampling/analysis method. Reliable information can only be obtained from sample results with method detection limits significantly lower than the average value of the results and significantly lower than any comparison values to which the sample results will be compared.

The analytical results of the concentration of airborne particulate matter were provided by the laboratory as the initial weight of the filter prior to the sampling event and the final weight of the filter after the sampling event. The concentration of the particulate matter was calculated by dividing the weight of the material collected on the filter by the volume of air drawn through the filter by the pump using the following formulas.

Weight Gain of Filter = Final Weight – Initial Weight

Sample Volume = Average Pump Flow Rate × Sample Collection Time

Average Air Sampling Pump Flow Rate = (Presampling Flow Rate + Postsampling Flow Rate) ÷ 2

Concentration = Weight Change ÷ Sample Volume

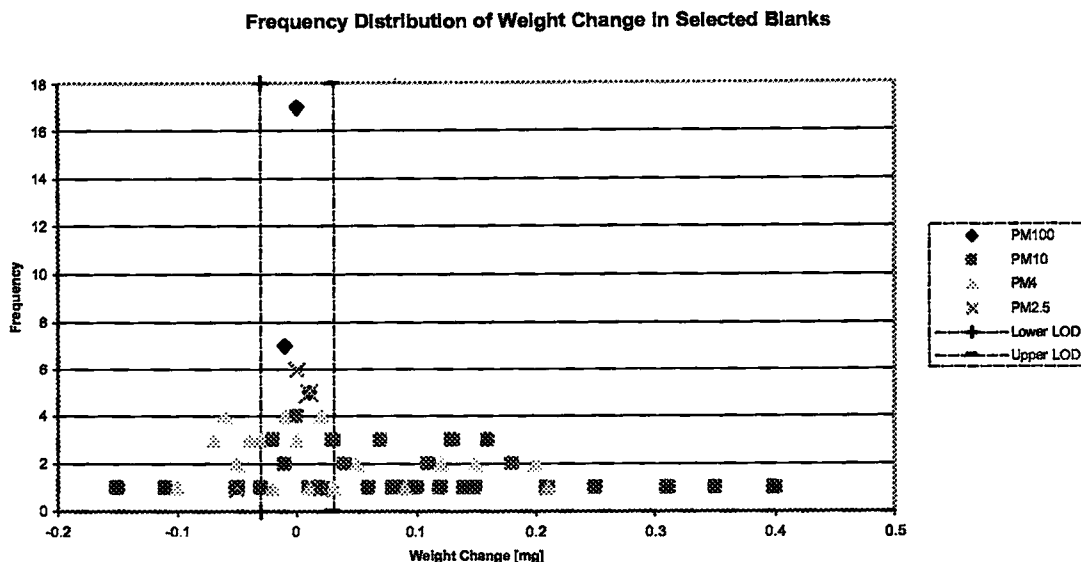
Airborne Particulate Matter Sample Results

Each area that was sampled for airborne asbestos was also sampled for airborne particulate matter (PM). The sample results from the PM measurements did not meet the data QA/QC objectives. A variety of statistical and graphical analyses were performed on, and with, the measured results in an attempt to identify the cause and extent of inconsistencies of the measured results. A subset of the measured results that are not potentially affected by these inconsistencies were not identified. Therefore, the entire data set describing airborne particulate matter concentrations was rejected. In addition, the specific cause of the inconsistencies was not identified. The following information explains why the airborne particulate matter results were rejected.

Ideally, the particulate matter data would have provided information about the airborne concentration with an aerodynamic diameter of 100 microns and less (PM100), of 10 microns and less (PM10), of 4 microns and less (PM4), and of 2.5 microns and less (PM2.5). These different size fractions (PM100, PM10, PM4, and PM2.5) are collected using slightly different equipment, but following the same basic procedures. A pump draws air into a sampling head, and size specific particulate matter is deposited onto a filter. The difference in filter weight, before and after the sampling, represents the mass of the particulate matter that was captured by the filter. Knowing the presampling and postsampling air flow rates of the pump and the time duration for sample collection allows us to calculate the average volume of air that was drawn through the filter. The concentration of the size fraction in the sampled air is then calculated by dividing the PM mass by the air volume sampled.

