QUALITY ASSURANCE PROJECT PLAN

BUILDING DEMOLITION EVALUATION PHASE III STUDY
ALTERNATIVE ASBESTOS CONTROL METHOD
FOR BUILDING DEMOLITION

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Contract No. EP-C-05-058
Task Order No. 0057

A.1. QUALITY ASSURANCE PROJECT PLAN APPROVAL SHEET

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ORD, NRMRL, U.S. EPA

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A.2. TABLE OF CONTENTS

APPENDICES

Appendix A. Alternative Asbestos Control Method
Appendix B. Soil Sample Preparation and Analysis Method for Asbestos

LIST OF TABLES

LIST OF FIGURES

A.3. DISTRIBUTION LIST

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Roger C. Wilmoth, USEPA, NRMRL Program Manager
Holly Wootten, Task Order Lead, The Cadmus Group, Inc.

A.4. PROJECT TASK/ORGANIZATION

A.4.1. Project Organization

The United States Environmental Protection Agency's (U.S. EPA's) Office of Research and Development (ORD) and U.S. EPA's Region 6 are cooperatively conducting this research project to determine the effectiveness of the Alternate Asbestos Control Method. The Cadmus Group, Inc. (Cadmus) is the prime contractor on the project and will have overall responsibility to ensure that the project is conducted in accordance with the approved Quality Assurance Project Plan (QAPP). The Louis Berger Group, Inc. (Berger) will assist Cadmus in the conduct of this study.

The overall project organization is presented in Figure 1. It graphically shows the functional organization structure and lines of communication for this project. The project structure along with the technical personnel selections are designed to provide efficient management and a high level of technical competence to accomplish this research project. The roles and responsibilities of key project personnel are summarized in Table 1.

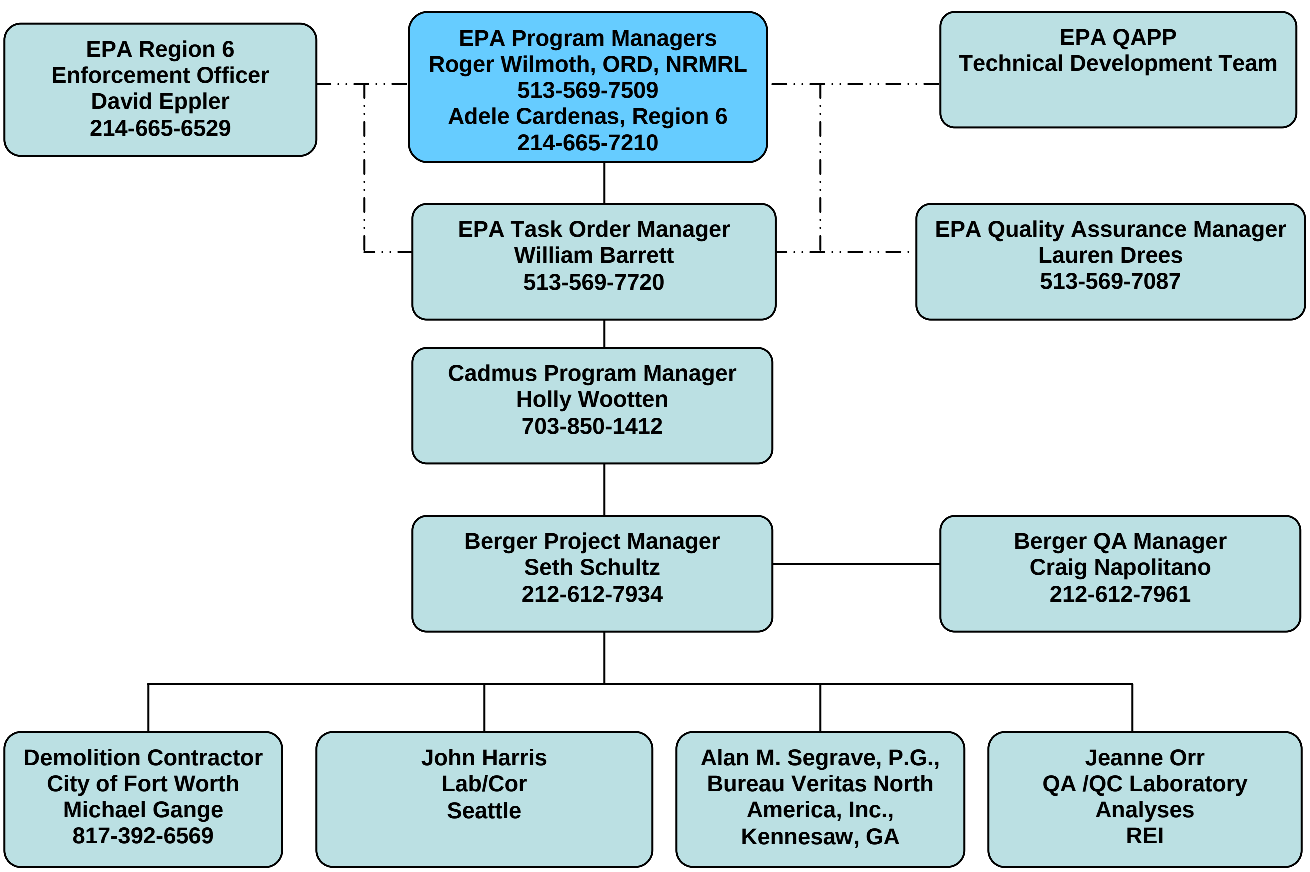

Figure 1. Project Organizational Structure.

Table 1. Roles and Responsibilities of Key Project Personnel

Personnel	Role and Responsibility
Roger Wilmoth U.S. EPA, ORD, NRMRL	*Program Manager*, will have overall administrative and technical responsibility for this program.
William Barrett U.S. EPA, ORD, NRMRL	*Task Order Manager (TOM)*, will direct the project and ensure that it is proceeding on schedule and within budget. Point of contact for Cadmus.
Lauren Drees U.S. EPA, ORD, NRMRL	*QA Officer*, will provide QA oversight to ensure that the planning and plan implementation are in accordance with the approved QAPP. In addition, ORD's QA Officer will oversee a field audit and laboratory audit.
Holly Wootten Cadmus	*Overall Project and Task Order Lead*, will have overall administrative responsibility for the Cadmus Team and to serve as the primary client interface to ensure continuity between EPA, the Cadmus Team and all subcontractors (listed below) in working towards stated project objectives.
Seth Schultz LBG	*Berger's Project Manager*, will have overall administrative and technical responsibility for LBG on this project. Will also have overall administrative and technical responsibility for Berger and its sub-contractors to ensure that data collection and analysis and the technical report meet the planned study objectives.
Craig Napolitano LBG	*Quality Assurance Manager* to ensure compliance with final QAPP and study objectives. Will oversee laboratory analysis and perform data validation.
Tracy Bramlett IHST	Industrial Hygiene subcontractor to Berger. Conducted building inspection, will perform worker sampling.
Michael Gange City of Fort Worth, Texas	Management of the AACM demolition contractor
Alan M. Segrave, P.G., Bureau Veritas North America, Inc.	Will provide primary laboratory analysis of asbestos samples
John Harris, Lab/Cor	Will provide laboratory analysis of soil samples
Jeanne Orr Reserviors Environmental, Inc (REI)	Will provide quality assurance (QA) secondary sample analysis

A.5. PROBLEM DEFINITION/BACKGROUND

A.5.1. Background

The Clean Air Act provides the USEPA with the authority to promulgate and enforce a "work practice standard" for demolition of buildings that contain regulated asbestos containing materials (RACM) if it is not feasible to establish an emission standard. Section 112 of the Clean Air Act, determined asbestos to be a hazardous air pollutant, and the use of asbestos is regulated under the National Emission Standard for Hazardous Air Pollutants (NESHAP) for Asbestos, 40 CFR Part 61, Subpart M (Asbestos NESHAP). Requirement for the demolition and renovation of buildings that contain asbestos are contained in 40 CFR 61.145.

The asbestos NESHAP defines RACM as the following [40 CFR 61.141]:

(a) Friable asbestos material,
(b) Category I nonfriable ACM[1] that has become friable,
(c) Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading, or
(d) Category II nonfriable ACM[2] that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.

The asbestos NESHAP requires emissions control when demolition or renovating a facility if the combined amount of RACM is: [40 CFR 61.145(a)(1)]

- At least 80 linear meters (260 linear feet) on pipes or at least 15 square meters (160 square feet) on other facility components, or

- At least 1 cubic meter (35 cubic feet) off facility components where the length or area could not be measured previously.

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[1] Category I nonfriable asbestos-containing material (ACM) means asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos as determined using the method specified in 40 CFR 763, Appendix E(1), Polarized Light Microscopy.

[2] Category II nonfriable ACM means any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos as determined using the methods specified in 40 CFR 763Appendix E(1), Polarized Light Microscopy that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure. [40 CFR 61.141]

For facilities containing asbestos above the threshold quantity, the emissions controls required for demolition include removal of all RACM prior to any demolition activity that would break up, dislodge, or similarly disturb the material or preclude access to the material for subsequent removal. The asbestos NESHAP specifies emissions control procedures to be used during RACM removal and/or building demolition [40 CFR 61.145(c)] and wastes generated during demolition must be disposed of in accordance with the requirements of 40 CFR 61.150.

If the facility is being demolished under an order issued by a State or local government agency because the facility is structurally unsound and in danger of imminent collapse, the RACM is not required to be removed prior to demolition, but the portion of the building that contains RACM must be kept adequately wet during demolition [40 CFR 145(a)(3) and 40 CFR 61.145(c)(9)].

It is generally regarded that the cost of compliance with the asbestos NESHAP is currently forestalling redevelopment efforts in a number of communities because the labor costs associated with removal of the RACM is significantly greater than the costs of building demolition. As a result, the USEPA has devised the Alternate Asbestos Control Method (AACM) that provides emissions controls believed to be equivalent to the current work practices required by the asbestos NESHAP. Previous studies indicated that there were situations where releases of asbestos were documented from demolition activities. These studies included both demolitions conducted by the NESHAP process and ones conducted under imminent danger of collapse situations. (Wilmoth et al 1993, Wilmoth et al 1994, City of Saint Louis 2004).

To date, the USEPA has conducted an evaluation of the AACM by performing a controlled side-by-side comparison of the AACM and the NESHAP on identical buildings at Fort Chaffee Redevelopment Authority (Wilmoth et al, 2007). The buildings in the first study had positive asbestos–containing wall systems and vinyl asbestos floor tile. A follow-up study has also been conducted to evaluate the AACM's ability to control emissions from the demolition of a building that had exterior transite siding.

This third phase of the AACM evaluation is intended to evaluate the ability of the AACM to control emissions from a building that has textured wallboard surfaces, such as asbestos-containing popcorn ceiling.

The AACM requires that certain RACM (such as thermal system insulation and fireproofing) be removed before demolition in accordance with the asbestos NESHAP; other RACM (such as transite, wallboard joint compound, resilient flooring/mastic, glazing compound, popcorn ceilings, etc.) may remain in place. The AACM varies from the existing Asbestos NESHAP in the use of an amended-water wetting process, type of demolition equipment, and demolition techniques. Once the RACM has been removed, the demolition can then be conducted using amended water to suppress emissions of asbestos before, during, and after demolition to trap asbestos fibers, minimizing the potential for release to the air. The RACM is less likely to become airborne when the wetting process and demolition techniques specified in the AACM are used. Wastewater generated during the demolition is collected and filtered, and all debris is disposed of as asbestos-containing waste. Soil in the affected area is excavated and disposed as asbestos-containing waste. Appendix A contains the AACM developed by EPA Region 6, the EPA ORD, and with input from the EPA QAPP Technical Development Team.

The purpose of this research project is to gather additional data to document the environmental and cost-effectiveness of the AACM.

A.5.2. Objectives

The goal of this research study is to collect data on the environmental effectiveness and cost of the AACM for demolition of buildings that contain popcorn- ceiling style wallboard texture, troweled-on surfacing on walls, and some vinyl asbestos floor tile. The AACM may be considered for modification to the asbestos NESHAP as an additional tool to safely demolish asbestos-containing structures.

Emissions must be inferred from measured concentrations in receptors (air, soil, water, dust, and personal monitoring). Because of the complex nature of the potential emissions from building demolition, it is difficult to state in advance precisely how these data will be evaluated, but all the data and observations obtained will be used to document environmental releases, time requirements, and costs.

A.5.2.1. Primary Objective

1. To determine the airborne asbestos concentrations during the demolition of the subject building by the AACM process and compare to background concentrations.

A.5.2.2. Secondary Objectives

The following secondary objectives will provide additional information to further characterize the interrelationships among several multimedia parameters to enhance the understanding of the process and to further the science. These data will also be considered in a holistic sense in assessing the effectiveness of the demolition method:

AIR

1. To document visible emissions during the AACM demolition.

2. To determine total fibers in air (phase contrast microscopy (PCM)) during the AACM demolition and compare to background concentrations.

DUST

3. To determine the settled dust asbestos loadings during the building demolition building by the AACM process and compare those to background loadings.

WORKER

4. To determine worker breathing zone fiber concentrations (PCM) during the AACM.

5. To determine worker breathing zone asbestos concentrations (TEM-transmission electron microscopy) during the AACM.

SURROUNDING SOILS/PAVEMENT/BUILDING SLAB

6. To determine the asbestos concentration in post-cleanup soils and/or pavement (TEM) from the AACM demolition and compare those to pre-demolition soils and/or pavement concentrations and to background soils/pavement asbestos concentrations.

WATER

7. To measure the asbestos concentrations in the source water, the amended water during demolition, the surface water collected during the AACM demolition., and the treated water released to the POTW.

TIME

8. To document the time required for all activities related to the demolition by the AACM.

COST

9. To document the cost required for all activities related to the demolition by the AACM and to compare those with estimated costs for demolition of the building by the NESHAP process.

A.6. PROJECT/TASK DESCRIPTION

The following sections provide a description of each project task.

A.6.1. Task 1 - Pre-Demolition Site and Building Inspection

The first task was the conduct of a comprehensive pre-demolition inspection in accordance with the Asbestos Hazard Emergency Response Act (AHERA) (40 CFR 763), and the requirements of the American Society of Testing and Materials (ASTM) E2356-04e1 Standard Practice for Comprehensive Building Asbestos Surveys to identify the type, quantity, location, and condition of Asbestos-Containing Materials (instead of only RACM) in the building in accordance with the asbestos NESHAP and the Texas Department of State Health Services (DSHS) asbestos program requirements. This section provides an outline of the known environmental condition of the site.

A.6.1.1. Site Description

The site selected for conduct of this study is the former office building for the Oak Hollow Apartment complex located at 5901 Boca Raton Boulevard, Fort Worth, Texas. The subject building is a two-story structure that is slab-on grade construction, as shown in Figure 2. It appears that the building was constructed with wood frame, and has exterior brick veneer applied to the lower portion of the structure. The upper portion of the structure use wood panel siding. The building has an asphalt shingled roof. The interior of the building contains a wallboard system that has a surface texture coating and a wallboard system ceiling with asbestos-containing “popcorn” ceiling texture. The walls have been painted, likely numerous times, using latex paint. Various flooring materials are present in the structure, including flexible tile with mastic and carpets. The City of Fort Worth conducted an asbestos survey of the building for their own purposes. The ACM identified during this inspection are listed in Table 2.

Table 2. ACM Identified in the Former Office Building of the Oak Hollow Apartments, 5901 Boca Raton Boulevard, Fort Worth, Texas.

ACM Type	Description	Quantity	Asbestos Type	Estimated Concentration Range	Location
Sheetrock	Ceiling Texture (Popcorn)	2,200 ft^2	chrysotile	2 – 5 %	Office #1 Upstairs Open Area Next to Fire Place Lounge, Work Room Sauna
Sheetrock	Sheetrock and Joint Compound	5,700 ft^2	chrysotile	2%	Upstairs Open Area Office #3 Foyer, Work Room Storage Room
Flashing	Roof flashing	6 linear feet	chrysotile	5%	Chimney
Flooring Materials	9" x 9" Floor Tile with Mastic	80 ft^2	chrysotile	2%	Kitchen

Figure 2. Oak Hollow Apartment Complex Office Building located at 5901 Boca Raton in Fort Worth, Texas.

The comprehensive pre-demolition inspection was conducted in accordance with the Asbestos Hazard Emergency Response Act (AHERA) (40 CFR 763) and the requirements of the ASTM E2356-04e1 Standard Practice for Comprehensive Building Asbestos Surveys to identify the type, quantity, location, and condition of Asbestos-Containing Materials (instead of only RACM) in the building in accordance with the asbestos NESHAP and the Texas Department of State Health Services (DSHS) asbestos program requirements. As noted in the asbestos NESHAP [40 CFR 61.145(a)], in addition to RACM, Category I and Category II Non-friable Asbestos-Containing Materials must also be identified prior to demolition or renovation.

The building has been surveyed for the presence of inorganic lead (*e.g.* lead paint) in accordance with Housing and Urban Development's (1997) "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing" to characterize the potential for occupational exposure during demolition. Representative composite bulk samples of the suspect lead-containing building materials were collected in accordance with the HUD sampling protocols and analyzed to determine the lead content by EPA SW-846 Methods 3050B/7420. No lead was present in the paint chips, and as a result, lead is not a concern for either worker exposure or waste disposal.

Additionally, the electrical switches in the building were inspected and found to not contain mercury. The ballasts in the fluorescent lights were visually inspected and found to be labeled as “non-PCB containing.” The fluorescent light tubes will be removed from the building prior to demolition and properly disposed of, or recycled.

The area surrounding the project is primarily residential, including apartment complexes, townhouses and single-family homes, as shown on Figure 3. The apartment complex that the subject building is located within and the apartment complex to the south, circled in yellow, have been acquired by the City of Fort Worth, are currently unoccupied, and will be demolished following conduct of the AACM evaluation. The apartment complex located to the southeast, across Boca Raton Boulevard, and the apartment complex to the north of the subject building are currently occupied. In addition, a low-density residential community is located approximately 300 feet to the northwest of the subject building. A police substation is located approximately 500 feet southeast of the subject building. For purposes of the evaluation, Boca Raton Boulevard will be closed during the demolition and subsequent soil removal. Additionally, the bus stop located along Boca Raton Boulevard will be relocated. The City of Fort Worth will also construct a wall along Boca Raton Boulevard to provide elevated sampling locations.

A.6.2. Task 2 - Building Demolition

The AACM building will be demolished using the demolition practices specified in the “Alternative Asbestos Control Method” contained in Appendix A. This task will be conducted by a contractor to the City of Fort Worth, Texas. The USEPA will coordinate with the City of Fort Worth to conduct the demolition in such a way that the goals of Task 3 - Building Demolition Sampling and Sample Analysis can be accomplished.

A.6.3. Task 3 - Building Demolition Sampling and Sample Analysis

Task 3 includes the collection and analysis of air, dust, worker, water, soil, and pavement samples in order to evaluate the impact of the AACM at this site. Specific requirements for monitoring are described in Section B of this QAPP.

Figure 3. Aerial Photograph of Subject Site and Surrounding Area.

A.6.4. Task 4 - Quality Assurance Activities

This project is a Category II Project - this study is being performed to generate data used in support of the development of environmental regulations or standards.

