Draft

Air-Monitoring Plan
Swann Park Site, Baltimore, Md.

Prepared for

Honeywell

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Prepared in Partnership with the

Mayor and City
Council of Baltimore

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CH2MHILL

Contents

1 Introduction 1-1

2 Perimeter Air Monitoring 2-1
2.1 Purpose 2-1
2.2 Monitoring Methods 2-1
2.3 Monitoring Locations 2-1
2.4 Frequency of Monitoring and Sampling 2-2
2.5 Recordkeeping 2-2

3 Excavation Zone Air Monitoring 3-1
3.1 Purpose 3-1
3.2 Method of Monitoring 3-1
3.3 Monitoring Locations 3-2
3.4 Frequency of Monitoring 3-2
3.5 Recordkeeping 3-3

4 Excavation Personnel Air Sampling 4-1
4.1 Purpose 4-1
4.2 Method of Sampling 4-1
4.3 Sampling Locations 4-1
4.4 Frequency of Sampling 4-1
4.5 Recordkeeping 4-2

5 Action Levels 5-1
5.1 Action Level—Visible Monitoring 5-1
5.2 Action Level—Perimeter (Fence Line) Air Monitoring 5-2
5.2.1 Rational for Perimeter Action Level 5-2
5.2.2 Work Zone Air Monitoring 5-3

6 Data Collection Requirements 6-1
6.1 Minimum Data Requirements 6-1
6.2 Meteorological Data 6-2
6.3 Public Posting of Particulate Air Monitoring Results 6-2

Appendix

A Data Collection Forms
B DataRAM 4 Monitoring Protocol

Tables

1 Air-Monitoring Action Levels

Figures

1 Site Location and Vicinity
2 Proposed Air-Monitoring Stations

SECTION 1

Introduction

This Air Monitoring Plan (Plan) presents the procedures that will be used to minimize and monitor dust that may be generated during the excavation of arsenic-impacted soil and other construction activities at the Swann Park property at 296 W. McComas Street, Baltimore, Maryland. Swann Park is located in south-central Baltimore City (Figure 1). Construction activities are expected to occur over a 4-month period, beginning in May 2008, and include the removal of approximately 8,000 tons of impacted soil, site regrading, placement of a geotextile marker layer, placement of a 2-foot layer of clean soil across the entire site, and installation of subgrade infrastructure for various utilities.

As soil is excavated or otherwise disturbed during construction, dust can be generated. Throughout the excavation activities, dust generation will be monitored visually and by using direct-reading "real-time" particulate monitors. A combination of fixed and mobile monitoring equipment will be placed adjacent to excavation areas and adjacent to the property boundaries (north, south, east, and west). A monitor is also to be placed on McComas Street, to the east of Swann Park.

The air-monitoring and dust control measures will include the following:

- Spraying soils with water to minimize the generation of dust.
- Collecting dust-monitoring and weather data during the construction to confirm successful dust control and mitigation and to evaluate the need to initiate actions to mitigate dust generation on a real-time basis, as the construction activities are performed.
- Monitoring and documenting airborne particulate levels near the active excavation areas and at the property boundaries.
- Providing the dust-monitoring data to the public on a real-time basis by posting the data on a bulletin board at the site and to the Swann Park Cleanup Web site (www.baltimoreswannparkcleanup.com).

While dust suppression measures will used, air monitoring will be performed to quantify levels of dust within disturbed areas and at the perimeter of the property. Occupation Safety and Health Administration (OSHA)–approved personal compliance monitoring (air sampling) of construction workers will be performed by subcontractor health and safety personnel for arsenic and total dust concentrations to assess worker exposure levels.

The remainder of this plan includes a description of the perimeter dust-monitoring procedures, the excavation zone dust-monitoring procedures, construction-worker-monitoring procedures, and the development of action levels that will be used for air monitoring. Specific action levels for each of the various types of monitoring that will be performed at the site are presented in Section 5 of this Plan.

SECTION 2

Perimeter Air Monitoring

2.1 Purpose

Air monitoring will be performed to document that excavation and material handling operations do not generate dust particulates above action levels at the property boundaries of Swann Park, as defined in Section 5. In the event that dust concentrations exceed the action level, onsite activities will be temporarily suspended so that additional dust mitigation measures can be performed. The results of the air monitoring will be posted on a bulletin board at the site and on the Swann Park Cleanup Web site (www.baltimore swannparkcleanup.com).