In addition to the filters that were used to measure the concentration of airborne particulate matter, the laboratory also sent filters to be used as field blanks. Two blanks were sent for each PM fraction for each of the two sampling teams for each building. The blanks traveled with the sample filters, went to the sampled building or area, and were treated just like the sample filters—except that they were not used. Ideally, there should be very little difference in the weight of the blanks before the sampling and after the sampling because they were not used. A weight gain in field blanks may indicate improper sample handling in the field or problems in filter weighing in the lab. For the latter a decrease in post field blank filter weight is also an indication of lab weighing error.

The graph shown with this discussion shows the frequency distribution of the air sample filter weight change in all but seven of the blanks used. Seven blanks were not included because their weight change (from a negative -90 milligrams (mg) to 5.99 mg) was greater than the limits shown in this graph (-0.2 mg to 0.5 mg). The vertical axis represents the number of blanks that had a weight change within 0.01 mg of the weight change shown on the horizontal axis.



The dashed vertical lines show the upper and lower limits of detection expected for this method (± 0.03 mg). The distance between limits of detection represents the maximum weight gain expected for the blanks if the entire sampling procedure was followed as required by standard sampling methodologies. All of the size fractions had at least two blanks outside the limit of detection boundaries. (The two out of range blanks for PM100 are not shown on the graph because they are also beyond the boundaries of the graph). Approximately 6% of the PM100, 70% of the PM10, 57% of the PM4, and 8% of the PM2.5 blanks had weight changes greater than the limit of detection.

In general, blanks are used (1) to assess the ability of the sampling and laboratory analysis methodology to accurately estimate the concentration of particulate matter in the air at the sampled location and (2) to validate that there is no filter contamination problem from the time the blanks are initially weighed in the laboratory until the time the blanks are weighed in the laboratory after sampling. Errors could occur at any step in the process.

The large weight change of the blanks indicates errors in either the laboratory weighing process or the air sampling process. The graph illustrates that the results of the airborne particulate matter sampling cannot be used to reliably estimate the actual concentration of any of the particulate matter size fractions; therefore, the entire data set was rejected from further consideration.

Appendix B. Survey Result

Summary of Residential Sampling Survey Form Results and Review of Photographs (Abbreviations and terms used in the table are defined on the last page in this table.)									
Event Number	Location	Number of Broken Windows	Dust Visible Initially	Dust Visible Currently	Residence Occupied	Cleaning Method	Aggressive Sampling	Level of Dust In Photo	Photo Comments
1	Outside	28						None Visible	
1	Common	0	SI	N		C		None Visible	Prepared for asbestos abatement
1	Residence 1	2	LI	Y	U	None	N	Large Amount	Large amount of WTC dust; more than other locations sampled
1	Residence 2	0	NI	N	U	None	Y	None Visible	
2	Outside	1		Y				None Visible	
2	Common	0	NI	N		C		Slight Amount	
2	Residence 1	0	SI	N	Y	C	N	None Visible	Residence window faces WTC site
2	Residence 2	0	SI	N	U	C	Y	None Visible	
3	Outside	0		N				None Visible	Sampled from courtyard several floors up
3	Common	0	LI	N		AA		None Visible	
3	Residence 1	0	LI	N	Y	AA	N	None Visible	
3	Residence 2	0	MI	N	Y	C	N	None Visible	
4	Outside	0		N				Slight Amount	
4	Common	0	NI	Y		O		None Visible	
4	Residence 1	0	SI	Y	N	None	Y	None Visible	
4	Residence 2	0	SI	Y	N	None	Y	None Visible	
5	Outside	50		Y				Large Amount	
5	Common	0	SI	N		AA		None Visible	
5	Residence 1	6	LI	LI	Y	AA	Y	None Visible	
5	Residence 2	6	LI	LI	Y	AA	Y	None Visible	Room looks clean but lots of WTC dust outside one window sill
6	Outside	200		N				None Visible	
6	Common	0	SI	N		C			Couldn't identify photos for common area
6	Residence 1	0	LI	N	U	C	Y	None Visible	
6	Residence 2	0	SI	N	U	C	Y	None Visible	
7	Outside	2		N				None Visible	
7	Common	0	MI	N		C		None Visible	Many window sills (not sure where) have significant amount of WTC dust on outside ledge, not noticeable on inside of window.
7	Residence 1	0	MI	N	Y	C	N	None Visible	
7	Residence 2	0	MI	N	Y	C	N	None Visible	Resident has window view of WTC site