All field and laboratory data shall be reviewed, verified, and validated, including as a minimum, review of field sampling logs, verification of sample collection data (e.g., air sampler flow rates and volume collected), review of laboratory count sheets, verify count and other data transcription, check all mathematical calculations, and review and summarize QA/QC related sample analyses.

The USEPA will conduct on-site audits (laboratory and field) of project-specific activities.

A.6.5. Task 5 - Reporting and Deliverables.

A.6.5.1. Deliverable A. Pre-Demolition Site and Building Inspection Report

A report of the pre-demolition site and building inspection will be prepared. This report shall include, but are not limited to, a detailed site description, building description, results of the pre-demolition inspection documenting the types and nature of ACM within the building, demolition work plan including schedule, ACM removal cost estimates, demolition cost estimates, field sampling plan, demolition specifications, berm construction details, and water treatment system details.

A.6.5.2. Deliverable B. Draft Report

A draft report will be prepared of the research project and a final PowerPoint presentation, including a detailed site description, the project-specific methodology employed for the demolition, sample collection and analysis, discussion of monitoring data including statistical analysis of the sample data to determine whether project objectives have been met, and cost effectiveness of the demolition technique. The contractor will present a briefing to Agency officials on the results/conclusions.

A.6.5.3. Deliverable C. Final Report

The draft report will undergo independent peer review at the direction of the USEPA. The contractor shall make the necessary changes after all peer review comments have been received by EPA and communicated to the contractor.

A.6.6. Project Schedule

Table 3 includes the major milestones.

Table 3. Major Project Milestones

ID	Task Description	Completion Date
1	Kick Off Conference Call – (Site Selected)	10/12/2007
2	Site Visit	11/1/2007
3	Site Assessment Sampling	11/1/2007
4	Draft QAPP for Review	11/16/2007
6	Receipt of Site Assessment Laboratory Analysis	11/19/2007
7	Finalize QAPP	11/30/2007
8	Conduct AACM Demo	12/12/2007
9	Laboratory Audit	12/20/2007
10	Data Analysis & Preparation of Draft Report	2/1/2008
11	Review Draft Report	3/1/2008
12	Final Report	4/30/2008

A.7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The overall quality assurance objective of this project is to implement procedures for field sampling, laboratory analysis, and reporting that will provide data for the development of scientifically valid conclusions and support decision making regarding the project objectives identified in Section A.5.2. EPA has developed a seven-step Data Quality Objective (DQO) procedure designed to ensure that data collection plans are carefully thought out and to maximize the probability that the results of the project will be adequate to support decision-making (EPA QA/G-4, August 2000, EPA/600/R-96/055). This seven-step decision process has been applied to the Primary Project Objective.

A.7.1. Primary Objective

To determine the airborne asbestos concentrations during the demolition of the apartment complex office building by the AACM process and compare to background concentrations.

A.7.1.1. Step 1: State the Problem

The asbestos NESHAP (40 CFR Part 61, Subpart M) requires the removal of RACM prior to demolition of the facility as described in Section A.5.1. Asbestos removal in accordance with NESHAP can account for a significant portion of the total demolition cost. Because of the abatement cost for these types of buildings, demolition is not occurring in many cases. Demolition of asbestos-containing buildings that have been declared to be unsafe for entry could result in the release of asbestos to the environment because RACM is not required to be removed under this scenario.

The EPA will perform a controlled demonstration as part of the Agency's effort to evaluate the effectiveness of the AACM. The AACM, if successful, would likely accelerate the demolition of many orphaned buildings around the nation that remain standing and present a variety of potentially serious risks to nearby residents.

A.7.1.2. Step 2: Identify the Decision

Is the airborne concentration of asbestos during demolition of a building and debris loading using the AACM greater than the background asbestos concentration?

A.7.1.3. Step 3: Identify Inputs to the Decision

Information that is required to resolve the decision statement:

1. Accurate and representative measurements of airborne asbestos concentrations released during demolition of the building using the AACM.
2. An analytical sensitivity that is sufficiently low to detect an anomalies when using the AACM.
3. Accurate and representative measurements of the wind speed and wind direction during demolition of the building.
4. Accurate and representative background data for use in distributional testing.

A.7.1.4. Step 4: Define the Study Boundaries

1. *Spatial boundary of the decision statement*: This decision related to the air concentration of asbestos is defined as the area within the sampling ring around the building. This ring is outside the work area, no more than 25 to 35 feet from the building or demolition activities. Further, decisions regarding the air matrix apply to air within the breathing zone of potentially exposed individuals engaged in demolition and debris handling at the Fort Worth site.

2. *Temporal boundary of the decision statement*: Weather conditions such as freezing temperatures will impede the demolition contractor's ability to adequately wet the structure. Rain conditions may influence the transport and deposition of asbestos fibers released from demolition and debris handling. The study will not be conducted during rain or snow conditions. Sustained wind speeds of 15 mph (60-minute average) or gusts above 20 mph may affect the transport and dispersion of asbestos fibers; i.e., the asbestos concentration would be inversely proportional to the wind speed. To ensure that this does not occur, demolition and sampling will cease when the wind speed in the area exceeds these values. To ensure adequate conditions to detect any visible emissions that are visually detectable without the aid of instruments, the demolition will be conducted during daylight hours (07:00 to 17:00 hours).

3. *Practical constraints on data collection:*

- Loading of particulate on a single sample filter collected over the entire one-day period of the demolition and debris loading activities could prevent the direct preparation of the filters for TEM analysis.[3] To minimize the probability of such an occurrence, the air sampling flow rate has been selected to achieve acceptable filter loading during the sampling period. As an additional safeguard, low volume air samples will be collected at the same locations as the high volume samples. These samples will be archived. Although undesirable, should overloading occur on most filters, an indirect TEM method will be used for analysis (ISO 13794:1999).

- The number and placement of stationary air monitors could be affected by demolition and debris handling activities. This is particularly applicable on the southeast side of the buildings where the demolition excavator is located and debris loading activities will occur. Physical constraints for demolition equipment access may necessitate the movement of some samplers as the physical conditions require.

A.7.1.5. Step 5: Develop a Decision Rule

Decision rules will be used to quantify the degree of difference between various characteristics of the demolition and background data distributions. All hypotheses are set up as one-sided with the *alternative hypothesis that some characteristic of the demolition distribution (e.g. mean, median, quantile) is greater than the corresponding characteristic from the background distribution*. The result from each of these tests is a *p*-value, which represents the probability of obtaining the observed difference in the distributional characteristic of interest (e.g. the mean) under the assumption of the null hypothesis that the demolition and background data sets both arise from the same underlying distribution. If the *p*-value is small, then the assumption that the demolition and background data sets both arise from the same underlying distribution is rejected, and the alternative hypothesis as stated above is concluded.

A.7.1.6. Step 6: Tolerable Limits on Decision Errors

In the first Fort Chaffee demonstration, there were a high proportion of air sample filters where zero asbestos fibers were identified. The area of a sample collection filter is about 385 square millimeters (mm^2), and the area of an individual grid is 0.0091 mm^2, or a filter contains about 40,000 grid openings. During the initial study at Fort Chaffee, as many as 50 grid openings

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[3] The direct transfer TEM method (ISO 10312:1995) should not be used if the general particulate loading of the sample collection filter exceeds approximately 10 $\mu g/cm^2$ of filter surface, which corresponds to approximately 20 percent coverage of the collection filter by particulate.

Table 4. Upper and Lower Confidence Limits of the Poisson 95-Percent Confidence Interval of a Count.[a]

Structure Count	Lower 95 Percent Confidence Limit[b]	Upper 95 Percent Confidence Limit[b]
0	0	3.689
1	0.025	5.572
2	0.242	7.225
3	0.619	8.767
4	1.090	10.242
5	1.624	11.669
6	2.202	13.060

[a] Source: ISO Method 10312:1995(E) Annex F, Table F.1.
[b] Two-tailed confidence interval.

were counted, resulting in an examination of less than 0.5 mm2, or an area of up to 0.12 percent of the total filter area was counted. The Poisson distribution can be used to describe the number of asbestos fibers on a sample collection filter. The 95% Poisson confidence intervals for means ranging from zero to six are displayed in Table 4. A 95% confidence interval would contain the mean number of asbestos fibers 95 times out of one hundred, if the demolition of the same building using the same method were repeated again and again.

ISO Method 10312:1995(E) defines the analytical sensitivity as the calculated airborne asbestos structure concentration in asbestos structure/liter, equivalent to counting of one asbestos structure in the analysis. The limit of detection is defined as the calculated airborne asbestos structure concentration per liter equivalent to counting 2.99 asbestos structures in the analysis. Annex F of ISO 10312:1995(E) indicates that the level of detection is 2.99 times the analytical sensitivity, which corresponds with the one-sided 95 percent upper confidence interval of the Poisson distribution. As such, fiber counts below 3, which is the one-tailed 95-percent upper confidence interval for a count of zero from a Poisson distribution. In this case, the sample counts will be evaluated to determine whether the data fit a Poisson distribution using a goodness-of-fit test such as the Kolmogorov-Smirnov test or the χ^2 test such as the Pearson-Fisher. Depending on the distribution of fiber counts observed, the statistical treatment of low fiber count data will be evaluated.

A suite of background comparison tests for dealing with a set of data with a large number of non-detect (censored) data, originally developed in the early 1990s by Dr. Richard Gilbert at Pacific Northwest National Laboratory, will be used to compare the demolition and background data distributions. Each test compares a somewhat different (although correlated) characteristic of the demolition and background data distributions. For each test, if the *p*-value is small enough (e.g. less than a significance level of 0.05) the null hypothesis is rejected, and the conclusion is drawn that the demolition data are greater than the background in the context of the characteristic tested. If the *p*-value is much greater than 0.05 then the demolition and background data distributions are considered similar, or the background data are greater than demolition data, which might instead indicate a comparability problem with the background data set.

The background comparison suite of inferential tests, *t*, Gehan, Quantile Q(.80) and Slippage, consists of a single parametric and three non-parametric tests. A parametric test makes assumptions about the underlying distributions, whereas a non-parametric test does not. Distributions are uniquely characterized by parameters (e.g. mean and standard deviation) and hence the name "parametric test." For example, the *t*-test, which quantifies the observed difference between the means of two distributions, is a parametric test that requires the assumption of normality. The results of the *t*-test are relatively robust to departures from normality; however for extremely skewed or bimodal distributions, the results of the *t*-test may be suspect. The non-parametric analog of the *t*-test is the Gehan test, a generalization of the Wilcoxon Rank Sum test that accommodates multiple detection limits through an ordering algorithm. The Gehan test quantifies the degree of difference between the medians of two distributions. As a non-parametric test, the Gehan test is less prone to the effects of very extreme data. Statistical tests that evaluate normality (e.g. D'Agostino & Pearson) will be used to determine the appropriateness of applying the *t*-test.

Two additional non-parametric tests will be used to assess differences that may exist in the tails of the two distributions. Specifically, the Quantile test is used here to determine if there are an anomalously large number of demolition data that exceed the 80^{th} percentile of the background distribution. This test is performed using combinatorial counting techniques under the assumption that both the demolition and background data arise from the same underlying distribution. If there are an anomalously large number of demolition data greater than the 80^{th} percentile of the background distribution, then it is concluded that, with respect to statistical significance, the 80^{th} percentile of the demolition data distribution is greater than the 80^{th} percentile of the background data distribution. Effectively this means the tail of the demolition distribution is "fatter" than that of the background distribution; therefore there is a statistical difference in the tails of the distributions. The Slippage test will be used to see if there are an anomalously large number of demolition data that exceed the maximum of the background data. This test is similar in function to the Quantile test. If there are an anomalously large number of demolition data greater than the maximum of the background data, then it is concluded that, with respect to statistical significance, the maximum data of the demolition distribution are greater than the maximum of the background distributions.

If any of the *p*-values from the four hypothesis tests are less than the nominal alpha level of 0.05, the conclusion from that test will be used for the overall result. The *t*-test will be included only if the assumptions of normality and homogeneity of variance are met. If these assumptions are not met, the conclusion for the overall result will be based on the three nonparametric inferential tests.

In addition, exploratory data analysis plots such as box plots, histograms, *q*-*q* plots and cumulative distribution plots, will be used as qualitative assessment of the form of the distributions for both demolition and background data. Displays meet the need to see the behavior of the data, to reveal unexpected features, such as outliers; and confirm or disprove assumptions, such as the distributional assumptions of normality and homogeneity of variance required for the *t*-test. In the event an observation(s) is outside the main body of the data, records will be reviewed for an assignable cause(s) and the data value(s) corrected if appropriate. Even if there is no assignable cause(s), the value(s) will be included in all analyses and appropriate measures will taken to meet inferential test assumptions if necessary (i.e., data transformation to meet normality or homogeneity of variance assumptions).

A.7.1.7. Step 7: Optimize the Design for Obtaining Results

Using the data from the first Fort Chaffee demonstration (Wilmoth et al, 2007) to estimate the standard deviation for the various matrices effect size differences were calculated using a two sample *t*-test. An approximation to the standard deviation was used, the range divided by four, due to the number of non-detects. The approximation was used in order to avoid the controversy surrounding which is the "best" method for calculating summary statistics when data are censored. For each standard deviation estimate where censored data were encountered, zero was used as the minimum value. This was done to provide a conservative estimate of the standard deviation.

Effect size estimates are based on the proposed sample sizes in Section B1.2, a Type I Error rate of 0.05, power of 0.90, and using either a two sample independent *t*-test. The Type I Error rate is the probability of rejecting the null hypothesis when it is actually true and the power is the probability of rejecting the null hypothesis when it is actually false. The effect size is the smallest mean difference that is statistically significant under the proposed sample sizes and based on the assumption the observed standard deviations are no larger than the estimated. The effect sizes are displayed in Table 5**.**

Table 5. Effect Sizes for Type I Error Rate = 0.05, Power = 0.9,Based on a Two-Independent Sample t-Test

Primary Objective: To determine the airborne asbestos concentrations during the demolition of the apartment complex office building by the AACM process and compare to background concentrations.		
Background Air	***AACM Air***	***Air Effect Size***
Sample size = 6 [a]SD = 0.00024 s/cm^3	Sample size = 18 [a]SD = 0.00095 s/cm^3	0.00074 s/cm^3

[a]SD = Approximate standard deviation (determined as the difference between the minimum and maximum concentrations divided by four)**.** Minimum and maximum concentrations were generated during Phase 1. Ring 2 AACM data used as background, if available; otherwise, NESHAP data used for background.
[b]SD = Standard deviation.

A.7.1.8. Analytical Sensitivity/Limit of Detection

The target analytical sensitivity will be 0.0005 structure/cubic centimeter of air (s/cm^3) for all asbestos structures (minimum length of $\geq$0.5 µm). An analytical sensitivity of 0.0005 s/cm^3 was selected for the following reasons: 1) It is near concentrations that have been reported as a background level of asbestos in ambient air (EPA 1986), and 2) It has been used in other EPA ambient air studies (Wilmoth et al, 2007, Stewart 2003; California Environmental Protection Agency 2003; Wilmoth et al 2004; Wilmoth et al 1990; Kominsky and Freyberg 1995; and "*Contaminants of Potential Concern Committee of the World Trade Center Indoor Air Task Force Working Group"* (May 2003)). This analytical sensitivity was also used in the Phase 1 study.

Achieving the analytical sensitivity for asbestos in air samples is generally dependent on two factors: the volume of air collected through the filter and the area of the filter analyzed; i.e., the number of grid sections analyzed multiplied by the area of the grid sections analyzed. The required analytical sensitivity will be achieved for each collected air sample by collecting as large a volume of air as practical and by increasing the filter search areas, as needed.

The method detection limit is general considered to be the concentration of the analyte that can be measured and reported with a known confidence that the concentration of the analyte is significantly different from zero. EPA's *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846) indicates that the method detection limit is the 99 percent one-tailed upper confidence limit based on the standard deviation of a minimum of three samples with a known spike addition. In accordance with ISO Method 10312:1995(E), the limit of detection will be 2.99 times analytical sensitivity, which is the one-tailed 95 percent upper confidence interval of a zero fiber count. All samples having less than 3 fibers counted will be treated as non-detect.

A.7.1.9. Data Quality Indicators (DQI)

A.7.1.9.1. Sample Collection DQI

- Precision is the absolute value of the difference of the two analyses, divided by the square root of the sum, which is an estimate of the standard deviation of the difference based on a Poisson counting model. Precision criteria for co-located samples are presented in Table 25. If these criteria are not met the effect on project conclusions will be evaluated.

- Completeness is defined as follows:

$$\%Completeness = \frac{V}{N} x100$$

where V is the number of measurements judged valid, and N is the number of measurements planned. An overall measure of completeness will be given by the percentage of samples specified in the sampling design that yield usable "valid" data. Although every effort will be made to collect and analyze all of the samples specified in the sample design, the sample design is robust to sample loss. The loss of a few samples, provided they are not concentrated at a set of contiguous sectors, will likely have little effect on the false-negative error rate. The project goal is to collect at least 95 percent of the samples specified in the sample design. If completeness objectives are not met the effect on conclusions will be evaluated.

- Representativeness is a subjective measure of the degree that the data accurately and precisely represent the sample collection conditions of the environment. Representative sample collection depends on the expertise and knowledge of the personnel to make sure the samples are collected in a manner that reflects the true concentration in the environment. The sampling locations, number of samples, sampling periods, and sampling durations have been selected to ensure reasonable representativeness.

- Comparability is a qualitative term that expresses the measure of confidence that one data set can be compared to another and combined for the decision to be made. Data collection using a standard sampling and analytical method (e.g., ISO 10312:1995, counting structures longer than and shorter than five µm in length, and PCME (PCM equivalent fibers[4]) maximizes the comparability of the results with both past sampling results (if such exist) and future sampling results.

A.7.1.9.2. Sample Analysis DQI

Analysis of identical image fields as measured by the primary analytical laboratory who will determine the precision data quality indicator. Precision in number of asbestos fibers and asbestos fiber dimensions from the same filters and image fields from selected tests will be measured. Filters loaded with asbestos collected by air filtration have an inherent variability that is exacerbated by the exceedingly small area analyzed by TEM. Although the variability cannot be mitigated by sampling strategies or sampling preparation strategies, it can be quantified, and if factors exist that are artificially magnifying the variability, those factors can in theory be isolated and identified. The best approach to this is through interlaboratory re-preparation and re-analysis of filters and intra-laboratory re-preparation and re-analysis of filters. Interlaboratory re-analysis establishes that the variability is not caused by the laboratory's sample preparation and analytical techniques. If the laboratory was improperly preparing the samples and was causing the results to consistently bias high or low, then the second laboratory's analysis of numerous samples should

---

4 A PCME(phase contrast microscopy equivalent) fiber is a fiber with an aspect ratio greater than or equal to 3:1, longer than 5 µm, and which has a diameter between 0.2 and 3.0 µm.

reveal this trend. If the samples had exceedingly high variability across the filter (or if the lab was causing artificial variability through sample preparation and analysis techniques), then this would be revealed by re-preparation and analysis of the filter by the same laboratory.