2.2 Monitoring Methods

Real-time particulate air monitors (e.g., DataRAM 4 or equivalent) equipped with an omni-directional air intake device and a PM_{10} impactor head will be used at the site to monitor dust levels throughout the entire 4-month project. The monitors will be operated each workday and will measure PM_{10} (those particles less than 10 microns in diameter) dust concentrations. The monitors are calibrated by the equipment manufacture before being used at a site. When the monitors are turned on daily, the instrument is self-calibrating and measures and records ambient conditions (temperature and humidity). Once turned on, the monitors record dust concentrations on a 15-minute time-weighted average (TWA).

The Site Safety Coordinator (SSC) will check the monitors periodically throughout each workday and when earthmoving work is being performed to determine if dust levels have exceeded the action level. The results from these inspections will be manually recorded using the data record form provided in Appendix A. The data will be downloaded from the DataRam at each of the five permanent monitoring stations at the end of each workday. Following a review of the monitoring data, the data will be posted on the onsite bulletin board and uploaded to the Swann Park Cleanup Web site.

2.3 Monitoring Locations

Four permanent, real-time, direct-reading dust-monitoring stations will be located at the property boundaries (north, south, east, and west) of Swann Park, with a fifth permanent monitoring station located on West McComas Street, immediately adjacent to the park's eastern fence line. The monitors will be placed on a level platform secured to a tripod. Each monitor will be removed at the end of each work day and taken back to the office trailer, where the data will be downloaded. The monitors for the perimeter locations will be placed in same location each day within a waterproof box (Pelican Box) affixed to the tripod. The inlet port of the sampler will be located at a height approximately 5 to 6 feet above the ground surface (approximate breathing level) at an unobstructed location. The locations of the monitoring stations are shown in Figure 2.

2.4 Frequency of Monitoring and Sampling

The fence-line perimeter monitors will be operational each day when construction activities are performed at Swann Park. All air monitoring will be suspended during periods of high humidity (e.g., fog and rain) since moisture entering the monitor can damage the unit. Operation of the monitors during humid site conditions can result in slightly higher air borne values being recorded. These conditions will be taken into consideration when the monitoring data are downloaded and reviewed. Contaminated soil will not be excavated during periods of severe weather conditions which would also result in the temporary suspension in the air-monitoring program.

2.5 Recordkeeping

All records will be maintained by the SSCs and be maintained in the project files. Records will consist of the following:

1. Field log notebooks
2. Downloaded electronic data from the permanent and temporary air-monitoring stations
3. Hard copy figures and data tables
4. Analytical results and related correspondence

SECTION 3

Excavation Zone Air Monitoring

3.1 Purpose

The active work areas of the Swann Park property will be designated as Exclusion Zones during the periods when arsenic-contaminated soils are being excavated, handled, loaded, and transported from the property. Monitoring will performed within these areas to ensure that adequate dust suppression measures are being deployed as material-handling activities are performed across the site.

As arsenic-impacted soil is excavated, the soil will be direct-loaded into dump trucks or placed into soil piles for subsequent loading. Once a truck is filled, the truck bed will be covered with a tarp to limit the generation of dust onsite and during soil transport to an offsite landfill. All loaded trucks will proceed to a vehicle washing station to remove fugitive dust before exiting the site.

The seven excavated areas will be filled using either soil from regrading of the site or "certified" clean borrow soil from an offsite borrow source. The fill soil will be brought to the property from an offsite location which complies with the Maryland Department of Environment's (MDE's) Voluntary Cleanup Program (VCP) guidance for characterization of clean fill material. Only borrow sources from non-industrial or commercial properties where testing has determined that contaminants (including arsenic) are below MDE guidance documentation will be used at the site. The clean borrow soil will be delivered by truck via a temporary road constructed on top of the existing asphalt cap on the adjoining Race Street Site.