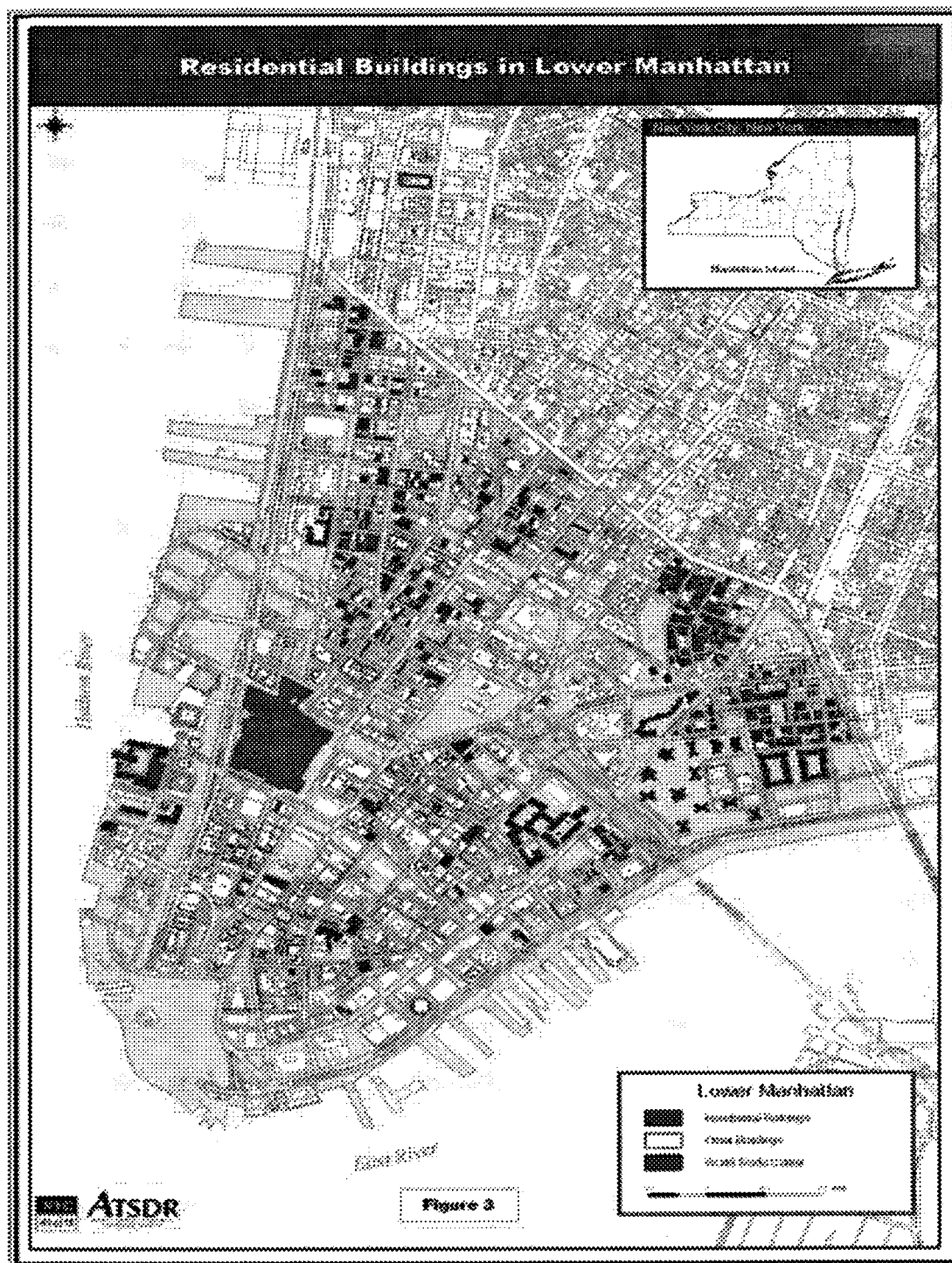
Summary of Residential Sampling Survey Form Results and Review of Photographs (Abbreviations and terms used in the table are defined on the last page in this table.)									
Event Number	Location	Number of Broken Windows	Dust Visible Initially	Dust Visible Currently	Residence Occupied	Cleaning Method	Aggressive Sampling	Level of Dust in Photo	Photo Comments
8	Outside	0		N				None Visible	
8	Common	0	MI	N		C		None Visible	
8	Residence 1	1	SI	N	Y	O	N	None Visible	
8	Residence 2	1	MI	N	Y	C	N	None Visible	Resident has window view of WTC site
9	Outside	2		N				None Visible in Picture	Utility/road construction occurring near building and across the street from the front door.
9	Common	0	LI	N		C		None Visible	
9	Residence 1	0	MI	Y	Y	C	Y	None Visible	
9	Residence 2	0	MI	Y	Y	C	Y	Slight Amount	
10	Outside	0		Y				Slight Amount	
10	Common	0	SI	N		AA		None Visible	
10	Residence 1	0	NI	N	Y	AA	Y	None Visible	View of Statue of Liberty
10	Residence 2	1	SI	N	Y	AA	Y	None Visible	
11	Outside	0	LI	N				None Visible	Looks like many dried, fallen leaves on sidewalk
11	Common	0	SI	N		MS		None Visible	
11	Residence 1	0	SI	N	V	None	Y	None Visible	
11	Residence 2	0	UNK	N	V	UNK	Y	None Visible	Wall AC unit was removed, it was just a hole to the outside
12	Outside	0		N				None Visible	Looks like many dried, fallen leaves on sidewalk
12	Common	0	SI	N		MS		None Visible	
12	Residence 1	0	MI	Y	V	None	N	Large Amount	Very messy, doesn't look like "WTC dust" (has "post-move-out" look)
12	Residence 2	0	SI	N	V	None	Y	None Visible	
13	Outside	0		N				Slight Amount	A little messy, but does not look like WTC dust
13	Common	0	MI	N		MS		None Visible	
13	Residence 1	0	MI	N	V	C	Y	None Visible	
13	Residence 2	0	MI	Y	V	C	Y	Large Amount	Very messy, but not with WTC dust (post-move-out look)
14	Outside	0		N				None Visible	Air sample from garden area; no bulk sample taken; WTC dust visible on neighboring building.
14	Common	0	SI	N		C		None Visible	
14	Residence 1	0	MI	Y	U	None	Y	Large Amount	Light dust on floors; one pile of "material," could be from remodeling activity