Because no reference materials are available to assess the accuracy of the TEM measurements, the best approach is to establish consensus standards through duplicate analysis of precise sub-samples. This is accomplished through a procedure called "verified counting," which is documented in a National Institute of Standards and Technology (NIST) technical guide and used by asbestos analytical laboratories. Two laboratories (in this case the primary analytical laboratory and the QC laboratory) analyze precise identical areas of the sampling filter, and compare their results, which consist of numbers of asbestos structures and drawings and dimensions of each asbestos structure. In this fashion, they can mutually agree on the concentration of asbestos in the sub-sample, and can verify that each is following the very specific guidelines for asbestos structure counting by TEM. Any lack of precision or presence of bias can be readily established and quantified.

A.8. SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

A.8.1. Field Personnel

Field leaders must have extensive experience in conducting asbestos-related field research studies including those related to building demolitions. A state-licensed Asbestos Abatement Consultant with training in the Asbestos NESHAP (40 CFR Part 61, Subpart M) will be on site during demolition and debris loading activities to oversee the demolition process as well as document the release of any visible emissions. Other field personnel will be properly trained to conduct their job at the site. As appropriate, field personnel shall have experience in asbestos ambient air monitoring, occupational exposure monitoring, related environmental measurements, and data recording. The field personnel will be trained in the requirements of the site-specific Health and Safety Plan (HASP). All personnel entering the containment area demolition will be state licensed asbestos abatement supervisors and/or workers.

A.8.2. Laboratory Personnel

Laboratory personnel must be familiar with the analytical methods and reporting requirements outlined in the QAPP. Bureau Veritas is a National Voluntary Laboratory Accreditation Program (NVLAP)-accredited lab for the analysis of airborne asbestos.

A.9. DOCUMENTATION AND RECORDS

A.9.1. Field Operations Records

A.9.1.1. Sample Documentation

The following information will be recorded:

- Name(s) of person(s) collecting the sample;
- Date of record;
- Description of sampling site (e.g., Air Monitoring Station 1);
- Description of sample including a photographic image showing the sample number;
- Location of sample documented on site map with GPS coordinates, as applicable;
- Type of sample (e.g., area, personal, settled dust, water, duplicate, field blank);
- Unique sample number that identifies the sampling site, sample type, date, and sequence number;
- Flow meter number and airflow reading (start/stop);
- Sample time (start/stop) recorded in 24-hour time;
- A pre-printed sheet of sample labels (two identical labels per sample number) will be prepared. One label will be attached to the sample container before sample collection period begins, and the other matching label will be attached to the field data sheet that records relevant data on the sample being collected. The labels will be water-proof and will be printed using indelible ink.
- Relevant notes describing site observations such as, but not limited to, site conditions, weather conditions, demolition and debris handling equipment, water application technique (spray or concentrated stream), equipment problems, etc. The notes will be recorded in a bound notebook.

Example data forms are presented in Table 6 through Table 14. At the end of each day, all samples and the corresponding Sampling Data Forms will be submitted to the contractor project manager at the demolition site. The contractor project manager will verify 100% of the information recorded on the Sampling Data Form for completeness and that all samples are in custody; any discrepancy will be resolved and corrections will be noted, initialed, and dated on the form.

Table 6. Sample Location Sketch Form

CLIENT: ______________________ DATE: ______________

SITE: ______________________ MONITOR: ______________

SITE ADDRESS: ______________________ PROJ. MANAGER: ______________

______________________ LBG PROJ. #: ______________

WORK AREA(S): ______________________

SAMPLE LOCATION SKETCH (PER EACH SHIFT)

Legend: X INSIDE WORK AREA SAMPLE LOCATION (IWA) Comments:

O OUTSIDE WORK AREA SAMPLE LOCATION (OWA)

Table 7. Daily Inspection Log Sheet

<table>
<tr><td>CLIENT:</td><td colspan="3"></td><td colspan="3">PROJECT MANAGER:</td></tr>
<tr><td>SITE :</td><td colspan="6">PAGE ______ OF ______</td></tr>
<tr><td>INSPECTOR:</td><td></td><td>SIGNATURE:</td><td colspan="2"></td><td>DATE:</td><td></td></tr>
<tr><td colspan="7">CONTRACTOR:</td></tr>
<tr><td colspan="7">Type of Work being performed:</td></tr>
</table>

TIME (24-hour)	**CONSTRUCTION ACTIVITIES (Narrative Description of Activities)**

Table 8. Contractor Workers/ Visitors Log

CONTRACTOR WORKERS/ VISITORS LOG		DATE ___________
CLIENT:		PROJECT MANAGER:
SITE :		PAGE ______ OF ______
CONTRACTOR:		
Type of Work Performed:		

NAME		TITLE (Circle one)	CERTIFICATE & LICENSE ADEQ Cert #		LICENSE EXPIRATION DATE	MISC. EXPIRATION DATE	TYPE OF RESP.
		SUPERVISOR					1 2 3 4 5
		HANDLER					
		SUPERVISOR					1 2 3 4 5
		HANDLER					
		SUPERVISOR					1 2 3 4 5
		HANDLER					
		SUPERVISOR					1 2 3 4 5
		HANDLER					
		SUPERVISOR					1 2 3 4 5
		HANDLER					
Notes:						Key: 1. Half Face Resp. 2. Full Face Respirator 3. PAPR 4. Type "C" espirator 5. Type C Supplied Air	

Table 9. Asbestos Pavement Sample Chain of Custody Form

LOUIS BERGER GROUP, INC.	ASBESTOS PAVEMENT SAMPLE LOG/CHAIN OF CUSTODY	PAGE ______ OF ______

PROJ. NO.:		DATE:	
CLIENT:		TECHNICIAN:	
SITE:		PROJ. MANAGER:	

THE LOUIS BERGER GROUP, INC. TELEPHONE # : (212) 612-7900 **FAX #: (212) 425-1618** ADDRESS: 199 Water Street 23rd Floor, New York, NY 10038	**RESULTS TO:** **EMAIL TO:**	**TURNAROUND TIME:** ☐ 1 HR ☐ 4 HR ☐ 6 HR ☐ 24 HR ☐ ______

SAMPLE ID	DESCRIPTION / LOCATION	TIME		FLOW RATE (L/MIN)		VOLUME (L)
		START/END	MINUTES	START/END	AVERAGE	
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						

TECHNICIAN'S LOG

CASSETTE	ROTOMETER		TYPE OF SAMPLING		
☐ PCM ☐ TEM	ID #:	CALIB. DATE:____/_____/_____	☐ BACKGROUND	☐ POST ABATEMENT	☐ PERIODIC
☐ __________	[ALL GIVEN FLOW RATES INCORPORATE THE CALIBRATION FACTOR]		☐ PRE-ABATEMENT	☐ AMBIENT	☐ ____________
			☐ DURING ABATEMENT	☐ OSHA	

CHAIN OF CUSTODY		DATE	TIME	LABORATORY INFORMATION	
Relinquished by (print)	(Sign)	/ /	Am/Pm	LAB NAME:____________________	
Received by (print)	(Sign)	/ /	Am/Pm	ANALYZED BY:____________________	
Relinquished by (print)	(Sign)	/ /	Am/Pm	DATE: / /	TIME: Am/Pm
Received by (print)	(Sign)	/ /	Am/Pm	QC BY:____________________	
Relinquished by (print)	(Sign)	/ /	Am/Pm	DATE: / /	TIME: Am/Pm
Received by (print)	(Sign)	/ /	Am/Pm		

NOTES/COMMENTS

Table 10. Air Sample Field Log

The Louis Berger Group, Inc.
199 Water Street, 23rd Floor
New York, New York10038
Tel 212 612 7900
Fax 212 363 1618

AIR SAMPLING FIELD LOG			
SAMPLE NUMBER		TIME ON:	
		TIME OFF:	
DATE		GPS COORDINATES	
FLOW	2L 4L	SAMPLE HEIGHT	
SAMPLING SESSION	WETTING DEMOLITION	PUMP NUMBER	

TIME	FLOW	NOTES
900	2.02	
1100	2.12	Change less than 10%
1300	2.35/2.02*	Change greater than 10% sample adjusted back to 2.02

NOTES: All sample time must be in milatary time
If sample flow is greater than 10% adjustment must be made back to orignally intended vol.
Rotometer correction factor MUST be applied in the field

Table 11. Asbestos Air/Worker Sample Chain of Custody Form

LOUIS BERGER GROUP, INC.	ASBESTOS AIR SAMPLE LOG/CHAIN OF CUSTODY	PAGE ______ OF ______

PROJ. NO.:		DATE:	
CLIENT:		TECHNICIAN:	
SITE:		PROJ. MANAGER:	

THE LOUIS BERGER GROUP, INC. TELEPHONE # : (212) 612-7900 **FAX #: (212) 425-1618** ADDRESS: 199 Water Street 23rd Floor, New York, NY 10038	**RESULTS TO:** **EMAIL TO:**	**TURNAROUND TIME:** ☐ 1 HR ☐ 4 HR ☐ 6 HR ☐ 24 HR ☐ _______

SAMPLE ID	DESCRIPTION / LOCATION	TIME		FLOW RATE (L/MIN)		VOLUME (L)
		START/END	MINUTES	START/END	AVERAGE	
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						
SAMPLE # PUMP #						

TECHNICIAN'S LOG

CASSETTE	ROTOMETER		TYPE OF SAMPLING		
☐ PCM ☐ TEM	ID #:	CALIB. DATE:____/_____/_____	☐ BACKGROUND	☐ POST ABATEMENT	☐ PERIODIC
☐ ___________	[ALL GIVEN FLOW RATES INCORPORATE THE CALIBRATION FACTOR]		☐ PRE-ABATEMENT	☐ AMBIENT	☐ _____________
			☐ DURING ABATEMENT	☐ OSHA	

CHAIN OF CUSTODY		DATE	TIME	LABORATORY INFORMATION
Relinquished by (print)	(Sign)	/ /	Am/Pm	LAB NAME:____________________
Received by (print)	(Sign)	/ /	Am/Pm	ANALYZED BY:____________________
Relinquished by (print)	(Sign)	/ /	Am/Pm	DATE: / / TIME: Am/Pm
Received by (print)	(Sign)	/ /	Am/Pm	QC BY:____________________
Relinquished by (print)	(Sign)	/ /	Am/Pm	DATE: / / TIME: Am/Pm
Received by (print)	(Sign)	/ /	Am/Pm	

NOTES/COMMENTS

Table 12. Water Chain of Custody Form

EMSL Analytical, Inc. Chemistry Lab 307 West 38th Street, N.Y., N.Y. TEL: (212) 290-0051 FAX: (212) 290-0058	**Chain of Custody / Analysis Request Form** Print ALL Information. Put N/A in blanks not applicable	EMSL Project #_____________ Account Rep:_____________ Indicate State where samples collected: ________________
REPORT RESULTS TO:	**SEND INVOICE TO:**	**TURNAROUND TIME**
Name:	Name: PO#:	Date Results needed by:______________
Company:	Company	*Standard 6-10 days or 2 weeks ☐ *11-15 days or 3 weeks☐ *16-21 days or 4 weeks ☐
Address	Address	The following turnaround times require lab approval:
City	City	☐ *4-5 days or 1week ☐ 72 Hrs ☐48 Hrs
State ZIP	State ZIP	☐ 24 Hrs Approved by
TEL: FAX:	TEL: FAX:	*same price and tat for weeks or days
Sampled by: (Signature)	# of Samples in Shipment:______________	Date of Sample Shipment:______________

Failure to complete shaded areas will hinder processing of samples.					MATRIX					Method Preserved					Sampling		List Test Needed						
	Sample Number	Station Location /Sample ID	COMP	GRAB	WATER	SOIL	AIR	SLUDGE	OTHER	HCL	HNO3	H2SO4	ICE	OTHER	DATE	TIME							
1.																							
2.																							
3.																							
4.																							
5.																							
6.																							
7.																							
8.																							
9.																							
10.																							

Released By Signature	Date & Time Released	Delivery Method	Received By Signature	Agency	Date & Time Received	Condition Noted

Comments:	Please indicate reporting requirements: ☐1. Results Only ☐2. Results and QC ☐3. Reduced Deliverables ☐4. Disk Deliverable

Table 13. Weather Station Measurement Log

(Use of form is optional- Information must be in bound notebook)

Date: ________________		**Page _______ of _______**

Time	**Wind Speed MPH**	**Wind Direction**	**Barometric Pressure, in Hg**	**Temperature ^{0}F**	**Relative Humidity %**	**Entries By**

Table 14. Asbestos Bulk Chain of Custody for Soils and Settled Dust Samples

ASBESTOS BULK CHAIN OF CUSTODY

PAGE ___ OF ___

PROJECT NO.: ____________
CLIENT: ____________
PROJECT SITE: ____________
Project Manager: ____________

LOCATION(S) SURVEYED: ____________
PROPOSED PROJECT: ____________
DATE(S) OF INSPECTION: ____________
Inspector(s): ____________

THE LOUIS BERGER GROUP, INC.
TELEPHONE NO.: (212) 612-7900 FAX NO.: (212) 425-1618
ADDRESS: 199 Water Street 23rd Floor, New York, NY [illegible]

RESULTS TO: ____________
Please stop at 1st Positive in any Homogenous Group

TURNAROUND TIME:
☐ 4 HR. ☐ 12 HR. ☐ 24 HR. ☐ 48 HR.

HA	SAMPLE NO.	SAMPLE LOCATION	MATERIAL DESCRIPTION	APPROX. QUANTITY (LF/SF)	Start/ Stop Time

CHAIN OF CUSTODY

[illegible]

A.9.1.2. Meteorological Measurements

Met One Instruments, Inc or equivalent, meteorological stations will record temperature, barometric pressure, relative humidity, wind speed, and wind direction at five-minute averages. The data files will be downloaded by using an on-site personal computer. These same metrics will also be noted from the instrument's visual display and recorded on a Meteorological Data Measurement Log (Table 13) at least hourly.

A.9.1.3. Photo Documentation

A digital photographic image will be taken of every sampling location at the time of sample collection. This will include the sampling station and visual debris on the pavement. A five-inch by seven-inch sample location identification marker that lists the sample number will be shown in the photograph adjacent to the sample and location. The sample location identification will be legibly printed on the sample location identification marker. Other digital photographic images will be taken as necessary to thoroughly document the site conditions (such as "visible emissions," if such occur) and activities. In addition, a camcorder will be used by EPA staff to videotape the demolition and demolition debris removal operations.

A.9.2. Chain-of-Custody Records

Sample chain-of-custody procedures as described in Section B.3 shall be followed.

A.9.3. Laboratory Records

The laboratory shall submit complete data packages for all sample analysis (i.e., asbestos and total fibers, as applicable) for all matrices (air, settled dust, pavement, and water). This information will be submitted in sufficient detail to allow the subsequent verification of the reported analyses. Alternative forms routinely used by the laboratories may be substituted for those forms specified in the referenced methods.

TEM Reporting

TEM analytical data reports shall include the following is required:

- Structure counting data shall be recorded on forms equivalent to the example shown in ISO 10312:1995.

- The test report shall contain items (a) to (p) as specified in Section 11, "Test Report," of ISO 10312:1995. In addition, the files containing the raw data (in Microsoft Excel format) shall be submitted. The format of these files shall be as directed by the project manager, but shall contain the following items:

1. Laboratory Sample Number
2. Project Sample Number
3. Date of Analysis
4. Air Volume
5. Active Area of Sample Filter
6. Analytical Magnification
7. Mean Grid Opening Dimension in square millimeters (mm^2)
8. Number of Grid Openings Examined
9. Number of Primary Structures Detected
10. One line of data for each structure, containing the following information as indicated in Figure 7 “Example of Format for Reporting Structure Counting Data” of ISO 10312:1995, with the exception that the lengths and widths are to be reported in millimeters as observed on the screen at the counting magnification:
11. Grid Opening Number
12. Grid Identification
13. Grid Opening Identification/Address
14. Structure or Sub-structure Number
15. Asbestos Type (Chrysotile or Amphibole)
16. Morphological Type of Structure (fiber, bundle, matrix, cluster)
17. Length of Structure in millimeter (mm) units (e.g., 32)
18. Width of Structure in 0.1 mm units (e.g., 3.2)
19. Any Other Comments Concerning Structure (e.g., partly obscured by grid bar)

B. MEASUREMENT/DATA ACQUISITION

B.1. EXPERIMENTAL DESIGN

B.1.1. Air Dispersion Modeling

This section presents the modeling approach used to assist in the placement of ambient air monitors that will be used to measure the concentration of airborne asbestos fibers during the demolition. Results of the modeling were used as a predictive tool to evaluate possible monitoring locations, both laterally (x, y) as well as vertically (z), around the building.

B.1.1.1. Source Identification

The sources identified for purposes of this modeling consist primarily of two major operations taking place during the demolition activities: 1) the actual demolition of the building itself and 2) the loading of the truck bed with demolition debris. These two operations will be occurring simultaneously and have the potential to release dust and other airborne particulate matter to the atmosphere. Therefore, both were included in the modeling analysis to account for their potential contributions. The following describes in further detail the characterization of these sources.

B.1.1.1.1. Source No.1: Oak Hollow Office Apartment Building Demolition

The Oak Hollow Apartment Office Building is approximately 3,500 square feet and has a second story loft. A demolition grappler will be used to remove finite sections of the building and then transfer the debris to a large open-bed truck. The demolition process will start at one end of the building and work its way down along the length of the building. The source defined in this case is associated with the extraction of sections of the building being demolished by the grappler prior to loading the debris onto the truck.

B.1.1.1.2. Source No. 2: Transfer of Building Demolition Debris into Truck Bed

Figure 4 is a photograph of a grappler loading extracted material from a demolition site into a truck bed. As shown in the figure, the grappler has extracted a section of a building and is unloading the debris into the back of a truck. The emission source defined in this case is associated with the potential emissions resulting from the transfer of the extracted material into the bed of the truck.

Figure 4. Transfer of building debris to truck bed.

B.1.1.1.3. Model Selection

Two U.S. EPA-approved models, SCREEN3 and the Industrial Source Complex Model, Version 3, in its short-term mode (ISCST3), were considered for use in this analysis. Both models are based on a steady-state Gaussian plume algorithm, and are applicable for estimating ambient impacts from point, area, and volume sources out to a distance of about 50 kilometers.

B.1.1.1.4. Source Characterization

Due to the nature and extent of the building demolition process, both of these sources are most appropriately modeled as volume sources. A volume source is used to model emissions that initially disperse three-dimensionally with no plume rise. These sources can either be surface based, structure based (elevated sources on or adjacent to a structure), or elevated (elevated sources not on or adjacent to a structure). Typical volume sources include side or roof building vents, conveyor transfer points, emissions from a crusher or screen, and emissions from loading and unloading trucks. The inputs for modeling a volume source include the following:

- Emissions rate (grams per second, g/s)
- Initial lateral dimension of the volume source (σ_{yo})
- Initial vertical dimension, initial depth of the volume source (σ_{zo})

Table 15 summarizes these inputs for the building demolition and truck loading activities.

Table 15. Summary of Selected Volume Source Modeling Parameters

Parameter	Source		Basis/Comment
	Bldg. Demolition[1]	Truck Loading[2]	
Emission Rate (g/s)	1 g/s	1 g/s	Unit Emission Rate
Init. Lateral Dim. (σ_{yo})	0.70 ft	0.70 ft	Defined based on model guidance for ISCST3
Init. Vertical Dim. (σ_{zo})	6.98 ft	1.4 ft	
Release Height (m)	14 ft	-	Avg. Height of Bldg.
	--	7, 12, 15 ft	Based on multiple drop distances to truck bed.