The trucks transporting clean soil to the property will use designated clean onsite vehicle haul routes. After soil is unloaded, a bulldozer will be used to spread the clean soil and a compactor will compact the soil to the final 2-foot fill requirements. Once empty, trucks will proceed along the dedicated clean vehicle haul route and through the truck-washing area before exiting the site to minimize dust generation and cross-contamination of clean areas of the site.

Contamination Reduction Zone consists of areas adjacent to the Exclusion Zones, such as the truck-washing area, where the exterior of trucks are cleaned and mud is removed from truck tires before vehicles exit the site. Wash and rinse water will be collected and containerized as part of the vehicle cleaning operation.

3.2 Method of Monitoring

Visual monitoring for dust generation will be performed in addition to maintaining the permanent air-monitoring stations as a means to evaluate the effectiveness of dust suppression measures within or adjacent to material-handling areas. These control procedures may include the use of water spray to surpass dust emissions during all phases of excavation and materials handling. Formula 480 or another suitable, sprayed-on-cover-

type dust suppression application, will be used within the active material-handling area at the end of the each day.

Real-time measurements for dust particulates will be obtained using up to two mobile air monitors (e.g., DataRAM 4). The DataRAM 4 instrument, equipped with an omni-directional air intake device and a PM_{10} impaction head, will be used for the perimeter and work zone area dust monitoring. Use of a DataRAM 4 air monitoring instrument yields a real-time, direct-reading aerosol monitor that measures mass concentrations of dust in air. This type of air monitor samples the ambient air continuously, passing it through an optical chamber that is in the form of a long cylinder illuminated by a laser from one side, perpendicular to the long axis of the chamber. The amount of laser light scattered by particles in the air is measured and used to estimate a particle-scattering coefficient. This scattering coefficient is proportional to the mass of airborne particulate matter.

The PM_{10} impaction device on the DataRAM is used to calculate the average particle diameter and average concentration of the PM_{10} (particles less than 10 microns in diameter) fraction of the airborne particulates. The PM_{10} fraction is the respirable portion of the total particulate (dust) suspended in air. The monitoring protocol and instrument specification for the DataRAM is provided in Appendix B. Applicable data collected from the DataRAMs will be recorded on Data Record and Calibration Record forms (see Appendix A).

Similar to the perimeter particulate air monitors, monitoring data from these monitors will be downloaded at the end of each workday. The monitors will be checked periodically throughout the day and the display readings will be recorded. Dust concentrations will be calculated in 15-minute TWAs.

3.3 Monitoring Locations

Visual monitoring for airborne dust will be performed on an ongoing basis within each area where excavation and material-handling activities are being performed. The entire onsite work force will be held accountable for observing, reporting, controlling, and minimizing dust generation during all phases of the onsite work.

As many as two mobile real-time particulate air monitors will be placed onsite within 50 to 100 feet of the two active excavation areas where work may be occurring simultaneously. The mobile monitoring stations will be placed downwind from the work areas based on the current and forecasted wind direction as indicated by the onsite weather station. The location of the monitors may have to be modified on any given day if obstructed by the operation of the excavation equipment or other site limitations. The SSC will use appropriate discretion in locating these monitors in the event excavation activities are being conducted near the property boundaries or conditions otherwise do not permit placement of the monitors directly downwind of a work area.

3.4 Frequency of Monitoring

Monitoring for visible airborne dust emissions will be conducted continuously during excavation activities by the entire onsite work force and Construction Management Team personnel. The real-time PM_{10} dust air monitoring will also be operated continuously during excavation and material-handling operations when potential arsenic-containing dust may be

generated. The real-time monitoring will not be conducted during inclement weather conditions (e.g., rain or heavy fog) because these conditions interfere with the equipment function and may damage the monitors. However, light precipitation will reduce the potential for the generation of dust so work can proceed under these conditions, even if the monitors cannot be operated. During these periods of operation, visual observations will be used to determine if dust emissions are being generated which require suppression measures.

3.5 Recordkeeping

All records will be maintained by site Health and Safety Officers. Records will consist of the following:

1. Field log notebooks
2. Downloaded electronic data from monitors
3. Inspection results (Appendix A form)
4. Hard copy figures and data tables

SECTION 4

Excavation Personnel Air Sampling

4.1 Purpose

Personal air-sampling devices will be worn by select field personnel to evaluate the dust levels within excavation zones. Arsenic and total dust will be analyzed by an American Industrial Hygiene Association (AIHA) approved laboratory. Personnel working within the excavation zone will be equipped with Level C personal protection until data from personal air-sampling devices indicate that it is not needed.