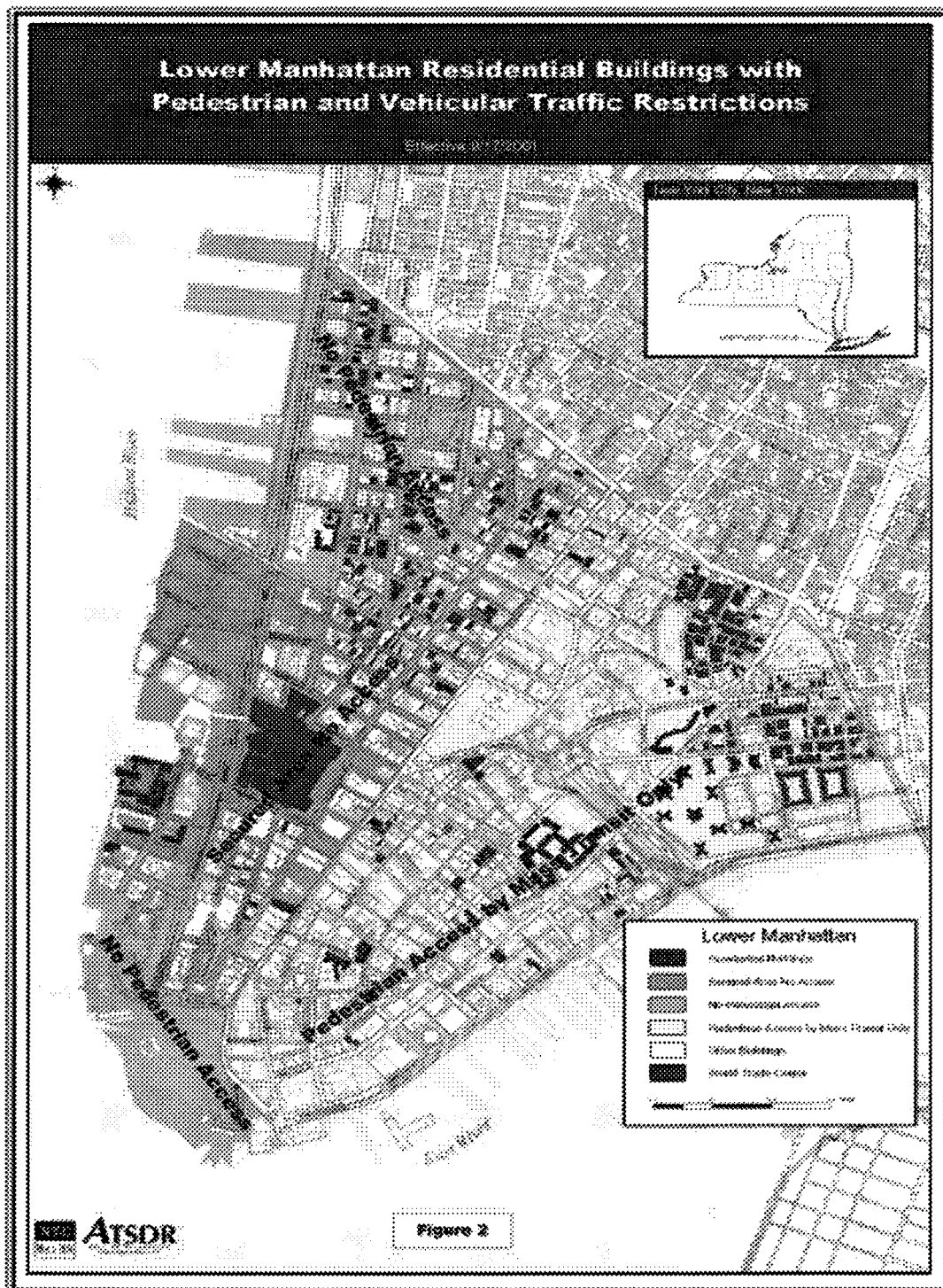
Summary of Residential Sampling Survey Form Results and Review of Photographs (Abbreviations and terms used in the table are defined on the last page in this table.)									
Event Number	Location	Number of Broken Windows	Dust Visible Initially	Dust Visible Currently	Residence Occupied	Cleaning Method	Aggressive Sampling	Level of Dust In Photo	Photo Comments
14	Residence 2	0	MI	Y	U	None	Y	None Visible	Pile of trash swept into center of room; no WTC dust
15	Outside	0		N				None Visible	Bulk sample from roof top courtyard,
15	Common	0	SI	Y		MS		None Visible	Dust visible in (and sampled from) cracks between tiles.
15	Residence 1	0	SI	Y	U	O	Y	None Visible	
15	Residence 2	0	SI	N	U	O	Y	None Visible	
16	Outside	0		N				None Visible	
16	Common	0	MI	N		C		None Visible	
16	Residence 1	0				MS		None Visible	
16	Residence 2	0	LI	N	Y	O	N		No picture
17	Outside	0		N				Slight Amount	Dirty/messy, but doesn't look like WTC dust
17	Common	0	SI	Y		C		None Visible	
17	Residence 1	0	SI	N	Y	C	N	None Visible	
17	Residence 2	0	MI	Y	U	C	Y	Slight Amount	
18	Outside	0		N				M	Sample looks granular and sandy, not gray like WTC dust
18	Common	0	LI	N		MS		None Visible	Leaf track-in visible
18	Residence 1	0	MI	N	Y	C	N	None Visible	Window view of WTC site
18	Residence 2	0	LI	N	Y	C	N	None Visible	
19	Outside	0		N				Moderate	Visible in, and sampled from, sidewalk joint with building; sidewalk looked cleaner.
19	Common	0	SI	N		C		None Visible	
19	Residence 1	0	LI	N	Y	O	N	None Visible	
19	Residence 2	0	NI	N	Y	O	N		No picture
20	Outside	0		N				Unk	Too distant to see surface dust
20	Common	0	SI	N		MS		None Visible	
20	Residence 1	0	NI	N	Y	O	N	None Visible	
20	Residence 2	0	SI	N	Y	O	N		No picture
21	Outside	0		N				None Visible	
21	Common	0	SI	N		C		None Visible	
21	Residence 1	0	SI	N	Y	C	N	None Visible	
21	Residence 2	0	NI	N	Y	C	N	None Visible	