[1] Parameters based on size of grappler (assuming 3 ft x 3 ft) and a building height of 15 ft.
[2] Parameters based on size of grappler (assuming 3 ft x 3 ft), height of side wall of truck bed, and a release height evaluated at 7 ft, 12 ft, and 15 ft.
[3] U.S. EPA, User's Guide for the Industrial Source Complex (ISC3) Dispersion Models: Volume 2 – Description of Model Algorithms, September 1995 (EPA-454/B-95-003b), Table 6-1 "Summary of Suggested Procedures for Estimating Initial Lateral Dimensions and Initial Vertical Dimensions for Volume and Line Sources". Refer to the following assumptions described below:

Initial Lateral Dimension for both sources:
Based on size of grappler (assuming 3 ft x 3 ft), where for single volume source, is equivalent to length of side divided by 4.3. Thus σ_{yo} = 3 ft / 4.3 = 0.70 ft for both source types.

Initial Vertical Dimension for both sources:
Building Demolition: For an elevated source on or adjacent to a building, the initial vertical dimension is equivalent to the building height divided by 2.15. Thus σ_{zo} = 14 ft / 2.15 = 6.51 ft.

Truck Loading:
For an elevated source not on or adjacent to a building, the initial vertical dimension is equivalent to the vertical dimension of the source divided by 4.3. Thus σ_{zo} = 3 ft / 4.3 = 0.70 ft (Assuming the vertical dimension of the grappler is 3 ft). Add the release height of 12 ft =12.7 ft; therefore the average height (12.7+6.5)/2= 9.6ft

- Release height (m).

B.1.1.1.5. SCREEN3 Model

SCREEN3 was the U.S. EPA's regulatory screening model for many New Source Review (NSR) and other air permitting applications. The SCREEN3 model utilizes a predefined matrix of meteorological conditions that cover a range of wind speeds and stability categories (A through F), where the maximum wind speed is stability-dependent. The model is designed to estimate the worst-case impact based on a defined meteorological matrix for use as a "conservative" screening technique.

In order to determine the relative extent of impact due to these operations, the SCREEN3 model was used to assess the impacts from the building demolition and truck loading sources defined previously. In lieu of actual emissions data, a unit emission rate of 1 g/s was assigned to each of the two sources. Impacts from these sources were modeled from the source origin out to a distance of 1,000 feet. Receptors were spaced every 5 feet out to 100 feet, then every 100 feet thereafter until reaching a distance of 1000 feet. In addition to the ground level impacts, SCREEN3 has the capability to model elevated (free standing) receptors, called flagpole receptors. Therefore, to assess the potential impacts from these sources at elevations above ground level, flagpole receptors were modeled at heights of 5, 10, and 15 feet.

Results of the SCREEN3 modeling associated with the building demolition activities for each of the flagpole heights are shown in Figure 5 and Figure 6. Figure 5 shows the resulting change in concentration as a function of distance from this source out to a distance of 1000 feet. As shown in Figure 5, peak concentrations occur within the first 50 feet of the source and rapidly taper off as distance from the source increases. Figure 6 presents the same profile from the source out to 100 feet. Figure 6 shows that the peak concentration from the building demolition source is predicted to occur within 10 feet of the source.

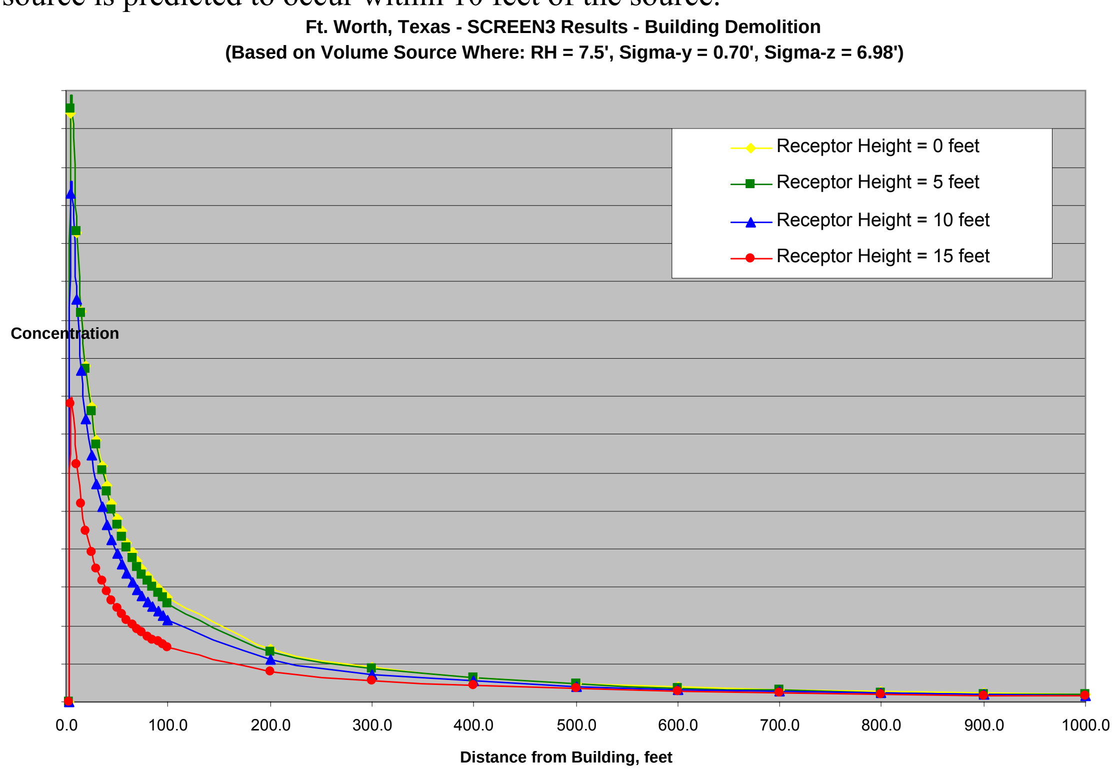

Figure 5. SCREEN3 Results for Building Demolition Source (0 to 1,000 feet).

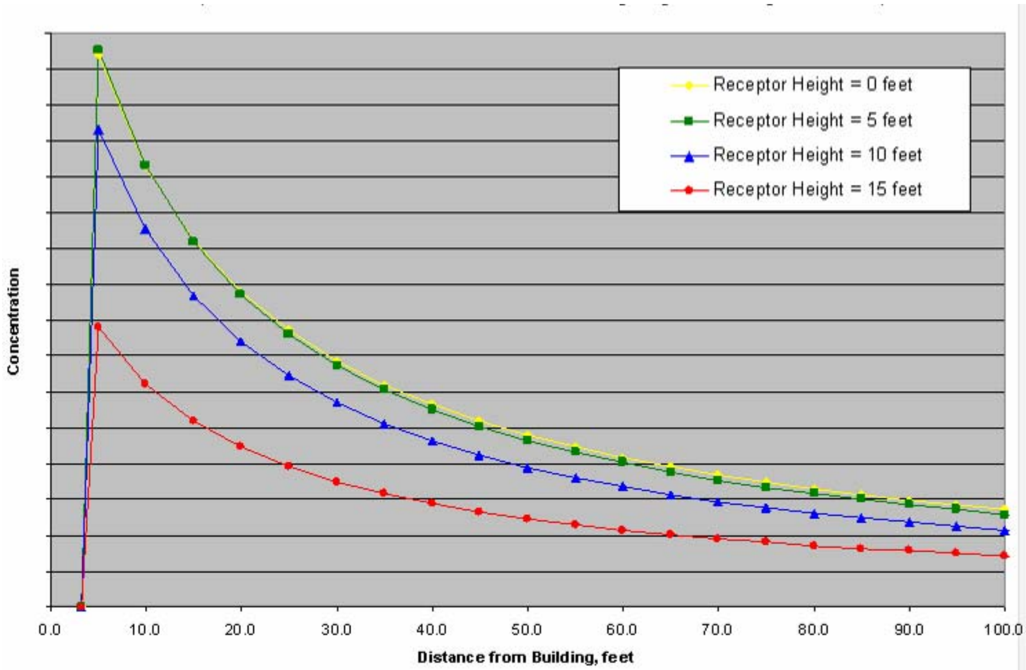

Figure 6. SCREEN3 Results for Building Demolition Source (0 to 100 feet).

A similar procedure was used to assess the SCREEN3 results for the truck loading source. Figure 7 and Figure 8 display the predicted concentration profiles as a function of distance for source release heights of seven and 15 feet. Multiple source release heights were evaluated because as the bed of the truck becomes full, the distance that the material will drop can change. The data from these figures also shows that the maximum/peak concentrations, regardless of release height, occur within 15 feet of the source origin.

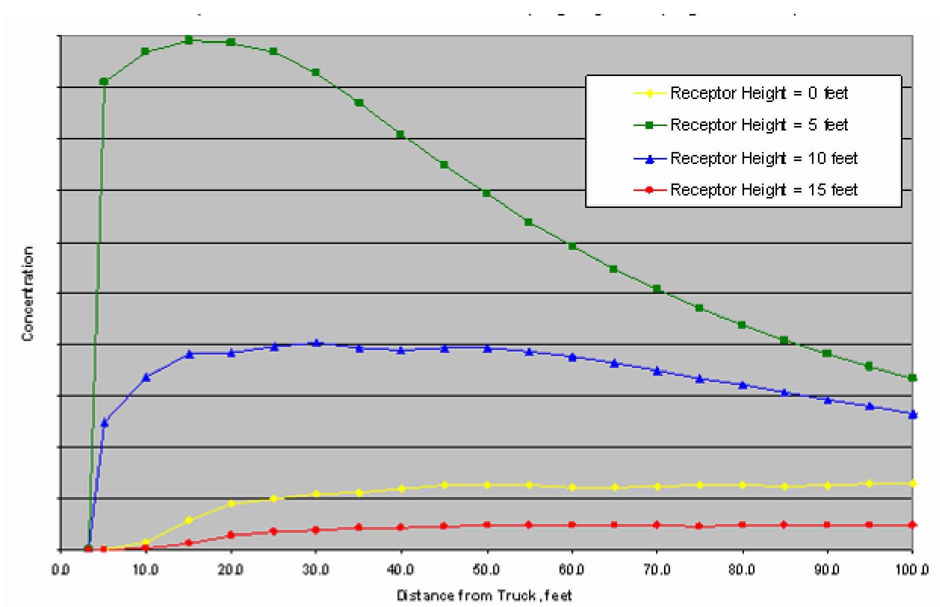

Figure 7. SCREEN3 Results for Truck Loading Source (Release Ht =7 ft).

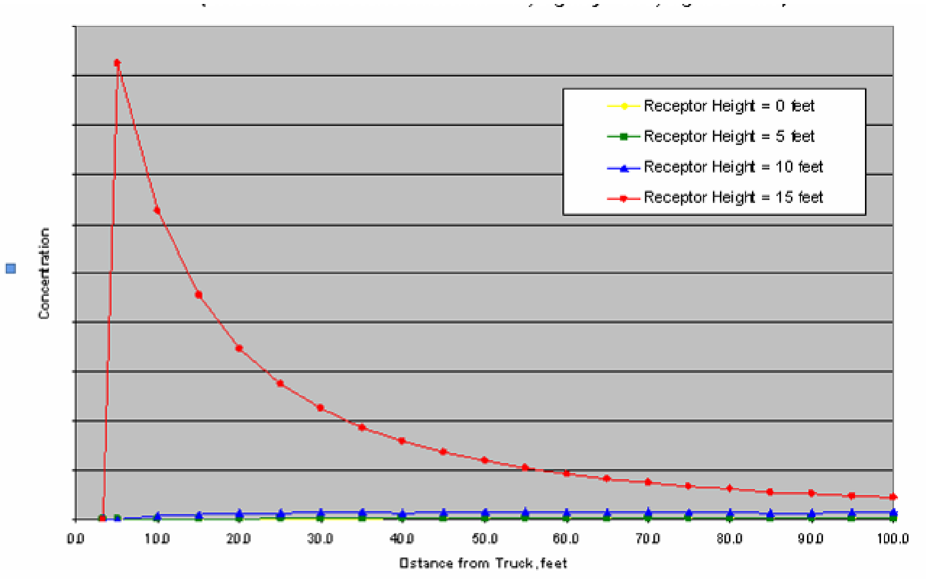

Figure 8. SCREEN3 Results for Truck Loading Source (Release Ht =15 ft).

B.1.2. Monitoring During Demolition

Because of the variability of the wind direction, it was concluded that the air and dust sampling design should be based on a concentric ring approach rather than on an upwind to downwind approach. This study design is consistent with the primary objective of this project: i.e., to compare the effectiveness of the AACM to control asbestos emissions during demolition and compare this to the asbestos background levels for air.

It is expected that demolition and debris removing/site cleanup will take approximately four to five hours.

B.1.2.1. Background Air and Surface Monitoring

Background air monitoring will be conducted at a minimum of 500 feet upwind from the demolition activity. Potential sites for various wind conditions will be GPS located and documented. The background sampling will be conducted during both the demolition and the overnight wetting period. Six background air samples will be collected at a height of five feet. The background samples will be collected during the overnight period, as described below, at an air flow rate of two liter/min from the time that the building was wetted on the previous day until changed out prior to building demolition. Background samples collected during the demolition will be collected at both the two and four liters per minute flow rate over the time required to demolish the building. Air samplers will be spaced at a minimum of three feet apart at the background sampling site.

Asbestos in dust will also be monitored. Settled dust collectors will be placed at the same locations as the background air samples. The dust collectors will be placed five feet above ground.

Pavement dust asbestos levels will also be monitored to enable comparisons with the pre-demolition and post-cleanup pavement dust asbestos concentrations. Four microvac samples will be taken in a parking lot of the police substation located southeast of the subject site prior to the conduct of the demolition.

B.1.2.2. Perimeter Air Asbestos Monitoring

Modeling conducted using the EPA dispersion models SCREEN3 indicates that the maximum airborne asbestos concentrations during demolition and loading of debris will most likely occur approximately between ten and 25 feet from the building and during loading activities at a height between ten to 15 feet above the ground. The perimeter air samplers will be located outside the work area bounded by the amended water containment structures, and the samplers will be placed no closer than 25 feet from the exterior of the building. The 25-ft distance was chosen based upon lessons learned during the first study at Fort Chaffee where some evidence of splashing was observed at the 15-ft distance from the loading process. On the southeast side of the building the monitors in the primary ring will be positioned 20 feet outside the edge of the truck loading area (see Figure 9).

The primary sampling ring will consist of 18 samplers spaced evenly around the building as shown on Figure 9. The air sampler intakes in this primary ring will be at a ten-ft height above the ground. The ring will be augmented by six samplers placed on the roofs of the adjacent buildings, of which three will be placed on each roof of the apartment buildings located immediately to the north and south of the subject building. Supplemental air samplers will also be located along the wall to be constructed along Boca Raton Boulevard and near the Woodstock Apartment complex located across Boca Raton Boulevard, east of the building. The supplemental samplers will consist of three sampler locations on the wall, and three near the Woodstock Apartments.

It is assumed that the demolition, construction debris, and cleanup will be completed in one day. The air sampling will commence prior to the wetting of the building on the day before the conduct of the demolition. The sample filters will be changed prior to the rewetting of the building on the morning of the demolition. The second set of samples will be initiated on the morning of the demolition and will continue until demolition/cleanup activities cease for following completion of the demolition. It is assumed that the sampling schedule will be as follows:

- 5PM to 6 AM – Wetting and overnight period.
- 6 AM to 5 PM – Building demolition and cleanup.

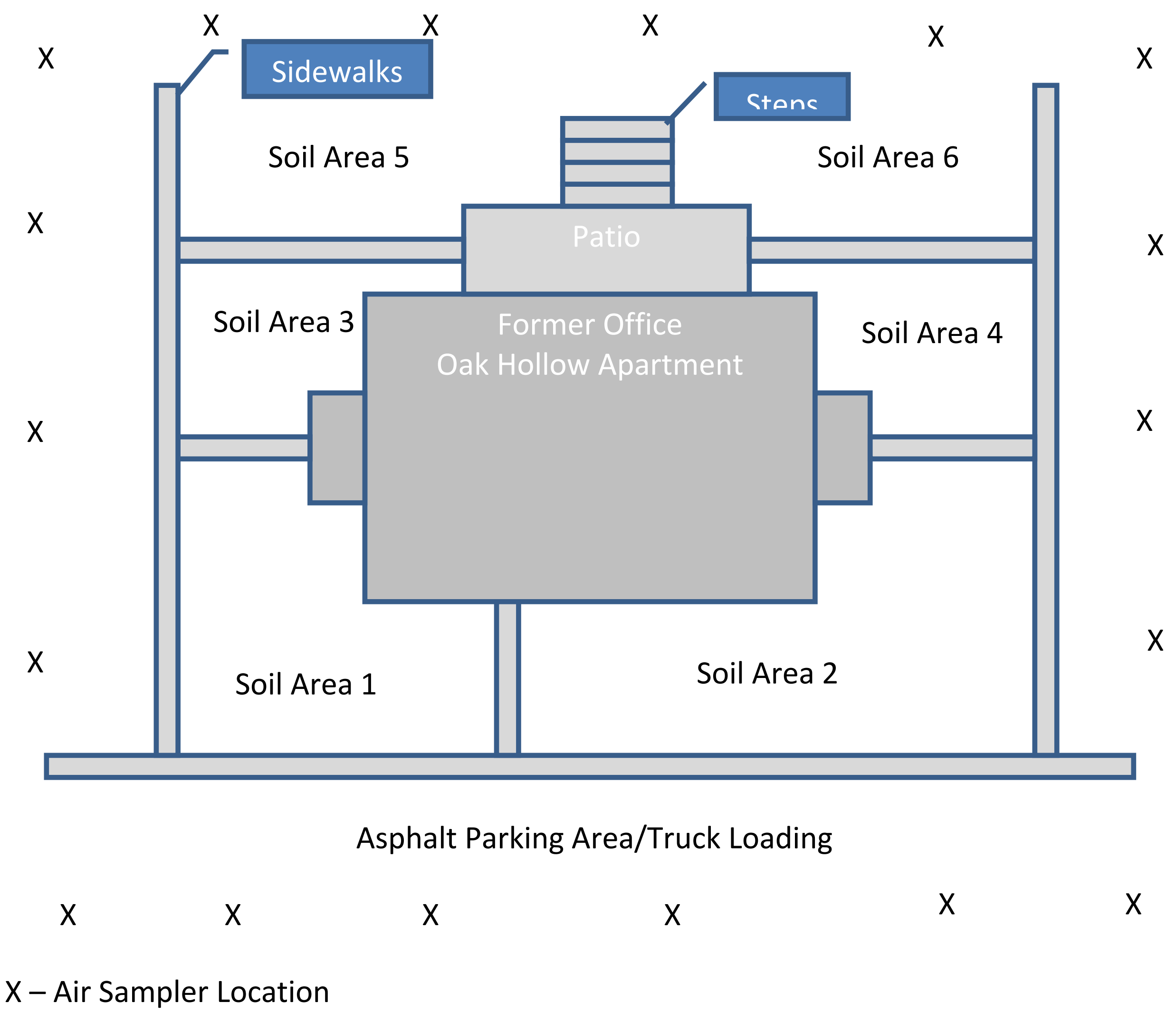

Figure 9. Sampling Locations.