4.2 Method of Sampling

Low-flow portable air-sampling pumps will be fitted with a filter cassette collection device and will be worn during the initial stages of excavation by a representative on the onsite work force. A typical air-sampling pump will be the GilAir5 (or equivalent) with an air flow rate range of 1 to 4 L/min. The filter cassette is a 37-mm, 5-micron, preweighed PVC-type unit. The representative number of samples will be based on the number of workers involved in the excavation activity, the specific work tasks being performed, and the judgment of onsite SSC involved. Air samples will be collected in the workers' breathing zone for the duration of the excavation work. OSHA Modified Method 105/125G will be used for arsenic analysis and NIOSH Method 0500 will be used for total dust analysis. All samples will be collected from within the breathing zone.

4.3 Sampling Locations

Homogeneous Exposure Groups (HEGs) will be identified as part of this excavation and materials-handling phase of the project. Establishing HEGs is a recognized exposure assessment method for personnel performing similar activities where exposure potential would be predicted to be the same or reasonably equivalent. The contractor's safety representative or the SSC will identify personnel in each HEG to wear the personal monitoring devices.

4.4 Frequency of Sampling

MARCOR will be responsible for determining the frequency of sampling and administering the program in coordination with CH2M HILL.

In general, dust samples will be obtained once the initial intrusive activity commences and will continue for several days in order to characterize potential worker exposures. Periodic monitoring may be conducted when work begins on a different portion of the site, a different type of operation is being initiated, or if employees are working with materials known to contain arsenic at locations where monitoring was not performed previously.

4.5 Recordkeeping

All records will be compiled by a safety representative from the contractor and be maintained in project files. Copies will be forwarded to CH2M HILL for project documentation. Records will include the following:

1. Pre-calibration (before personal air sampling begins)
2. Post-calibration (after personal air sampling has been completed)
3. Field observations
4. Calculations and chain-of-custody forms
5. Analytical results

SECTION 5

Action Levels

The air-monitoring program at the Swann Park property consists of a combination of perimeter, work zone, and personnel (worker) monitoring for particulates (dust) and arsenic. Table 1 outlines the various action levels to be adhered to during the Swann Park project.

TABLE 1
Air-Monitoring Action Levels

Air-Sampling Instrument (Real Time)	Action Level	Action Taken When Action Level Is Met or Exceeded
Perimeter dust (PM_{10})	0.228 mg/m^3 (TWA 15 min)	Dust control will be implemented and onsite construction management personnel will be alerted if or when dust levels are at the "alert" level.
Perimeter dust (PM_{10})	0.455 mg/m^3 (TWA 15 min)	Operations that directly impact the generation of dust as measured at the perimeter monitoring stations will be temporarily suspended until dust minimization actions are taken.
Work zone dust (total)	0.91 mg/m^3 (TWA 15 min)	Additional dust control methods will be implemented and construction activities responsible for generating the dust may be temporarily suspended if dust control is not effective. Respirators may be worn by workers in the exclusion zone represented by the air-sampling results.
Work zone arsenic (total)	0.01 mg/m^3 (TWA 8 hours)	Results from personal arsenic sampling will be used to assess if respiratory protection for worker protection and safety is required.

TWA, time-weighted average.

5.1 Action Level—Visible Monitoring

The observation of airborne dust in the excavation area will be used as a primary action level by site project team personnel. If dust is visible in a localized area, dust suppression methods will be immediately implemented. Onsite personnel will then check the perimeter monitors to determine if a dust levels have exceeded the action level. If dust is visible from any active excavation area and is evident at the fence line, engineering controls or alternate dust control methods will be initiated at once. As stated previously, the dust suppression primarily consists of using water to wet down an area of dust generation. Covering stock piles with tarps, spraying with dust suppression material, such as Formula 480, or wetting the stock pile with water are effective dust suppression methods.