Summary of Residential Sampling Survey Form Results and Review of Photographs (Abbreviations and terms used in the table are defined on the last page in this table.)									
Event Number	Location	Number of Broken Windows	Dust Visible Initially	Dust Visible Currently	Residence Occupied	Cleaning Method	Aggressive Sampling	Level of Dust in Photo	Photo Comments
22	Outside	8		Y				None Visible	Sidewalk/entrance to building and roof courtyard look clean, but there is a pile of material to sample on roof; location is unknown.
22	Common	1	LI	N		C		None Visible	
22	Residence 1	0	MI	Y	Y	MS	N	None Visible	
22	Residence 2	0	LI	N	Y	C	N	None Visible	
23	Outside	0		N				None Visible	
23	Common	0	SI	N		C		None Visible	
23	Residence 1	0	MI	Y	Y	O	N	None Visible	
23	Residence 2	0	MI	N	Y	O	N	None Visible	
24	Outside	0		N				None Visible	
24	Common	0	LI	N		MS		None Visible	
24	Residence 1	0	SI	N	Y	O	N	None Visible	
24	Residence 2	0	SI	N	Y	C	N	None Visible	
25	Outside	0		N				None Visible	
25	Common	0	NI	N		MS		None Visible	
25	Residence 1	0	NI	N	Y	O	N	None Visible	
25	Residence 2	0	SI	N	Y	C	N	None Visible	
26	Outside	0		N				None Visible	
26	Common	0	NI	N		MS		None Visible	Floor area sampled contained some broken tiles.
26	Residence 1	0	NI	N	Y	O	N	None Visible	
26	Residence 2	0	SI	N	Y	O	N	None Visible	
27	Outside	0		N				None Visible	
27	Common	0	MI	N		MS		None Visible	
27	Residence 1	0	LI	N	Y	C	N	None Visible	
27	Residence 2	0	SI	N	Y	C	N	None Visible	
28	Outside	0						None Visible	Bulk sample from 4-inch wide strip between two different tiled areas; thick with granular/dusty/other material, not sure if any is WTC.
28	Common	0	LI	Y		C		None Visible	
28	Residence 1	3	LI	N	U	C	N	None Visible	
28	Residence 2	0	MI	N	U	C	N	None Visible	
29	Outside	0		N				None Visible	Bulk sample from small pile at an inside corner of the building wall