All primary air samples will be collected at an air flow rate of four liter/minute to achieve a target air volume of 2,400 liters; however, higher sample volumes can be acceptable if the filters do not become overloaded. In addition, a set of low volume samples will be collected at a flow rate of two liter/minute to achieve a target air volume of 1,200 liters. These samples will be archived and analyzed only if the primary samples are overloaded. The estimated number of air samples to be collected and analyzed for asbestos (including background) is summarized in Table 16.

Table 16. Air Monitoring Samples for Asbestos Analysis[a]

Sample Type	Overnight Samples	Demolition Samples	Number of Samples
High-Volume (4 l/min) Perimeter Asbestos			
Perimeter Ring		18	18
Adjacent Building Roofs		6	6
Wall along Boca Raton Blvd		3	3
Woodstock Apartments		3	3
Duplicates		2	2
Field blank		2	2
Total Samples		34	34
Low-Volume (2 l/min) Perimeter Asbestos[b]			
Perimeter Ring	18	18	36
Adjacent Building Roofs		6	6
Wall along Boca Raton Blvd		3	3
Woodstock Apartments		3	3
Duplicates	2	2	4
Field blank	2	2	4
Total Samples	22	34	56
Low and High Volume Background Asbestos			
Background Samples	6 @2 l/min	6@4 L/min 6 @2 l/min[b]	18
Duplicate	1 @2 l/min	1@4 L/min 1 @2 l/min[b]	3
Field blank	1	2	3
Total Samples	8	16	24
TOTAL NUMBER OF ASBESTOS SAMPLES ANALYZED	30	42	72
TOTAL NUMBER OF ASBESTOS SAMPLES COLLECTED	30	84	114

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers(NIOSH 7400, A Rules).
[b] These samples will not be analyzed unless the high-volume samples are overloaded with the exception of the overnight samples they will be analyzed.

B.1.2.3. Worker Personal Breathing Zone Monitoring

Personal breathing zone samples will be collected from all workers directly involved with the wetting of the building prior to demolition, the demolition of the building, and the handling of the resultant construction debris. Samples for asbestos/total fibers will be collected and the time-weighted average concentration will be calculated for comparison to the OSHA Permissible Exposure Limit for Asbestos (29 CFR §1926.1101). In addition, this monitoring will provide a reasonable characterization of the asbestos concentrations in air closest to the source of any potential release; i.e., building demolition and debris loading.

Each worker will be fitted with a personal sampling pump to collect samples that represent the entire demolition activity. The samplers will run the entire time the individual is performing the specific assigned task. The estimated number of air samples to be collected and analyzed for asbestos and total fibers is presented in Table 17.

Table 17. Worker Breathing Zone Monitoring Samples for Asbestos

Worker	Number of Samples
Asbestos[a]	
Hose Operators, Building Wetting	2
Excavator Operator	1
Hose Operators (2)	2
Laborers (4)	4
Truck Operators (3)	3
Duplicate	2
Field Blank	2
Total Samples	16

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Rules).

B.1.2.4. Impact of Demolition Activities on the Surrounding Ground Surface

The potential impact to the ground surface from the demolition activities will be evaluated by comparing the asbestos concentrations on the ground surface (parking lot and soil areas) before demolition (“pre-demolition”) to that after the demolition operations. The soil/ground surface sampling plan has been developed to assess the existing surface materials prior to demolition.

The building is surrounded by sidewalks and areas that were formerly planted with grass and maintained. The sidewalks delineate six distinct soil areas surrounding the building. Pre-demolition parking lot pavement and soil samples will be collected prior to demolition of the building. Following demolition and removal of sidewalks and the building slab, a set of post-demolition (pre-excavation) and post-excavation soils samples will be collected. Additionally following the completion of demolition operations, a set of parking lot pavement dust samples will be collected.

A total of 13 hard surface dust samples and QA samples will be collected from the paved parking areas. In paved areas, microvac samples will be collected from the surface of the asphalt/concrete pavement. A total of 28 soil samples and QA samples will be collected from the site, one from each of the six delineated areas prior to the demolition, and one from each of 9 grid areas demarcated following demolition, and soil excavation. Four background soil and four background pavement dust samples will also be collected from the surrounding areas. The estimated number of ground surface samples to be collected and analyzed for asbestos is presented in Table 18.

Table 18. Ground Surface Samples for Asbestos[a] Analysis

Sample Type	Number of Samples	
	Pavement/Solid Surface	Soil
Background	4	4
Field Blank	1	-
Pre-Demolition	3	6
Field Blank	1	-
Post-Demolition/Cleanup	3	9
Field Blank	1	-
Post-Excavation	NA	9
Field Blank	NA	-
Total Samples	13	28

[a] TEM only
NA – Not applicable.

B.1.2.5. Settled Dust from Demolition

If any asbestos-containing dust is released during the demolition of the building and associated debris-loading activities, it could settle on nearby surfaces. Settled dust collectors will be placed at the same locations as the perimeter air samples. The dust collectors will be placed five feet above ground at 20-degree intervals at each air sampling monitor location on the sampling ring. All stationary dust containers will be activated by removing the cover shortly before demolition activities begin, and will continue for one hour after demolition activities cease.

The estimated number of settled dust samples for asbestos analysis, including background samples, is presented in Table 19.

Table 19. Settled Dust Samples for Asbestos[a] Analysis

Sample Type	Overnight Samples	Demolition Samples	Number of Samples
Perimeter			
Perimeter Ring	18	18	36
Adjacent Building Roofs	-	6	6
Wall along Boca Raton Blvd	-	3	3
Woodstock Apartments	-	3	3
Duplicates	2	2	4
Field blank	2	2	4
Total Samples	22	34	56
Background			
Samples	6	6	12
Duplicate	1	1	2
Field Blanks	1	1	2
Total Samples	8	8	16
Total Samples	30	42	72

[a]TEM only

B.1.2.6. Source, Surface, and Treated Water

Source Water—Samples of the source water (i.e., fire hydrant water) applied during the AACM will be collected for asbestos analysis at both the commencement and completion of the building demolition. Samples of the amended water used will also be collected and analyzed for asbestos at both the commencement and completion of the building demolition.

Surface Water— As required by the AACM, amended water from the demolition will be controlled and contained to prevent runoff of potentially asbestos-containing water during demolition and debris loading. Representative samples of surface water will be collected during the duration of the demolition activity. Drainage channels or berms will be constructed to direct water runoff for collection in basins. The sampling of the collected runoff water will be spaced over the duration of the demolition activity. Sample collection volumes will be noted as a function of time and as a function of the progression of the demolition.

Treated Water— As required by the AACM, water collected from within the containment berms will be treated using a 5-micron filter prior to disposal. Representative samples of treated water will be collected during the duration of the demolition activity. The sampling of the treated water will be spaced over the duration of the demolition activity. Sample collection volumes will be noted as a function of time and as a function of the progression of the demolition.

The estimated number of water samples that will be collected for asbestos analysis is presented in Table 20.

Table 20. Source and Surface Water Samples For Asbestos[a] Analysis

Sample Type	Number of Samples				Total Samples
	Source		Surface	Treated	
	Hydrant	Amended			
Water	2	3	3	3	11
Duplicate	1	1	1	1	4
Field Blank	1	1	1	1	4
Total Samples	4	5	5	5	19

[a] TEM only

B.1.3. Amended Water Application and Monitoring

Amended water is water to which a surfactant (wetting agent) has been added to improve the penetrating capability of water. The surfactant reduces the surface tension of the water which allows it to penetrate a material where water might normally run off, to reach interior spaces of materials. For this study, the chosen surfactant is Kidde Fire Fighting NF-3000 Class "A" Foam Concentrate, as shown on Figure 10. Foaming ingredients give water the ability to adhere to vertical surfaces, which allows the water longer contact with the surface. This wetting agent is similar to Kidde Fire Fighting product Knockdown® that is used by firefighters to aid in extinguishing a fire and is the same wetting agent used in the first AACM study at Fort Chaffee.

The NF-3000 wetting agent will be added to achieve a target application strength of one-half- percent concentration. According to the manufacturer, the surfactant is effective at significantly lower concentrations. Optimizing the application concentration is not a research goal of this project. It is important for the project to assure that at least 0.50-percent concentration is present at all times in the water applied during the demolition activities.

Figure 10. Wetting agent supply tank for the AACM demolition.

The amended water can be applied either directly from the flush hydrant equipped with a water meter, nitrile rubber weave construction fire hose, ball shutoff nozzle, and in-line foam eductor system. If used, the proportioning with the eductor system will be tested prior to the demolition to assure adequate delivery at the 0.50 percent amended concentration. Alternatively, the contractor may opt to use a non-potable water truck to transport water to the site. If a water truck is used, the amended water can be pre-mixed to the desired 0.50 percent concentration. It should be noted that the use of a water truck is typical procedure for a demolition contractor in remote locations where a city-water source is not available.

The wetting agent application system that will be used during the pre-wetting of the building consists of a single 30-gpm high-foaming nozzle and matching eductor. This system provides the best foam quality, but has less application range, which is not a problem at this site. The maximum reach of the foam from the 30-gpm nozzle is approximately 30 feet.

The wetting agent application system to be used during demolition will employ two matched 15-gpm non-aspirating variable-pattern nozzles and matching in-line eductor.

Wetting agent proportioning will be verified by performing periodic conductivity measurements of the application flow throughout the duration of the AACM demolition process. According to the National Fire Protection Association (NFPA) Standard for Low-, Medium, and

High-Expansion Foam (NFPA 11, 2005 Edition), there are two acceptable methods for measuring the wetting agent concentrate in water: (1) Refractive Index Method and (2) Conductivity Method. Both methods are based on generating a baseline calibration curve comparing percent concentrations (of pre-measured foam solutions) to the instrument reading. The method selected for the NF-3000 solution concentration determination for this study was the conductivity method.

As stated previously, the target application strength of the NF-3000 wetting agent is approximately one-half percent. Therefore, following the procedures contained in the NFPA 11 Standard using the Conductivity Method, three standard solutions will be prepared using the hydrant water and the foam concentrate from the application system. The percent concentrations for the three standards are 0.25, 0.5, and 1.0 based on a target concentration of one-half percent. The conductivity of each foam solution standard will then be measured and a plot created of the foam concentration versus conductivity. Figure 11 shows the plot serving as the baseline calibration curve for the first Fort Chaffee AACM study which used a foam concentration of one percent.

Throughout the duration of the AACM demolition activities, the concentration of the wetting agent will monitored by taking conductivity measurements at a minimum of every two hours. Sample collection will take place after water flowed for enough time to assure a good sample. The real-time sample conductivity measurements will be compared with the baseline calibration curve (conductivity versus concentration) as illustrated in Figure 11.

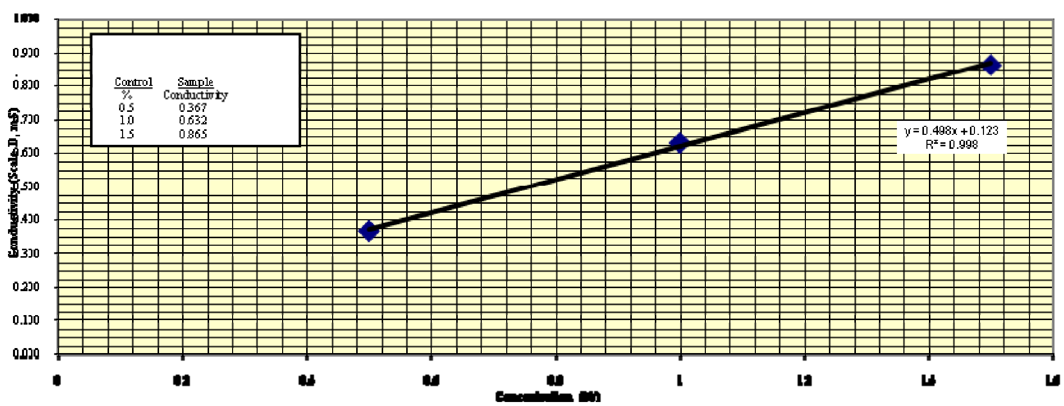

Figure 11. Calibration Curve for the NF-3000 Wetting Agent.

B.2. SAMPLING METHOD REQUIREMENTS

B.2.1. Air Sampling For Asbestos

The samples for both asbestos and total fibers analysis will be collected on the open-face, 25-mm-diameter 0.45-µm pore size mixed cellulose ester (MCE) filters with a five-µm pore size MCE diffusing filter and cellulose support pad contained in a three-piece cassette with a 50-mm conductive cowl. This design of cassette has a longer cowl than the design specified in ISO 10312:1995, but it has been in general use for some years for ambient and indoor air sampling. Disposable filter cassettes with shorter conductive cowls, loaded with the appropriate combination of filter media of known and consistent origin, do not appear to be generally available.

The filter face will be positioned at approximately a 45-degree angle toward the ground. At the end of the sampling period, the filters will be turned upright before being disconnected from the vacuum pump and then stored in this position.

The filter assembly will be attached with flexible Tygon® tubing (or an equivalent material) to an electric-powered (110-volt alternating current) 1/10-hp vacuum pump operating at an airflow rate of approximately four liter/min. An air volume of 1,920 to 2,400 liters is targeted for all samples. Lower volume samples (960-1,200 liters) from the same locations will also be collected and archived.

B.2.2. Personal Breathing Zone Sampling for Asbestos

Personal breathing zone samples for asbestos will be collected on open-face, 25-mm-diameter 0.8-µm pore size MCE filters with a cellulose support pad contained in a three-piece cassette with a 50-mm conductive cowl. The filter assembly will be attached to a constant-flow, battery-powered vacuum pump operating at a flow rate of two liters per minute. An air volume of approximately 480 to 900 liters will be targeted for all samples.

B.2.3. Meteorological Monitoring

A portable meteorological station manufactured by Met One Instruments, Inc., and equipped with AutoMet Sensors, or equivalent, will be used to record five-minute average wind speed and wind direction data, as well as temperature, barometric pressure, and relative humidity. The data files will be downloaded and archived using an on-site personal computer. Periodic (at least hourly) direct readout of the data will be recorded on a Meteorological Measurement Log.

B.2.4. Pre and Post Demolition Ground Surface Sampling

Samples will be collected from the ground surface of the site prior to the initiation of, and following the completion of demolition activities. The pre-demolition sampling will involve collection of samples from the land surface from six soil locations delineated by the sidewalks and three pavement dust samples located in the parking area. In addition, background surface samples will be collected from outside the bermed demolition area to document background asbestos concentrations. The following subsections describe the sampling protocols for either a soil or a pavement finished surface.

B.2.4.1. Surface soil sampling

Composite soil samples will be collected from the within the portions of the site that has bare soil surface cover. Each composite soil sample will be comprised of six separate grab subsamples. Each grab subsample will be collected from an area measuring six-inches by six-inches with approximately a ½-inch depth. The area will be delineated using a metal template, which helps ensure that each component of the 6-part composite sample will be of similar mass. Rocks and organic material (e.g., roots larger than ⅜-inch, surface grass covering) will be excluded from the subsamples.

The soil samples will be collected using a clean metal scooping tool (e.g., a garden trowel) and placed in a clean one-liter plastic container with lid. Between collections of each sample, the template and trowel will be cleaned with detergent water and rinsed with non-asbestos containing water.

B.2.4.2. Paved Surface Sampling

Surface dust samples will be collected from portions of the site with paved surfaces prior to and following building demolition using ASTM Method D 5755 – 03 entitled “Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading.” In accordance with the Method D 5755 – 03, a 10 cm by 10 cm area will be sampled with the microvacuum sampling apparatus. The sampling will be conducted with a 0.45-micron filter for two-minute duration at a rate of 2 liters/min (l/min). The pre-demolition sampling location will be marked with a nail and the post-demolition sample will be collected immediately adjacent to that same location.

Then, after debris removal and site cleanup, an additional set of pavement samples will be collected (post-demolition/cleanup).

B.2.5. Settled Dust Sampling

Settled dust samples for asbestos analysis will be passively collected using ASTM Method D 1739-98 “Method for Collection and Measurement of Dustfall (Settleable Particulate Matter).” The collection container is an open-topped cylinder approximately 6 inches in diameter with a height of 12 inches. The container will be fastened to the same sampling pole as the air samples at a height of 5 feet above the ground. The sampling time for the ASTM protocol will be extended 1 hour beyond the end of demolition activity. Upon completion of sampling the dust collection container will be capped and sealed for shipment to the laboratory.

B.2.6. Water Sampling—Source, Amended Water, Pooled Surface Water, and Treated Effluent

The sample container is an unused, one-liter pre-cleaned, screw-capped, plastic or glass bottle. Prior to sample collection, the water from the water source will be allowed to run for a sufficient period to ensure that the sample collected was representative of the source water.

Approximately 800 milliliters of water for each sample will be collected. An air space will be left in the bottle to allow efficient re-dispersal of settled material before analysis. A second bottle will be collected for each sample and stored for analysis if confirmation of the results obtained from the analysis of the first bottle is required.

The samples will be transported to the laboratory and filtered by the laboratory within 48 hours of collection. No preservatives or acids may be added to the sample. At all times after collection, the samples will be stored in the dark at about 5° C (41° F) in order to minimize bacterial and algal growth. The samples will not be allowed to freeze because the effects of freezing on asbestos fiber dispersions are not known. On the same day of collection the samples will be shipped in a cooler at about 5° C (41° F) to the lab for analysis via one-day courier service.

B.2.7. Costs

All costs associated with all aspects of the demolition will be documented and later analyzed to clearly assign the appropriate cost element to the individual demolition activity. Ultimately, the total costs per unit operation will be obtained and finally summarized. In addition, the City of Fort Worth has obtained cost estimates from contractors for the purpose of comparing the cost of the AACM demolition with the proposed cost of demolishing the building under the current asbestos NESHAP.

Information that is required to be collected includes but is not limited to:

- Obtain contractor estimates on the cost of all labor, materials, and supplies to perform the abatement and demolition of the building as if the NESHAP Method was going to be used. These costs include: preparation of asbestos abatement specifications by a licensed Asbestos Project Designer; removal of the RACM by a licensed asbestos abatement contractor; oversight of the abatement, worker, Personal Breathing Zone monitoring (asbestos), and clearance testing by a licensed asbestos consultant; transportation and disposal of the RACM to a licensed asbestos disposal facility.

- Accurate and reliable information on the cost of all labor, materials, and supplies to demolish the AACM Building. These costs include: pre-demolition wetting of the structure; demolition of the structure using asbestos-trained workers and NESHAP-trained observers; personal protective equipment and OSHA-mandated monitoring for asbestos; transportation and disposal of all construction debris as asbestos-containing waste at a licensed landfill.

B.3. SAMPLE CUSTODY REQUIREMENTS

Chain-of-custody procedures emphasize careful documentation of constant secure custody of samples during the field, transport, and analytical stages of environmental measurement projects.

B.3.1. Field Chain-of-Custody

Each sample will have a unique project identification number. A unique sample identification system will be developed for the samples collected at the demolition site as shown in Table 21. This identification number will be recorded on a Sampling Data Form (Table 6) along with the other information specified on the form. After the labeled sample cassettes and containers are inspected, the sample custodian will complete an Analysis Request and Chain-of-Custody Record (Table 9 through Table 14). The required Chain-of-Custody forms will accompany the samples, and each person having custody of the samples will note receipt of the same and complete an appropriate section of the form. Samples will be sent to the appropriate Laboratory (see Section A.9.2) via an overnight delivery service, such as Federal Express Overnight Service.