5.2 Action Level—Perimeter (Fence Line) Air Monitoring

A dust concentration as measured by the PM_{10} of 0.455 mg/m^3 (455 µg/m^3) has been established as the action level for the perimeter air-monitoring program. This action level was calculated using the result of a conservative model using the Marlowe Equation, which calculates a corresponding personal exposure level for contaminated dust for worker exposure limit, then dividing the results in half, thus this action level represents one-half of the calculated permissible exposure limit. This action level was established before actual construction and remediation on this site began and before extensive air sampling for arsenic was conducted.

The 0.455 mg/m^3 action level was based on a very conservative model (see discussion or rational in Section 5.2.1) assuming all perimeter dust was 100 percent arsenic and that the concentration of arsenic in the dust represented the highest concentration of arsenic ever found in the soil samples at Swann Park (2,200 mg/kg). This action level was established to ensure that perimeter dust, that may potentially reach the perimeter of the property, would have arsenic concentrations well within recognized acceptable concentrations. When dust levels exceed 0.455 mg/m^3 (15-minute TWA), operations that are directly generating dust in the area of the impacted perimeter monitoring station, will be temporarily discontinued until dust mitigation action can be performed.

A 15-minute TWA PM_{10} concentration exceeding 228 µg/m^3, the Warning Level, at the site property perimeter and work zones will be used by the SSC to advise MARCOR and other subcontractor site personnel of the need for additional evaluations and/or dust minimization measures at the point identified as causing the elevated readings. Onsite construction work may continue at this point at the discretion of the SSC.

A 15-minute time-weighted-average PM_{10} concentration exceeding 455 µg/m^3 at the property perimeter will be used by the SSC to advise the MARCOR and CH2M HILL Health and Safety and Construction Management Team of the need for additional dust suppression measures to be taken at the point identified as causing the elevated readings. Work in the areas would be temporarily discontinued and the dust mitigation measures being reevaluated, unless the elevated dust level could be attributed to particulate generation from a source not associated with the Swann Park site construction activities.

5.2.1 Rational for Perimeter Action Level

The real-time particulate aerosol monitor measures the concentration of total respirable dust (i.e., PM_{10}) in the air on a continuous basis. The action level for PM_{10} concentrations, measured in real-time by the particulate aerosol monitors, is based on a PM_{10} level conservatively chosen to represent the documented arsenic standard as described below.

Two possible reference standards were considered for the real-time monitoring action level: (1) OSHA's Permissible Exposure Level (PEL) and (2) ACGIH's Threshold Limit Value (TLV). The 8-hour PEL for arsenic is 10 µg/m^3, measured as Cr. The American Conference of Governmental Industrial Hygienists (ACGIH), a non-governmental organization, has developed an 8-hour TLV for hexavalent chromium of 10 µg/m^3. Both PELs and TLVs are commonly relied upon by industry in setting workplace exposure standards. Since both standards are the same, 10 µg/m^3 was applied. The arsenic concentration must be converted

to a corresponding PM_{10} concentration, using the following relationship based on the Marlowe Equation:

$$\frac{(1E+6)(\text{Exposure Limit mg/m}^3)}{(\text{Concentration mg/kg})(\text{Safety Factor})}$$

where:

1E+6 = 1,000,000 – conversion factor

Exposure limit for arsenic = 10 μg/m³

Concentration = highest soil concentration found at Swann Park

Safety factor = degree of confidence of soil concentrations
1 = very high confidence, 10 = very low confidence

Action level (PM_{10}) = [(1,000,000 mg/kg) × 0.01 mg/m³] / [2,200 mg/kg × 5]

= 0.910 mg/m³ = 910 μg/m³

The maximum detected concentration of arsenic at the site (2,200 mg/kg) was applied in initially deriving the PM_{10} action level equivalent to the TLV of 10 μg/m³ for arsenic. The calculated action level that is currently being applied for the particulate aerosol monitors is a 15-minute average PM_{10} concentration of 910 μg/m³.

5.2.2 Work Zone Air Monitoring

A dust concentration (total) of 910 μg/m³ (15-minute TWA) has been established as the action level for the work zone air-monitoring program. With these data, the total dust levels for an 8-hour period (8-hour TWA) was calculated to be at a concentration of 910 μg/m³ and be below the permissible exposure limit for arsenic of 0.01 mg/m³ (8-hour TWA). As a safety factor, the established the action level of 910 μg /m³ as a 15-minute TWA instead of a 480-minute (8-hour) TWA will be used.