Summary of Residential Sampling Survey Form Results and Review of Photographs (Abbreviations and terms used in the table are defined on the last page in this table.)									
Event Number	Location	Number of Broken Windows	Dust Visible Initially	Dust Visible Currently	Residence Occupied	Cleaning Method	Aggressive Sampling	Level of Dust In Photo	Photo Comments
29	Common	0	NI	N		C		None Visible	
29	Residence 1	0	SI	N	Y	O	N	None Visible	
29	Residence 2	0	SI	Y	Y	O	N	None Visible	
30	Outside	0							No picture
30	Common	0							No picture
30	Residence 1	0	SI	N	Y	O	N	None Visible	
30	Residence 2	0	MI	N	Y	C	N	None Visible	
31	Outside	0						None Visible	
31	Common	0	NI	N		MS		None Visible	
31	Residence 1	0	NI	N	N	MS	Y	None Visible	
31	Residence 2	0	NI	UNK	Y	O	N	None Visible	
32	Outside	0						None Visible	Trash visible on sidewalk
32	Common	0	NI	N		MS		None Visible	
32	Residence 1	0	NI	N	Y	O	N	None Visible	
32	Residence 2	0							
33	Outside	0						None Visible	
33	Common	0							
33	Residence 1	0							
33	Residence 2	0	NI	Y	Y	O	N	None Visible	
34	Outside	0		N				None Visible	
34	Common	0	NI	N		MS		None Visible	
34	Residence 1	0							
34	Residence 2	0	UNK	N	Y	O	N	None Visible	

Summary of Residential Sampling Survey Form Results and Review of Photographs (Abbreviations and terms used in the table are defined on the last page in this table.)									
Event Number	Location	Number of Broken Windows	Dust Visible Initially	Dust Visible Currently	Residence Occupied	Cleaning Method	Aggressive Sampling	Level of Dust in Photo	Photo Comments
AA = asbestos abatement professionals C = contractor LI = large increase M = moderate increase MS = building management staff N = no NI = no Increase O = owner/tenant SI = slight increase over normal UNK = unknown Y = yes									





FIGURES