Table 21. Sample Numbering Scheme

Location	Sample Type	Monitor Station	Flow Rate, liter/min	Sampling Period	Duplicates	Blanks
BG	DUST	BG01-BG06		W or D	DUP	BL
	AIR	BG01-BG06	4L	W or D	DUP	BL
	SOIL	01-04			DUP	BL
	PAVE	01-04	2L		DUP	BL
PC	HW	01-02			DUP	BL
	AW	01-02			DUP	BL
	AWSURF	01-03			DUP	BL
	TREATW	01-03			DUP	BL
	WORK	NAME	2L		DUP	BL
	Perimeter AIR	M01-M18	2L,4L	W or D	DUP	BL
	Roofs	R01-R06	2L,4L	D	DUP	BL
	Boca Raton Wall	B01-B03	2L,4L	D	DUP	BL
	Woodstock	WS01-02	2L,4L	D	DUP	BL
	PAVEPRE	01-10	2L		DUP	BL
	PAVEPOST	01-010	2L		DUP	BL
	SOILPRE	01-06			DUP	BL
	SOILINT	01-06			DUP	BL
	SOILPOST	01-06			DUP	BL

Where:
BG=Background
PC=Popcorn ceiling Building
PAVE= Pavement
SOIL = Soils
HW=Water from Hydrant
AW=Amended Water Source
AWSURF=Amended Water Collected from Surface
TREATW= Treated water
WORK=Worker
W = Wetting
D = Demolition
NAME= Last Name of Worker
POST=Post

As an example of the sample numbering scheme, sample PC-AIR-M07-4L-D-DUP designates the duplicate air sample from the building monitor number 07, collected during building demolition at the four-liter/min flow rate. Another example would be PC-WORK-DREES-2L, which would be the worker Drees at the two-liter/min flow rate.

B.3.2. Analytical Laboratory

The laboratory's sample clerk will examine the shipping container and each sample cassette or sample container to verify sample numbers and check for any evidence of damage or tampering. The chain of custody form will be checked by the laboratory for completeness, signed, and dated to document sample receipt. Any changes will be recorded on the original chain-of-custody form and then the form will be forwarded to the Berger Project Manager. The sample clerk will log in all samples and assign a unique laboratory sample identification number to each sample and sample set, in accordance with laboratory standard operating procedures. Chain-of-custody procedures will be maintained in the analytical laboratory.

B.4. ANALYTICAL METHOD REQUIREMENTS

B.4.1. Air Samples (TEM)

Perimeter Samples—The 0.45-µm pore size MCE air sampling filters will be prepared and analyzed using EPA-modified ISO Method 10312:1995, Ambient Air - Determination of Asbestos Fibres - Direct-Transfer Transmission Electron Microscopy Method." Note: After TEM analysis, a sector from the same filter will then be analyzed using PCM.

Personal Samples— The 0.8-µm pore size MCE air sampling filters will be prepared and analyzed using EPA-modified ISO Method 10312:1995, Ambient Air - Determination of Asbestos Fibres - Direct-Transfer Transmission Electron Microscopy Method." Note: After TEM analysis, a sector from the same filter will then be analyzed using PCM.

B.4.2. TEM Specimen Preparation

TEM specimens will be prepared from the air filters using the collapsing procedure of ISO 10312:1995, as specified for cellulose ester filters. Acetone will be used as the solvent in place of dimethylformamide (DMF). For each filter, a minimum of three TEM specimen grids will be prepared from a one-quarter sector of the filter by using 200 mesh-indexed copper grids. The remaining part of the filter will be archived in the original cassette in clean and secure storage.

B.4.3. Measurement Strategy

1. The minimum aspect ratio for the analyses will be 3:1, as permitted by ISO 10312:1995. As required in the ISO method, any identified compact clusters and compact matrices will be counted as total asbestos structures, even if the 3:1 aspect ratio was not met.

2. Table 22 presents the size ranges of structures that will be evaluated, and target analytical sensitivities for each TEM method. The laboratories will adjust individual numbers of grid

openings counted based upon the counting rules and the amount of material prepared for each sample.

3. The structure counting data will be distributed approximately equally among a minimum of two specimen grids prepared from different parts of the filter sector.

4. The TEM specimen examinations will be performed at approximately 20,000 magnification.

5. PCM-equivalent asbestos structures, as defined by ISO 10312:1995, will also be determined.

6. The type of structure will be specified. In addition to classifying structures as one of the six NESHAP-regulated asbestos types, any other amphibole mineral particles meeting the aspect ratio of ≥3:1 and lengths ≥0.5 µm) will be recorded, (e.g., winchite, richterite), but not included in the total asbestos concentration calculation. Reference to or implication of either use of the term cleavage fragments and/or discriminatory counting does not apply.

Table 22. Target Analytical Sensitivity

Method	Structure Size Range	Target Analytical Sensitivity
ISO 10312:1995 Perimeter Air Direct Preparation	All Structures (minimum length of 0.5 µm; aspect ratio ≥3:1)	0.0005 s/cm^3
ISO 10312:1995 Worker Air Direct Preparation	All Structures (minimum length of 0.5 µm; aspect ratio ≥3:1)	0.005 s/cm^3
EPA/600/R-93/116, 1993 Soil	All Structures (minimum length of 0.5 µm; aspect ratio ≥3:1)	0.1%
Modified ASTM D 5755-03 – Settled Dust	All Structures (minimum length of 0.5 µm; aspect ratio ≥3:1)	250 s/cm^2
ASTM D 5755-03 –Pavement Dust	All Structures (minimum length of 0.5 µm; aspect ratio >3:1)	1000 s/cm^2
EPA 100.2 Water, Flush Hydrant, Pooled Surface Water, and Treated Water	All Structures (minimum length of 0.5 µm; aspect ratio ≥3:1)	0.04 million s/L for Source; 2 million s/L for Surface and Treated

B.4.4. Determination of Stopping Point

The analytical sensitivity and detection limit of microscopic methods (such as TEM and PCM) are a function of the volume of air drawn through the filter and the number of grid openings or fields counted. In principle, any required analytical sensitivity or detection limit can be achieved by increasing the number of grid openings or fields examined. Likewise, statistical uncertainty around the number of fibers observed can be reduced by counting more and more fibers. Stopping rules are needed to identify when microscopic examination should end, both at the low end (zero or very few fibers observed) and at the high end (many fibers observed). Table 23 identifies the stopping rules used for this study.

Table 23. Stopping Rules For Asbestos Counting

Method	Stopping Rules
TEM (EPA-modified ISO 10312:1995) Perimeter air	Count a minimum of four grid openings. If ≥100 structures are identified, counting is stopped. If <100 structures are identified, count until 100 structures are identified or the required number of grid openings to achieve an analytical sensitivity of 0.0005 asbestos structures/cm^3. Always complete the structure count for the last grid opening evaluated.
TEM (EPA-modified ISO 10312:1995) Worker air	Count a minimum of four grid openings. If ≥100 structures are identified, counting is stopped. If < 100 structures are identified, count until 100 structures are identified or the required number of grid openings to achieve an analytical sensitivity of 0.005 asbestos structures/cm^3. Always complete the structure count for the last grid opening evaluated.
EPA/600/R-93/116, 1993 Soil	Count a minimum of four grid openings. If ≥100 structures are observed, counting is stopped. If < 100 structures are identified, continue counting additional grids until the 100 structures are counted or until an analytical sensitivity of 0.1% has been achieved. Always complete the structure count for the last grid opening evaluated.
EPA-modified ASTM D 5755-03 Settled Dust/Pavement Dust	Count a minimum of four grid openings. If ≥100 structures are observed, counting is stopped. If < 100 structures are identified, continue counting additional grids until the 100 structures are counted or until an analytical sensitivity of 250 s/cm^2 for settled dust or 1000 s/cm^2 for pavement samples has been achieved. Always complete the structure count for the last grid opening evaluated.
Modified EPA 100.2 Water	Count a minimum of four grid openings. If ≥100 structures are observed, counting is stopped. If < 100 structures are identified, continue counting additional grids until the 100 structures are counted or until an analytical sensitivity of 0.04 million s/L or two million s/L depending on water source has been achieved. If not, continue until this analytical sensitivity has been achieved. Always complete the structure count for the last grid opening evaluated.

B.4.5. Air Samples (PCM)

Perimeter Samples—The 0.45-µm pore size MCE air sampling filters will be prepared and analyzed for total fibers using NIOSH Method 7400 "Asbestos Fibers by PCM" ("A" Counting Rules). Fibers greater than 5 µm in length having an aspect ratio greater than or equal to 3:1 will be counted.

Personal Samples—0.8-µm pore size MCE air sampling filters will be prepared and analyzed for total fibers using NIOSH Method 7400 "Asbestos Fibers by PCM" (A Counting Rules). Fibers greater than 5 µm in length and with an aspect ratio greater than or equal to 3:1 will be counted.

B.4.6. Soil Samples

B.4.6.1. Soil Preparation

The composite soil samples will be shipped to the laboratory where the samples will be dried and homogenized as described in the Standard Operating Procedure (SOP) in Appendix B.

B.4.6.2. Soil Analysis (TEM and PLM)

Soil samples will be analyzed for asbestos using EPA's "Method for the Determination of Asbestos in Bulk Building Materials" (EPA/600/R-93/116, July 1993). The specific procedures for implementing this method for the soils in this study are provided in the SOP in Appendix B.

B.4.7. Settled Dust Samples (TEM)

The analytical sample preparation and analysis for asbestos will follow ASTM Standard D5755-03 "Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading" with the following exceptions:

Section 10.4.1 through 10.4.3: The sample collection container will be rinsed with approximately 100ml of 50/50 mixture of particle-free water and reagent alcohol using a plastic wash bottle. The suspension will be poured through a 1.0 by 1.0 mm opening screen into a pre-cleaned 500 or 1000 ml specimen bottle. All visible traces of the sample contained in the collection device will be rinsed through the screen into the specimen bottle. The washing procedure will be repeated three times. The volume of the suspension in the specimen bottle will be brought to 500ml with particle free water.

Section 16.2 Recording Data Rules: ISO 10312:1995 counting rules will be followed.

B.4.8. Pavement Dust Samples

The analytical sample preparation and analysis for asbestos will follow ASTM Standard D5755-03 "Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading."

B.4.9. Water Samples

The asbestos content of the water samples will be determined using EPA Method 100.2 "Analytical Method Determination of Asbestos in Water." The method will be modified to count all structures greater than or equal to 0.5 µm in length and with an aspect ratio of greater than or equal to 3:1 to achieve an analytical sensitivity of 0.04 million s/L for the source water and 2.0 million s/L for the surface/treated water.

B.5. QUALITY CONTROL REQUIREMENTS

The overall quality assurance objective is to provide defensible data of known quality meeting quality assurance objectives. To that end, procedures are developed and implemented for field sampling, chain-of-custody, laboratory analysis, reporting, and audits that will provide results which are scientifically valid.

B.5.1. Field Quality Control Checks

Quality control checks for the field sampling aspects of this project will include, but not be limited to, the following:

- Use of standardized forms (e.g., Table 6 through Table 14) to ensure completeness, traceability, and comparability of the data and samples collected.

- The air flow rate of the sampling pump will be set to the target value and measured at the beginning, then ever two hours with adjustments as necessary, and at the end of the sampling period. If the flow rate deviates more than ten percent, the impact to the results will be evaluated and the sample will be adjusted to its intended volume. All adjustments and readings will be recorded and factored in to a TWA over the sampling period of time to achieve the sample total volume.

- Proper handling of air sampling filters and sample containers to prevent cross contamination.

- Collection of field blanks and field duplicate samples.

- Field cross-checking of data forms to ensure accuracy and completeness. Strict adherence to the sample chain of custody procedures outlined in this QAPP.

B.5.1.1. Air Field QC for Asbestos and Total Fibers

Field QC air samples will include field blanks and field duplicates.

B.5.1.1.1. Field Blanks

Field blank samples are used to determine if any contamination has occurred during sample handling. Field blanks will be collected each day of sampling. Field blanks are filter cassettes that have been transported to the sampling site, opened for a short-time (< 30 seconds) near an actual sampling location without any air having passed through the filter, and then sent to the laboratory.

B.5.1.1.2. Field Duplicates

A duplicate sample is a second sample collected concurrently at the same location as the original sample.

B.5.1.2. Pavement Dust Field QC

Field QC air samples will include field blanks. Field blank samples are used to determine if any contamination has occurred during sample handling. Field blanks will be collected each day of sampling. Field blanks are filter cassettes that have been transported to the sampling site, opened for a short-time (< 30 seconds) near an actual sampling location without any air having passed through the filter, and then sent to the laboratory.

B.5.1.3. Settled Dust Field QC

Field QC settled dust samples will include field blanks and field duplicates.

B.5.1.3.1. Field Blanks

A field blank is prepared by placing a collection device in the field, removing the lid and then immediately replacing the lid.

B.5.1.3.2. Field Duplicates

A duplicate sample is a second sample collected concurrently at the same location as the original sample.

B.5.1.4. Water Field QC

Field QC water samples will include field blanks and field duplicates.

B.5.1.4.1. Field Blanks

A field blank is a clean glass empty container. The container will be opened in the field for approximately 30 seconds. When received at the laboratory, the container will be filled with approximately 800 ml of laboratory water.

B.5.1.4.2. Field Duplicate

A duplicate sample is a second sample collected at the same location as the original sample, but is collected immediately after the original sample is collected.

B.5.2. Laboratory Quality Control Checks

A summary of the analytical methods and the quality assurance/quality control (QA/QC) checks is presented in Table 24.

B.5.2.1. Air Laboratory QC

B.5.2.1.1. Lot Blanks

Before air samples are collected, a minimum of two percent of unused filters from each filter lot of 100 filters will be analyzed to determine the mean asbestos structure count. The lot blanks will be analyzed for asbestos structures by using ISO 10312:1995. If the mean count for all types of asbestos structures is found to be more than 10 structures/mm^2 the filter lot will be rejected.

B.5.2.1.2. Laboratory Blank

Laboratory blanks are unused filters (or other sampling device or container) that are prepared and analyzed in the same manner as the field samples to verify that reagents, tools, and equipment are free of the subject analyte and that contamination has not occurred during the analysis process. The laboratory will analyze at least one blank for every ten samples or one blank per prep series. Blanks are prepared and analyzed along with the other samples. If the blank control criteria (Section B.5.2.1.1) are not met, the results for the samples prepared with the contaminated blank are suspect and should not be reported (or reported and flagged accordingly). The preparation and analyses of samples should be stopped until the source of contamination is found and eliminated. Before sample analysis is resumed, contamination-free conditions shall be demonstrated by preparing and analyzing laboratory clean area blanks (see

Section B.5.2.1.3) that meet the blank control criteria. Laboratory blank count sheets should be maintained in the project folder along with the sample results.

B.5.2.1.3. Laboratory Clean Area Blanks

Clean area blanks are prepared whenever contamination of a single laboratory prep blank exceeds the criteria specified in Section B.5.2.1.1or whenever cleaning or servicing of equipment has occurred. To check the clean area, a used filter is left open on a bench top in the clean area for the duration of the sample prep process. The blank is then prepared and analyzed by using ISO Method 10312:1995. If the blank control criteria (see Section B.5.2.1.1) are not met, the area is cleaned by using a combination of HEPA-filter vacuuming and a thorough wet-wiping of all surfaces with amended water. In addition, air samples should be taken in the sample prep room to verify clean air conditions. At least 2,500 liters of air should be drawn through a 25-mm-diameter 0.45-µm pore size MCE filter by using a calibrated air sampling pump. The samples should then be analyzed by using ISO Method 10312:1995. If blank control criteria are not met, sample preparation shall stop until the source of contamination is found and eliminated. Clean area sample results shall be documented.

B.5.2.1.4. Replicate Analysis

The precision of the analysis is determined by an evaluation of repeated analyses of randomly selected samples. A replicate analysis will be performed on a percentage of the samples analyzed to assess the precision of the counting abilities of the individual analysts. A replicate analysis is a second analysis of the same preparation, but not necessarily the same grid openings, performed by the same microscopist as in the original analysis. The conformance expectation for the replicate analysis is that the count from the original analysis and the replicate analysis will fall within an acceptable analytical variability as shown in Table 25.

B.5.2.1.5. Duplicate Analysis

A duplicate sample analysis is also performed on a percentage of the samples analyzed to assess the reproducibility of the analysis and quantify the analytical variability due to the filter preparation procedure. A duplicate analysis is the analysis of a second TEM grid preparation prepared from a different area of the sample filter performed by the same microscopist as the original analysis. The conformance expectation for the duplicate analysis is that the counts from the original and duplicate analyses will fall within the acceptable analytical variability shown in Table 25

B.5.2.1.6. Verification Counting

Due to the subjective component in the structure counting procedure, it is necessary that recounts of some specimens be made by a different microscopist (i.e., a microscopist different than the one that performed the original analysis) in order to minimize the subjective effects. Verification counting will be done by more than one analyst in the initial laboratory and also by the QC laboratory. Counting will involve re-examination of the same grid openings by the participating analysts. Such recounts provide a means of maintaining comparability between counts made by different microscopists. Repeat results should result in a level of consensus between laboratories such that both laboratories have >80% true positives, <20% false negatives, and <20% false positives in their verified counting analysis of asbestos structures.

B.5.2.1.7. Interlaboratory QA Checks

Bureau Veritas shall submit a percentage of air samples to a QA laboratory for verified counting and duplicate analyses as described in the previous sections.

B.5.2.2. Soil Laboratory QC

For TEM on soils, QC checks include blanks, duplicates, replicates, and verified counting. For PLM on soils, QC checks include duplicates.

B.5.2.2.1. Laboratory Blanks

A laboratory blank is prepared by filtering 50 mL of water (the same type as used for sample suspension/sonication) through the same type of filter used to prepare TEM grids. A sample blank should be prepared each time a new batch of filters is opened and each time the filtering unit is cleaned. Blanks will be considered contaminated if they have a running average fiber loading greater 18 asbestos structures per square millimeter (EPA 1987). This generally corresponds to three or four asbestos structures found in ten grid openings. The source of the contamination must be found before any further analysis can be performed. Reject samples that are processed along with the contaminated blank samples and prepare new samples after the source of the contamination is found.

B.5.2.2.2. Laboratory Duplicates

A duplicate sample analysis is also performed on a percentage of the samples analyzed to assess the reproducibility of the sample preparation and analysis. A duplicate analysis is the analysis of a second aliquot of the original soil sample.

B.5.2.2.3. Replicate Analysis

Replicate analysis will be performed on a percentage of the samples as described for the air samples in Section B.5.2.1.4.

B.5.2.3. Settled Dust /Pavement Dust Laboratory QC

B.5.2.3.1. Laboratory Blanks

A laboratory blank is prepared by filtering water through the same type of filter used to prepare TEM grids. A sample blank should be prepared each time a new batch of filters is opened and each time the filtering unit is cleaned. Blanks will be considered contaminated if they have greater than or equal to ten asbestos structures per square millimeter. The source of the contamination must be found before any further analysis can be performed. Reject samples that are processed along with the contaminated blank samples and prepare new samples after the source of the contamination is found.