Air samples for total arsenic in the work zones and personnel air samples collected on workers will continue to be taken at periodic intervals as detailed in this air monitoring plan. These air sample results are to be used to ensure that the dust air sampling program and action levels are effective and still protecting potentially impacted workers and the public.

SECTION 6

Data Collection Requirements

During all monitoring activities, it is essential that comprehensive data be collected relative to the tasks being performed. Observational data and periodic field readings of onsite monitors are to be recorded on the appropriate data record form, found in Appendix A, or in observation record books dedicated to this project. Applicable chain-of-custody procedures must be maintained for all samples sent to an offsite laboratory for analysis. Data from the particulate aerosol monitors will be downloaded each day and stored on a server or other location that is regularly electronically backed up. Daily graphical summaries will be printed out from the particulate aerosol monitor. Filter cassette air sample laboratory results will be kept as hard copies.

6.1 Minimum Data Requirements

The following lists the minimum data that are to be collected for sampling and/or monitoring. In some cases the data may be recorded electronically by the instrument, and in other cases the data may be recorded manually on a form or a field log notebook:

Air pump/monitor data

- Pump or instrument ID
- Calibration date
- Calibrator type
- Initial flowmeter setting
- Initial flow rate (L/min)
- Final flowmeter setting
- Final flow rate (L/min)
- Average flow rate (L/min)

Sample media information (filter cassettes)

- Field sample ID
- Lab ID #
- Media type
- Type sample

Sampling information

- Start date
- Start time
- End date
- End time
- Sample time
- Sample volume (L)
- Sample volume (m^3)
- Analysis

Task description (for personal monitoring)

- Employee name/area description
- Employer
- Job task
- Activity

Results

- Total mass (µg) (arsenic lab results only)
- Concentration (µg/m^3)
- LOQ (µg) (arsenic lab results only)
- Lab comments
- Analysis date