B.5.2.3.2. Laboratory Duplicates

A duplicate sample analysis is also performed on a percentage of the samples analyzed to assess the reproducibility of the sample preparation and analysis. A duplicate analysis is the analysis of a second aliquot of the original dust samples aqueous suspension.

B.5.2.3.3. Replicate Analysis

Replicate analysis will be performed on a percentage of the samples as described for the air samples in Section B.5.2.1.

B.5.2.4. Water Laboratory QC

B.5.2.4.1. Laboratory Blanks

A laboratory blank is prepared by filtering 100 mL of water through the same type of filter used to prepare TEM grids. A sample blank will be prepared with each sample set.

B.5.2.4.2. Laboratory Duplicates

A duplicate sample analysis is also performed on one of the samples analyzed to assess the reproducibility of the sample preparation and analysis. A duplicate analysis is the analysis of a second aliquot of the original water sample.

B.5.2.4.3. Replicate Analysis

Replicate analysis will be performed on one of the samples as described for the air samples in Section B.5.2.1.4.

Table 24. Analytical Methods and Quality Assurance (QA)/Quality Control (QC) Checks

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
Perimeter Air	Asbestos by TEM	EPA-modified ISO Method 10312:1995; 0.0005 s/cm^3	Lot Blanks	2% of unused filters	<10 asbestos s/mm^2	Reject filter lot
			Laboratory Blanks	Each sample batch	<10 asbestos s/mm^2	Collect and analyze clean area blanks; re-prep filter samples
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm^2	Find and eliminate source of contamination
			Replicate Analysis (recount by same analyst)	6 samples	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation
			Verification Counting	4 samples	>80% true positives, <20% false negatives, <20% false positives	Re-examine grids to determine cause of variation
			Duplicate Analysis (reprep and analysis by same analyst)	6 samples	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation; re-prep filter samples
			Interlaboratory Verified Counting	2 samples	>80% true positives, <20% false negatives, <20% false positives	Re-examine grids to determine cause of variation
			Interlaboratory Duplicate Analysis	3 samples	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation; re-prep filter samples
			Blind recounts on reference slides	Daily	Per laboratory control charts	Investigate source of imprecision; re-count reference slides
			Blind recounts on filter samples	10%	See Step 13 of Method 7400	Investigate source of imprecision; re-count filter sample

Table 24. Analytical Methods and Quality Assurance (QA)/Quality Control (QC) Checks, Continued.

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
Worker Air	Total Fibers by PCM	NIOSH Method 7400; 0.006 f/cm^3 (480 L) 0.003 f/cm^3 (960 L)	Blind recounts on reference slides	Daily	Per laboratory control charts	Investigate source of imprecision; re-count reference slides
			Blind recounts on filter samples	10%	See Step 13 of Method 7400	Investigate source of imprecision; re-count filter sample
	Asbestos by TEM	EPA-modified ISO Method 10312:1995; 0.005 s/cm^3	Lot Blanks	2% of unused filters	<10 asbestos s/mm^2	Reject filter lot
			Laboratory Blanks	Each sample batch	<10 asbestos s/mm^2	Collect and analyze clean area blanks; re-prep filter samples
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm^2	Find and eliminate source of contamination
			Replicate Analysis	2 samples	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation
			Verification Counting	1 sample	>80% true positives, <20% false negatives, <20% false positives	Re-examine grids to determine cause of variation
			Duplicate Analysis (reprep and analysis by same analyst)	2 samples	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation; re-prep filter samples

Table 24. Analytical Methods and Quality Assurance (QA)/Quality Control (QC) Checks, Continued.

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
Settled Dust/Pavement Dust	Asbestos by TEM	ASTM D 5755-03; 250 s/cm^2 (Settled Dust) and 1000 s/cm^2 (pavement)	Lot Blanks	2% of unused filters	<10 asbestos s/mm2	Reject filter lot
			Laboratory Blanks	1 per 10 samples or each sample batch	<10 asbestos s/mm2	Collect and analyze clean area blanks; re-prep filter samples
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm2	Find and eliminate source of contamination
			Replicate Analysis	6 settled dust samples, 1 pavement dust samples	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation
			Duplicate Analysis	6 settled dust samples, 1 pavement dust samples	Acceptable Analytical Variability from Table 25	Reprepare and re-examine sample to determine cause of variation; re-prep filter samples

Table 24. Analytical Methods and Quality Assurance (QA)/Quality Control (QC) Checks, Continued.

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
Soil	Asbestos by TEM	EPA/600/R-93/116 (TEM) 0.1%	Laboratory Blanks	Each sample batch	Running average <18 s/mm^2	Find and eliminate source of contamination; re-prep samples
			Replicate Analysis	3 samples	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation
			Duplicate Analysis	3 samples	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation; re-prep samples
	Asbestos by PLM	EPA/600/R-93/116 (PLM) 0.1%	Duplicate Analysis	3 samples	Acceptable Analytical Variability from Table 25	Reprepare and re-examine sample to determine cause of variation

Table 24. Analytical Methods and Quality Assurance (QA)/Quality Control (QC) Checks, Continued.

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
Water	Asbestos by TEM	EPA 100.2; 0.04 million str/liter source 2 million str/ liter runoff	Lot Blanks	2% of unused filters	<10 asbestos s/mm2	Reject filter lot
			Laboratory Blanks	1 per 10 samples or each sample batch	<10 asbestos s/mm2	Collect and analyze clean area blanks; re-prep filter samples
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm2	Find and eliminate source of contamination
			Replicate Analysis	1 sample	Acceptable Analytical Variability from Table 25	Re-examine grids to determine cause of variation
			Duplicate Analysis	1 sample	Acceptable Analytical Variability from Table 25	Reprepare and re-examine sample to determine cause of variation; re-prep filter samples

Table 25. Accepted Analytical Variability For Sample Re-Analysis*

Type of Sample		Accepted Variability
Air Samples	lab replicate	1.96
	lab duplicate	2.24
	Interlaboratory duplicate, co-located	2.50
Non-Air Samples	lab replicate	2.24
	lab duplicate	2.50

Note: These accepted variabilities will be used as guidelines to assess data quality: no data will be automatically excluded without thorough review.

$$\text{Analytical Variability} = \left| \frac{AnalysisA - AnalysisB}{\sqrt{AnalysisA + AnalysisB}} \right|$$

which is the absolute value of the difference of the two analyses, divided by the square root of the sum, which is an estimate of the standard deviation of the difference based on a Poisson counting model. For replicate air samples, for which the simple Poisson model is most directly applicable, the value 1.96 is chosen so that the criterion will flag approximately 1 replicate pair out of 20 for which the difference is due only to analytical variability, i.e., it has a "false positive" rate of 5%. For the other types of analyses, where greater natural variability is expected than indicated by a pure Poisson model, the criterion value has been increased from 1.96 in order to avoid flagging too many cases where the difference between the values is due only to normal variation, and not to any problem with either analysis. The values 2.24 and 2.50 were selected as targeting false positive rates of 2.5% (1/40) and 1.125% (1/80) for the Poisson model.

Example 1: For replicate air samples where A = 0 fibers and B = 3 fibers, the variation is considered acceptable, while A = 0 and B = 4 would be flagged for further investigation. Likewise A = 1 and B = 6 is acceptable, while A = 1 and B = 7 is flagged. At higher levels, A = 20 and B = 34 is acceptable, but A = 10 and B = 24 is flagged.

Example 2: For interlab duplicate non-air samples, A = 0 and B = 6 is acceptable, but A = 0 and B = 7 is flagged. Likewise, A = 1 and B = 8 is acceptable, but A = 1 and B = 9 is flagged.

B.6. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

B.6.1. Instrumentation/Equipment

Field equipment/instruments (e.g., sampling pumps, meteorological instrumentation) will be checked and calibrated before they are shipped or carried to the field. The equipment and instruments will be checked at least daily in the field before and after use. Spare equipment such as air sampling pumps and conductivity meter will be kept on site to minimize sampling downtime. A backup meteorological instrument will be available onsite.

B.6.2. Laboratory Equipment/Instrumentation

As part of the laboratory's QA/QC Program, a routine preventive maintenance program is performed to reduce instrument failure and other system malfunctions of transmission and scanning electron microscopes. The laboratory has an internal group and equipment manufacturers' service contract to perform routine scheduled maintenance, and to repair or to coordinate with the vendor for the repair of the electron microscope and related instruments. All laboratory instruments are maintained in accordance with manufacturer specifications and the requirements of ISO Method 10312:1995.

B.7. INSTRUMENT CALIBRATION AND FREQUENCY

B.7.1. Field Instrument/Equipment Calibration

B.7.1.1. Air Sampling Pumps

Before the sampling pumps are used in the field, their performance will be evaluated by a qualified technician. The air sampling pumps for asbestos sampling, which are the primary air sampling item, will be evaluated to determine that they are capable of maintaining a stable flow rate for a given static pressure drop; i.e., the pressure drop created by a 25-mm, 0.45 µm MCE membrane filter with a five-µm pore-sized MCE backup diffusing filter and cellulose support pad contained in a three piece cassette at a flow rate of 4 liter/min @ STP.

The air sampling pumps with a flow control valve will be evaluated to ensure that they are capable of maintaining a stable flow rate for a given static pressure drop; i.e., the pumps can maintain an initial volume flow rate of within +/- 10% throughout the sampling period.

B.7.1.2. Airflow Calibration Procedure

Flow measurements will be taken by either a primary standard or secondary standard that has been pre-calibrated in the laboratory using a primary standard. Primary standard calibration documentation will be available in the field. The flow meter will be placed downstream of the filter cassette at the beginning, every two hours and ending of the sampling periods and the measurement recorded.

A detailed written record will be maintained of all calibrations. The record will include all relevant calibration data, including the following elements:

- Flow meter model and serial number
- Sampling train (pump, flow control valve, and filter)
- Relevant calculations

Pump checks will be performed at least every two hour during sample calibration. These periodic checks will include the following activities:

- Observe the sampling apparatus (filter cassette, vacuum pump, etc.) to determine whether it's been disturbed.
- Check the pump to ensure that it is working properly.
- Inspect the filter for overloading and particle deposition
- Record all information (location, pump number, time, flow rate, and corrective action) in a log book.

B.7.2. Calibration of TEM

The TEM shall be aligned according to the specifications of the manufacturer. The TEM screen magnification, electron diffraction (ED) camera constant, and energy dispersive X-ray analysis (EDXA) system shall be calibrated in accordance with the specifications in ISO Method 10312:1995, Annex B.

B.8. INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

B.8.1. Air Sampling Filter Media

See Section B.5.2.1.1 regarding the quality control check of the filter media.

B.8.2. Sampling Containers for Water Samples

Sample containers used to collect water samples for asbestos analysis will be provided by the Bureau Veritas who will be responsible for pre-cleaning these containers as required by EPA Method 100.2.

B.8.3. Hydrant Water

Hydrant water was collected prior to the demolition to verify its acceptability for use.

B.9. NON-DIRECT MEASUREMENTS

No data are needed for project implementation or decision making that will be obtained from non-measurement sources such as computer data bases, programs, literature files, or historical data bases.

B.10. DATA MANAGEMENT

Commercially available computer hardware and software will be used to manage measurement data to ensure the validity of the data generated. Controls include system testing to ensure that no computational errors are generated and evaluation of any proposed changes to the system before they are implemented. Commercially available software does not require testing, but validation of representative calculations is required by using alternative means of calculations.

B.10.1. Field Data Management

Field data will be entered into a Microsoft Excel spreadsheet (or other applicable spreadsheet) to facilitate organization, manipulation, and access to the data. Field data will include information such as sampling date, sample number, sampling site, sample description and location, sample type, air volume, sampling period and weather patterns for that day. Information will be collected and recorded via daily logs and chains –of-custodies (COC) in order to have a seamless flow of project specific data that can be QA/QC'ed accordingly. The project logs will record the contractors as well as the consultant project site specific activities. Special consideration will be given to the sample location graph as well as the contractor's progress with the demolition activities. The consultant (Berger) will be adequately staffed to provide ample attention to each activity (i.e. air sample calibration and COC, QA/QC, monitoring of demolition contractor's activities. It is anticipated that several consultant personnel will be on-site throughout the project from setup until completion in order to actually capture all of the data, work practices, and sampling required by the QAPP.

B.10.2. Laboratory Data Management

Laboratory data will be entered into a Microsoft Excel spreadsheet (or other applicable spreadsheet) to facilitate organization, manipulation, and access to the data. Laboratory data will include information such as sample number, sample date received and analyzed, type of analysis, magnification, grid location, grid square area, filter type, number of grids examined, number of asbestiform structures counted, structure type (fiber, bundle, cluster, or matrix), and structure length and width. An example format for reporting the structure counting data is contained in Figure 7 of ISO Method 10312:1995.

Bureau Veritas utilizes an automated Laboratory Information Management System (LIMS) to record, document and assimilate pertinent field, laboratory, and administrative data.

The validation of this software, including final report templates are performed by the Corporate MIS Department and the Quality Assurance Department. Data validation is a continuing process that takes place every time samples arrive at the laboratory and is carried through during log in, analysis and final reporting. This process is performed by the Laboratory Manager each time a final report goes through the procedures of review and signature. All calculations and reporting performed by the software is implemented by the Laboratory Management, the Corporate MIS staff or the Quality Assurance (QA) Department. This coordination between the QA Department, Laboratory Management and the MIS Department allows the software to be reviewed and altered as necessary to comply with regulatory agencies and/or accrediting organizations requirements.

B.10.2.1. Data Validation

In addition to the initial verification, there is a continual validation process that occurs each time that the Laboratory Manager proofs a report prior to release to the client. If any of the errors that are found during this proofing process are not traced back to transcription or analytical error, then the computer system is suspect and will be investigated. The processes that undergo this continuous validation include:

- Sample Receiving
- Sample Log In
- Sample Analysis
- Analytical Results Entry
- Proofing of Reports

B.10.2.2. Exported Data

Exported data is provided in a variety of formats. Export formats for data deliverables are implemented and controlled by the corporate MIS staff, which has the flexibility to implement new export formats as required. Electronically delivered data is not intended to replace hard copy results. Final, signed client reports are submitted in addition to delivery by email or diskette. In this way, exported data can be verified. Laboratory data is typically exported into a Microsoft Excel spreadsheet to facilitate organization, manipulation, and access to the data. Laboratory data will include information such as sample number, sample date received and analyzed, type of analysis, magnification, grid location, grid square area, filter type, number of grids examined, number of asbestiform structures counted, structure type (fiber, bundle, cluster, or matrix), and structure length and width.

C. ASSESSMENT/OVERSIGHT

C.1. ASSESSMENT AND RESPONSE ACTIONS

C.1.1. Performance and System Audits

C.1.1.1. Field Audit

The EPA-ORD QA Officer (or their representative) will audit the field sampling and data collection activities. The audit will include, but not be limited to, the examination of sample collection and equipment calibration procedures, sample labeling, sampling data and chain-of-custody forms, and other sample collection and handling requirements specified in the QAPP. Prior to the audit, a detailed checklist will be developed for use based on the approved QAPP. The auditor will document any deviations from the QAPP so that they can be corrected in a timely manner.

Prior to leaving the site, the auditor will debrief the EPA-ORD Task Order Manager and the Berger Project Manager regarding the results of the audit and any recommendations, if necessary. The results of the audit will be presented in a written report prepared by the auditor to the EPA-ORD Task Order Manager.

C.1.1.2. Laboratory Audits

The EPA-ORD QA Officer (or their representative) will conduct a laboratory quality assurance audit. The focus of the review will be the air analyses performed to support the primary project objective. Prior to the audit, a detailed checklist will be developed for use based on the approved QAPP. This audit will be conducted as soon after the laboratory receives the samples as practical to ensure compliance with the approved QAPP. The auditor will debrief the EPA-ORD Task Order Manager and the Berger Project Manager regarding the results of the audit and any recommendations, if necessary. The results of the audit will be presented in a written report prepared by the auditor to the EPA-ORD Task Order Manager.

If any serious problems are identified, the Berger Project Manager will ensure that immediate corrective action is performed. The laboratory will not analyze any samples until all audit recommendations have been resolved and documented in a memorandum to the Berger Project Manager. The Berger/Cadmus Project Manager will keep the EPA-ORD TOM informed of audit results and corrective actions.

C.1.2. Corrective Action

Sampling and analytical problems may occur during sample collection, sample handling and documentation, sample preparation, laboratory analysis, and data entry and review. Immediate on-the-spot corrective actions will be implemented whenever possible and will be documented in the project record. Implementation of the corrective action will be confirmed in writing through a memorandum to the Berger Project Manager. The Cadmus/Berger Project Manager will then forward a copy to the EPA Task Order Manager.

C.2. REPORTS TO MANAGEMENT

Effective communication is an integral part of a quality system. Planned reports provide a structure to inform management of the project schedule, deviations from the approved QAPP, impact of the deviations, and potential uncertainties in decisions based on the data.

The Cadmus Project Manager will provide verbal progress reports to the EPA Task Order Manager. These reports will include pertinent information from the data processing and report writing progress reports and corrective action reports, as well as the status of analytical data as determined from conversations with the laboratory. The Cadmus Project Manager will promptly advise the EPA-ORD Task Order Manager on any items that may need corrective action.

A written report will be prepared for each field and laboratory audit. The audit reports will be prepared by the person who conducts the audit. These reports will be submitted to the EPA Task Order Manager.

The final project report will be prepared in accordance with the guidelines specified in the EPA Handbook for Preparing ORD Reports, EPA/600K/95/002.

D. DATA VALIDATION AND USABILITY

D.1. DATA REVIEW, VERIFICATION, AND VALIDATION

The analytical laboratory will perform in-house analytical data reduction and verification under the direction of the laboratory's Quality Assurance Manager. The laboratory's Quality Assurance Manager is responsible for assessing data quality and advising of any data rated as "unacceptable" or other notations that would caution the data user of possible unreliability. The analytical results will be compared to the stated data quality indicators for each data quality objective. Field data and laboratory reports will then be reviewed and validated by Cadmus/Berger.

D.1.1. Laboratory Data Review

Sample data will be reviewed by the laboratory during the reduction, verification, and reporting process. During data reduction, all data will be reviewed for correctness by the microscopist or analyst. A second data reviewer will also verify correctness of the data. Finally, the Laboratory Quality Assurance Manager will provide one additional data review to verify completeness and compliance with the project QAPP. Any deficiencies in the data will be documented and identified in the data report.

D.1.2. Field and Laboratory Data Verification/Validation

Data verification and data validation will be conducted in accordance with EPA "Guidance on Environmental Data Verification and Data Validation," EPA QA/G-8 (EPA/240/R-02/004, November 2002. This will be performed by Cadmus/Berger's QA Officer, or designee.

Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method or QAPP requirements. The goal of data verification is to ensure and document that the data are what they purport to be, that is, that the reported results reflect what was actually done.

Data validation is the analyte- and sample-specific process that extends the evaluation of the data beyond data verification. Data validation continues with the review of the raw analytical data and analysis notes. The data review will identify any out-of-control data points and data omissions. Based on the extent of the deficiency and its importance in the overall data set, the laboratory may be required to re-analyze the sample. Included in the data validation of a sample set will be an assessment of chain-of-custody and analyses of field quality control samples (e.g., field blanks). Analytical data not appearing to be valid or not meeting data quality indicators will be flagged and reported to the Cadmus/Berger Project Manager. The Cadmus/Berger Project Manager will then transfer this information to the EPA Task Order Manager.