Other

- Operational conditions or other factors that might impact samples

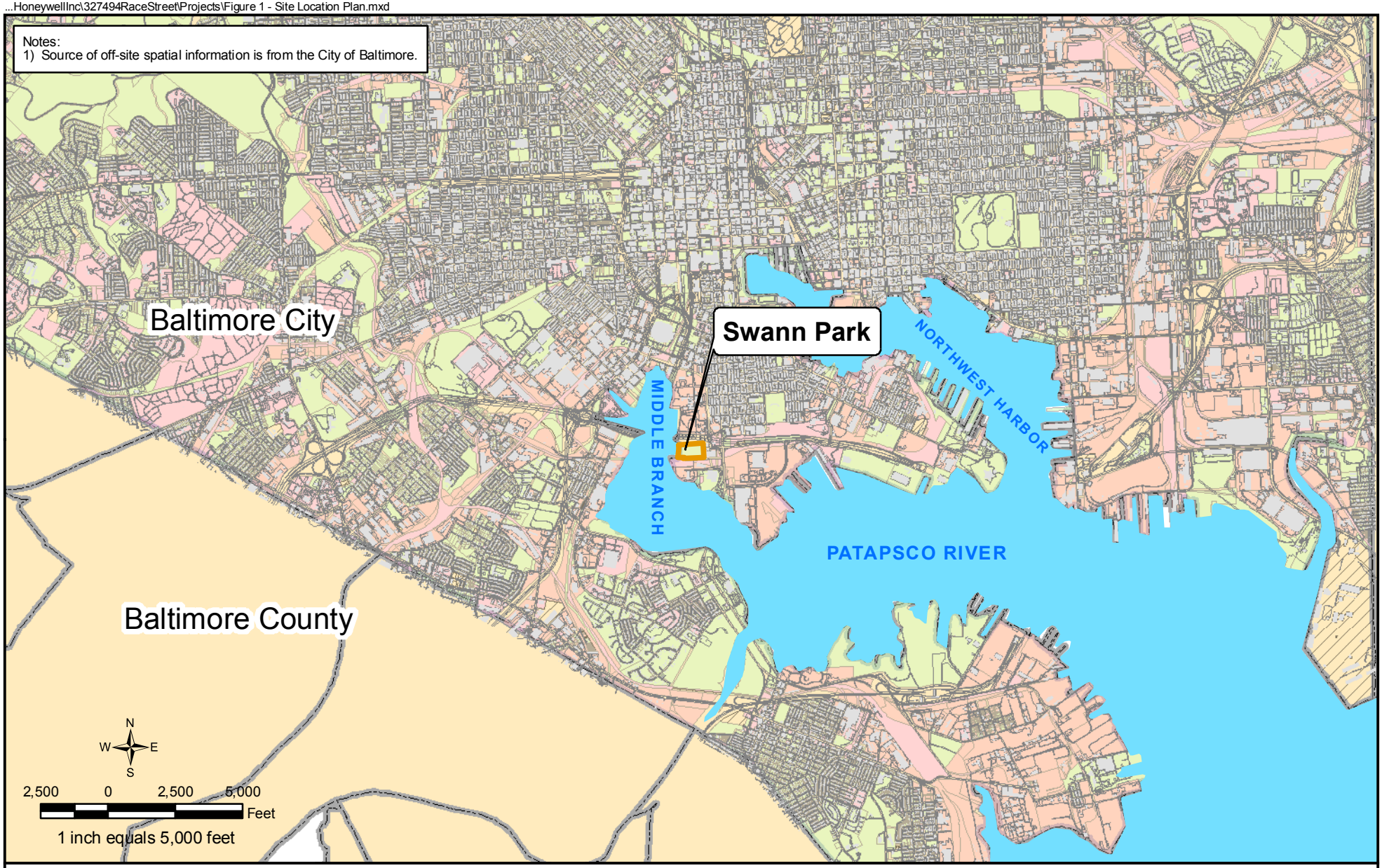
6.2 Meteorological Data

General weather conditions will be noted in the field log book on a daily basis. Weather data that will be collected from an onsite weather station and recorded will include: air temperature for the morning and afternoon and wind speed and wind direction. Other special weather conditions will also be recorded. The weather information may be used in evaluating the results of the monitoring data.

6.3 Public Posting of Particulate Air Monitoring Results

The average daily total dust concentration will be uploaded to the Swann Park Cleanup website for each of the five permanent perimeter air monitoring stations. These data will be uploaded within 24-hours of being downloaded from the onsite monitors at the end of each work day. A graph indicating the wind speed and direction as measured at the Swann Park onsite weather station will also be posted on the Swann Park Cleanup Web site on a daily basis.

...HoneywellInc\327494RaceStreet\Projects\Figure 1 - Site Location Plan.mxd



Legend

- Edge of Pavement
- Stream/River
- Buildings
- Swann Park Approximate Boundary

Land Use

- Unknown
- Commercial
- Recreation
- Industrial

Figure 1
Site Location and Vicinity
Air-Monitoring Plan
Swann Park
Baltimore, Maryland

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Legend

- Drop Inlet
- Manhole
- Storm Water Line
- Fence/Approximate Property Boundary
- Air Monitoring Stations
- Weather Station Location
- Approximate Limits of I-95
- Edge of Pavement
- Storm Manhole
- Below Ground Stormwater Conveyance System
- Concrete Column
- Concrete Footer

N
W E
S

100 0 100 Feet

1 inch equals 100 feet

Figure 2
Proposed Air Monitoring Stations
Swann Park Site Map
Air-Monitoring Plan
Swann Park
Baltimore, Maryland

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Appendix A
Data Collection Forms

Data Collection Form - Personal Air Monitors

Employee Name: **Date:** **Sample Number**:

Monitoring For: **Analytical Method**:

Time On: am/pm **Time Off-** am/pm **Total Sampling Time** minutes

Sampling Media:

Sampling Rate: liters/minute

Sample Volume: liters

Work Activities	PPE In Use
☐ Rounds and readings	☐ Respirator/gloves/Tyvek
☐ Product level measurements	☐ Respirator/gloves/Tyvek
☐ Product pumping	☐ Respirator/gloves/Tyvek
☐ Pressure washing	☐ Respirator/gloves/Tyvek
☐ Backwashing filters	☐ Respirator/gloves/Tyvek
☐ Cleaning treatment pad	☐ Respirator/gloves/Tyvek
☐ Collecting samples from treatment system	☐ Respirator/gloves/Tyvek
☐ Pulling pumps	☐ Respirator/gloves/Tyvek
☐ Checking or changing oil of pumps or equipment	☐ Respirator/gloves/Tyvek
☐ Stearn cleaning equipment	☐ Respirator/gloves/Tyvek
☐ Other (Specify)	☐ Respirator/gloves/Tyvek