D.2. DATA AND SAMPLE ARCHIVAL

Data and sample storage encompasses an archival of all collected samples, generated electronic files, and any laboratory notes collected during collection or analysis of samples. Upon completion of the analysis, the respective laboratory will store the remaining portions of the samples or sample preparations (e.g., TEM grids) until such materials are requested to be shipped to EPA. Note: No samples or sample preparations will be discarded. Following submission of the final project report, all laboratory and field records/files (paper and electronic) will be transferred to the Cadmus Project Manager. The Cadmus Project Manager will then transfer the complete project file to the EPA-ORD Task Order Manager for permanent retention.

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APPENDIX A. DRAFT ALTERNATIVE ASBESTOS CONTROL METHOD

ALTERNATIVE ASBESTOS CONTROL METHOD
Developed by EPA Region 6 and EPA Office of Research and Development
November 1, 2007

1.0 Background

In response to Section 112 of the Clean Air Act which requires EPA to develop emission standards for hazardous air pollutants, EPA promulgated the National Emission Standards for Hazardous Air Pollutants (NESHAP). 40 CFR Part 61 Subpart M (Asbestos NESHAP) specifically addresses asbestos, including demolition activities.

Asbestos NESHAP regulations require that all regulated asbestos-containing materials (RACM) above a specified amount be removed from structures prior to demolition. Asbestos-containing materials (ACM) are defined as those materials containing more than one percent asbestos as determined using the method specified in Appendix E, Subpart E, 40 CFR Part 763, Section 1, Polarized Light Microscopy (PLM).

RACM includes friable ACM; Category I non-friable ACM that has become friable, Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading; and Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected during demolition operations.

Asbestos removal can account for a significant portion of the total demolition costs. In many cities, the cost of asbestos removal prohibits timely demolitions and results in substandard structures which become fire and safety hazards, attract criminal activity, and lower property values.

For structures that are structurally unsound and in imminent danger of collapse, the Asbestos NESHAP requires that the portion of the structure which contains RACM must be kept adequately wet during demolition and during handling and loading of debris for transport to a disposal site. No other engineering controls are required.

This Alternative Asbestos Control Method (AACM) was developed by EPA as an alternative work practice to the Asbestos NESHAP, where certain RACM are removed prior to demolition and other RACM are left in place.

The goal is to provide significant cost savings while achieving an equal or better standard of protection of human health and the environment. This method is much more restrictive than the Asbestos NESHAP requirements for buildings in imminent danger of collapse.

2.0 Applicability

This Alternative Asbestos Control Method applies to any structure subject to the Asbestos NESHAP regulation (i.e., structures that meet the definition of facility under the Asbestos NESHAP), except as noted below.

The size of structures which can be demolished using this method is limited to three stories or less (maximum height of 35 feet). This allows adequate wetting of both the interior and exterior of the structures and is within the working reach of both the wetting and the demolition equipment.

3.0 Building Inspection/Asbestos Assessment

A comprehensive inspection of the interior and exterior of the structure to be demolished shall be conducted in accordance with EPA’s Asbestos Hazard Emergency Response Act (AHERA, 40 CFR Part 763). Specific criteria for inspection, sampling, and assessment are in Subpart E (763.85, 763.86, and 763.88, respectively). The inspection shall be performed by an accredited asbestos building inspector.

4.0 Asbestos Removal

Table 1 summarizes the ACM that may be present in buildings and whether or not the ACM must be removed prior to demolition.

All thermal system insulation (TSI) and spray-applied fireproofing shall be removed due to the inability to adequately wet these materials during demolition. Fire curtains may be removed if it is easier to do so than to adequately wet and handle this heavy material.

Vermiculite insulation, if present, shall be removed prior to demolition as an RACM, regardless of the measured asbestos concentration.

All asbestos removal operations shall be performed in accordance with state and federal law by a licensed asbestos abatement contractor.

5.0 Demolition Practices

Several demolition work practice standards shall be employed to ensure that the method is protective of human health and the environment. These standards involve the equipment used, the wetting process, the demolition process, and visible emissions.

Demolition contractors shall provide an Asbestos NESHAP-trained individual to oversee the demolition process.

5.1 Equipment Used

Track hoes and end loaders or equivalent shall be used during demolition to minimize the generation of dust. No bulldozers, explosives, or burning will be permitted.

5.2 Wetting Process

Structures to be demolished will be thoroughly and adequately wetted with amended water (water to which a surfactant has been added) prior to demolition, during demolition, and during debris handling and loading. Surfactants reduce the surface tension of the water, increasing its ability to penetrate the ACM.

For this method, the Asbestos NESHAP definition for “adequately wet” will be used. That is, “sufficiently mix or penetrate with liquid to prevent the release of particulates. If visible emissions are observed coming from the asbestos-containing material (ACM), then that material has not been adequately wetted. However, the absence of visible emission is not sufficient evidence of being adequately wet.” The demolition contractor’s Asbestos NESHAP-trained individual will verify that ACM is adequately wetted.

Amended water shall be applied with a minimum of two hoses. The water shall be delivered as a mist. Direct high-pressure water impact of RACM is prohibited.

The wetting process consists of three stages. In each stage, both interior and exterior wetting of the structure shall be performed. To the extent feasible, cavity areas and interstitial wall spaces shall be wetted during each of the wetting stages.

Table 1. Asbestos Removal Requirements of AACM

Asbestos-Containing Material	Removed Prior to Demolition?
Thermal System Insulation (TSI)	
▪ Tank insulation	Yes
▪ Pipe insulation	Yes
▪ Elbow/fitting/valve insulation	Yes
▪ Boiler insulation	Yes
▪ Duct insulation	Yes
▪ Cement and patching compound	Yes
Surfacing Material	
▪ Asbestos-impregnated plaster, stucco	No
▪ Spray-applied fireproofing	Yes
▪ Spray-applied surface coatings (popcorn ceiling, vermiculite treatments)	No
▪ Spray applied acoustical or decorative surfacing	No
▪ Troweled-on crows foot texture, splatter texture, and joint compound.	No
▪ Spray-applied surface coatings crows foot texture, splatter texture, etc.	No
Miscellaneous Material	
▪ Fire curtains in auditoriums	Optional
▪ Fire doors	Optional
▪ Vibration-dampening cloths	No
▪ Asbestos-cement tiles, sheets, roofing, shingles, and transite	No
▪ Asbestos-impregnated roofing cement and asphalt roofing	No
▪ Shingles	No
▪ Linoleum or other floor tile	No
▪ Roll flooring	No
▪ Ceiling tile	No
▪ Asbestos-impregnated pipe	No
▪ Vermiculite insulation	Yes
▪ Mastic for flooring	No
▪ Window Cauking	No

On the day before the demolition, access openings shall be made into the attic spaces from the exterior. The structure shall be first pre-wet (until adequately wet) from the interior and then from the constructed exterior attic access openings to enhance water retention and maximize wetting effectiveness.

This pre-wetting shall prohibit further access into the structure, because of safety concerns. The structure shall be re-wet (until adequately wet) from the exterior through the windows, doors, and attic access openings on the day of demolition prior to demolition. Finally, wetting (until adequately wet) shall be done during the demolition and during loading of debris into lined disposal containers.

5.3 Demolition Process

The demolition contractor shall minimize breakage of asbestos-containing materials. All demolition shall be completed in a timely manner that will allow the debris generated during that day to be completely removed from the demolition site for disposal.

5.4 Visible Emissions

The Asbestos NESHAP standard of "no visible emissions" shall be employed. Visible emissions mean any emissions, which are visually detectable without the aid of instruments, coming from RACM or asbestos-containing material. This does not include condensed, uncombined water vapor. The demolition contractor's NESHAP-trained individual shall verify the absence of visible emissions and has the authority to stop work if visible emissions are observed.

During a demolition, it is often not possible to distinguish visible emissions from ACM and those from construction debris; therefore, should a visible emission be observed, the demolition effort shall pause until the deficiencies in the application of the wetting controls eliminate the visible emission.

6.0 Weather Restrictions

Demolition activities shall be delayed/halted in the case of any inclement weather that will impede the demolition contractor's ability to adequately wet the structure (e.g., freezing temperatures).

In addition, if visible dusting is observed in the vicinity of the demolition site, the demolition shall be delayed/halted.

7.0 Monitoring Requirements

Demolition contractors are required to comply with all applicable OSHA (29 CFR 1926) regulations for worker protection during asbestos removal and demolition activities. This includes the use of personal protective equipment (PPE) such as Tyvek suits or equivalent, respirators (as necessary), and gloves (as necessary); and personal monitoring.

Because, like the Asbestos NESHAP, this method is designed to be a work practice standard, monitoring of air (other than that mandated by OSHA statute), soil, and other media is not required.

8.0 Waste Handling

Several wastes are generated during demolition activities, including demolition debris, disposable PPE, and potentially contaminated water and soil, and must be properly disposed. All wastes generated must be removed from the site at the end of the day and transported to an appropriate disposal facility. Transport and disposal shall be in accordance with all federal, state, and local requirements. All waste haulers shall be leak-proof. Double-lining of the haulers with 4-mil or thicker polyethylene film and then sealing the top seams of the film is a suggested mechanism, but the contractor must do what is required to prevent leaks from the transport vehicles. Vehicles shall be decontaminated within the bermed area before leaving the demolition area.

8.1 Demolition Debris

Segregation of portions of a structure that may contain RACM from portions of a structure that clearly do not contain RACM shall be done when practical in an effort to minimize RACM debris. For example, segregation may be used if a large warehouse is being demolished and only a small portion (e.g., office space) contains RACM.

When segregation is not practical, all demolition debris shall be disposed as RACM in a licensed asbestos disposal facility. Debris shall be kept adequately wet during loading into containers. Containers shall be covered during transport.

8.2 PPE

All disposable PPE shall be disposed as RACM. Reusable PPE shall be decontaminated in accordance with OSHA standard practices.

8.3 Potentially Contaminated Water and Impervious Surfaces

No potentially contaminated water runoff is permitted from the site during the demolition period. All impervious surfaces will be thoroughly washed with amended water before site closure.

Construction site best management practices shall be used to prevent water runoff. Drains and sewer connections must be capped or plugged prior to wetting. Berms and/or trenches must be created as necessary to prevent runoff of water from the demolition site. If possible, the bermed/trenched area should extend 25 ft from the building and/or loading area. If not possible, adjacent areas and structures need to be covered with plastic.

The berm/trench must be sufficiently spaced from the building to permit the movement of the demolition equipment and to allow the truck loading to occur within the enclosed space. All plastic shall be disposed as RACM.

If large water volume use or impermeable conditions surrounding the building create excessive water volume and simple containment and percolation is not feasible, the water must be pumped and either disposed as ACM or filtered through a series of filters ultimately removing all fibers equal to or larger than five microns before transporting to a publicly-owned treatment works or discharging to a sanitary sewer. The filters must be disposed as RACM.

8.4 Potentially Contaminated Soil

Following the removal of demolition debris, bare soil within the bermed area shall be excavated to a minimum depth of three inches or until no debris is found. Berms created shall also be removed and disposed as potentially asbestos-contaminated. All removed soil shall be disposed as RACM.

9.0 Site Closure

Following demolition and waste disposal, all waste and debris must be gone from the site and the site must be secured so as not to create a safety hazard

Appendix B. Soil Sample Preparation and Analysis Method for Asbestos

Evaluation of an Alternative Asbestos Control Method (AACM) for Building Demolition (Phase 3)
Prepared: May 2, 2006
Revised: May 24, 2007

This procedure has been developed to describe how EPA/600/R-93/116, July 1993 "Method for the Determination of Asbestos in Bulk Building Materials" will be specifically implemented for the analysis of soils during the AACM evaluation.

Sample Preparation

The outsides of all soil sample containers received are to be cleaned in a hood. All sample preparation is conducted under a negative air ventilation hood with a HEPA filter. Samples are weighed to the nearest 0.1g prior to and after the every step of the preparation process.

If rocks are observed, these are removed and weighed. If visible chunks of building materials are observed, these are removed and weighed. Building materials are analyzed by PLM, and the asbestos type and percentage are documented, if present.

The soil sample will be analyzed for moisture using ASTM 2540G. Using flat trays, the sample is spread out as much as possible to maximize surface area. The wet soil is reduced by hand to < 1 cm in size. Samples are dried in a convection oven at 60ºC for a period of 24-48 hours, or until a constant weight is obtained. A constant weight is determined when less than 4 % of the previous weight or 0.5 mg is lost. The dried sample is transferred to its original clean air-tight heat dried container until it is placed in the riffle splitter.

Using the riffle splitter, the sample will be distributed into two receiving pans. One pan will be immediately returned to its original container. This portion will be archived and stored if reanalysis is necessary. The portion in the second pan will be used for PLM/TEM. This portion will be coned and quartered to generate an optimal sample size for PLM/TEM (~20 grams). This sample will be transferred to a clean airtight bottle.

PLM/TEM Analysis

The PLM/TEM subsample is first examined by stereomicroscopy (qualitative and quantitative) with PLM identification and documentation of any fibers or bundles. Suspect fibers are removed and examined by polarized light microscopy (PLM) to determine their optical properties and to achieve a positive fiber identification. If no selected fibers are positively identified as asbestos, the analyst will proceed to the grinding and sample reduction steps.

The sample (excluding any rock material observed) is ground and homogenized, using a standard plate grinder, to a particle size of approximately 250 micrometers.

A portion of the ground sample is weighed and ashed in a muffle furnace for one hour at 250˚C and for four hours at 480˚C. After weighing the ashed sample, it is then hydrolyzed in concentrated hydrochloric acid, filtered onto tared MCE filters, and weighed. The dried sample is then ground lightly for 1 minute using a mortar and pestle to gently break up any agglomerations. The gravimetric reduction ratio (GRR) is calculated.

A quarter portion of the residue is prepared for PLM analysis. Polarized light microscopes are equipped with two polarizing filters, a first order red I compensator, a retardation plate, objective lenses ranging from 10X to 40X magnification, a 10X central stop dispersion staining objective, a 360 degree rotating stage, and a cross hair reticle. Samples are mounted with glass slides and coverslips using Cargille refractive index liquids. All stereoscopic analysis and slide mount preparation is done in a negative air ventilation hood, equipped with a HEPA filter.

Positive identification of asbestos is achieved through the determination of the following optical properties:

- Morphology (3:1 minimum aspect ratio)
- Sign of elongation
- Extinction characteristics
- Birefringence
- Color and pleochroism
- Refractive indices

These properties are summarized in "Table 2-2. Optical properties of asbestos fibers," from EPA/600/R-93/116, July 1993.

If, through stereoscopic and polarized light analysis of the sample, the analyst determines that the sample contains greater than or equal to ten percent asbestos, a visual estimate technique may be used to report the sample's overall percent asbestos.

If 0-10 percent asbestos is observed, point counting will be done. The point count procedure begins with the preparation of twenty slide mounts (required analytical sensitivity is 0.1 percent) of the gravimetrically reduced sample. Slide mounts should ideally be prepared such that a single layer of the sample exists between slide and coverslip with no overlapping particles, and such that the slide mount contains 50-75 percent empty area within the field of view. If the sample has been sufficiently reduced by gravimetric reduction, the analyst may adjust the number of fields to be counted, as long as they maintain a 0.1% analytical sensitivity.

A cross hair reticle is used to count fifty random non-empty points on each slide mount at 100X magnification, under crossed polars. A point is counted when the cross hairs fall directly above or on the edge of a fiber or particle. An empty point occurs when the cross hairs fall above an area of the mount without any material. If the cross hairs fall directly above two or more overlapping non asbestos particles, one point is counted. If the cross hairs fall directly above the overlap of one asbestos fiber and one non asbestos particle, a point is counted for each.

For each slide mount, fifty such non-empty points are counted and recorded as either an asbestos point or a non-asbestos point. This method is repeated for twenty different slide mounts so that a total of 1000 non-empty points are recorded. With this data, an overall percentage of asbestos can be determined by dividing the number of asbestos points by the number of total points (1000), and multiplying by 100 and the GRR as in the following equation:

(asbestos points/total points) x 100 X GRR = percent asbestos

In the event that an analyst positively identifies an asbestos fiber, but does not count any asbestos points during a point count, the sample will be reported as containing a trace percentage of asbestos.

Another quarter portion of the residue is suspended in deionized water and aliquoted onto MCE filters for TEM analysis. This is accomplished by placing 100 mg of the sample residue in a 120 mL bottle and filling the bottle with 100 mL of 50:50 water and reagent alcohol. This solution is acidified to pH 3 to 4 with acetic acid, handshaken for 30 seconds, sonicated for three minutes, handshaken for another 30 seconds, and allowed to settle for two minutes. A range of aliquots (no less than one mL) is pipetted into a 25 mm filtration system utilizing 25 mm MCE filters. Aliquots are taken from the middle of the bottle. If the 1 mL aliquot is too heavily loaded, a serial dilution must be performed so that no filtered aliquot is less than 1 mL. Any remaining portion of the suspension is archived.

TEM filters are prepped by direct standard prep methods for MCE filters. Strips are cut from the filters, then collapsed in a DMF/acetic acid solution, etched to remove the top organic layer and coated with carbon in a high vacuum evaporator. Three- millimeter squares are cut and placed on 200 mesh copper TEM grids, which are then placed on a DMF Jaffe wicke bath for 55 minutes to dissolve filter material. Filters are then placed on an acetone Jaffe wicke for 55 minutes to remove any remaining filter material.

The grid preparations are examined in the TEM at low magnification (about 500-1,000x) to determine the preparation showing optimal particulate loading. Optimal loading for bulk samples is slightly more than for air samples, generally between 10% to 20%. Analysis on each grid opening is done at 15,000 – 20,000x screen magnification.

At least 4 grid openings are analyzed evenly over 2 grids until the grid opening containing the 100th asbestos structure is completed or until the analytical sensitivity is achieved (sufficient area must be analyzed such that one 3 µm X 0.1 µm asbestos structure relates to <0.1% mass of the original sample).

Structures are identified and classified according to ISO counting rules. In the event that the density of asbestos structures creates too many overlapping structures to effectively classify each primary structure individually, a less-dense aliquot is chosen.

Data Reporting

Data output for each analytical procedure is as follows:

PLM:

- percent asbestos of the ground fraction determined by point counting, if conducted
- percent asbestos in the original sample, determined by visual estimation
- percent asbestos in the chunks of building material (if any) removed after drying
- a calculated recombined percent of asbestos in the entire sample (chunks of building material plus the ground sample, if point counting was done, or the original dried sample, if visual estimation was done)
- method reference, sample identification (lab and project), analysis date, and analyst identification
- type or types of asbestos present
- number of asbestos points and non-asbestos points counted
- identity and quantity of other fibrous minerals, if known (determined by visual estimation)
- description of any departures from the test method
- description of any sample preparation steps
- reporting of gravimetric calculations

TEM:

- percent asbestos and structures/gram in the ground fraction analyzed
- method reference, sample identification (lab and project), analysis date, and analyst identification
- filter effective area, magnification, grid opening size, number of grid openings analyzed
- any non-standard procedures
- complete structure counting data per ISO 10312
- milligrams per kilogram (mg/kg) by weight and structures/gram of each asbestos type
- separate concentration values for chrysotile and amphibole
- analytical sensitivity
- compositional data for amphibole varieties, if present