Smoker: ☐ Yes ☐ No

Comments:

Sample Collected By:

Industrial Hygiene

Chain-of-Custody Record

Division Name: _____ **Telephone:**_____

Address: _____

City: _____ **State:** _____ **Zip:** _____

Collector's Name: _____ **Telephone:** _____

Send Results to:

Name: _____

Site: _____

Address: _____

_____

Sample Submitted to: _____ **Date:** _____
(Laboratory)

SAMPLE NUMBER	SAMPLE DATE	MEDIA	SAMPLE VOLUME	ANALYSIS REQUIRED

Chain of Possession*:

1. _____ _____ _____
Signature of Sender **Title** **Inclusive Dates**

2. _____ _____ _____
Signature of Sender **Title** **Inclusive Dates**

3. _____ _____ _____
Signature of Sender **Title** **Inclusive Dates**

*Apparent gaps or breaks in the Inclusive Dates are covered by site sample shipping and receiving logs.

Appendix B
DataRAM 4 Monitoring Protocol

Product Specifications

Thermo Scientific DataRAM 4™

Portable continuous particle sizing monitor/Dual Wavelength Nephelometer

Expandable to a complete particle characterization system

- Aerodynamic particle size separators allow measurement of specific particulate fractions such as the thoracic, respirable, PM10, PM2.5, and PM1.0 fractions.
- An omnidirectional sampling inlet and an in-line mist and fog elimination heater are available for ambient air monitoring.
- An isokinetic sampling probe / nozzle kit enables duct / stack monitoring.
- Self calibration extends unattended operation
- A unique programmable automatic zeroing feature permits longterm unattended field operation
- Has both RS232 and RS485 data ports for bi-directional digital communications.

The Thermo Scientific DataRAM 4™ continuously monitors and logs the real-time concentration and median particle size of airborne dust, smoke, mist and fumes. In addition, air temperature and humidity are displayed and recorded. With appropriate particle discriminators, it provides measurements correlated with PM10, PM2.5, PM1.0, and respirable fractions. Its patented two-wavelength particle detection system provides the volume median particle diameter of the sampled aerosol, over a concentration range up to 400 mg/m^3. Unlike typical particle counting devices, the Thermo Scientific DataRAM 4™ is totally immune to particle coincidence errors, even at the highest concentrations.

Volume median particle sizes down to 0.05 µm can be measured by this unique spectral nephelometric technique.
The Thermo Scientific DataRAM 4™ monitors the concentrations of fine particulates in ambient air by a combination of aerodynamic size preselection, two wavelength nephelometry, and concurrent sensing / correction for relative humidity. This patented technique provides a continuous measurement of PM2.5, independent of particle size and moisture - without heating, diffusion drying, or denuding the sample stream.

Thermo Scientific DataRAM4™ Specifications

Concentration measurement range	(Referred to gravimetric calibration with SAE Fine test dust) (mmd = 2 to 3 µm, 8g = 2.5, as aerosolized) 0.001 to 400 mg/m^3
Scattered coefficient range	1.1 x 10^{-6} to 0.6m^{-1} (approximately) @ ⊠= 880 nm
Precision/ repeatability	(2-sigma - at constant temperature):
Concentration measurement range	(auto ranging) Referenced to gravimetric calibration (NIST traceable) with SAE Fine test dust (mmd - 2 to 3 µm, ⊠$_g$ = 2.5, as aerosolized) 0.0001 to 400 mg/m^3
Precision / repeatability	(2-sigma)For single-wavelength concentration sensing at 25°C ±1% of reading or ± 0.001 mg/m^3, whichever is greater
Accuracy	Referenced to gravimetric calibration (NIST traceable) with SAE Fine test dust (mmd = 2 to 3 µm, ⊠$_g$ = 2.5, as aerosolized) ±2% of reading ± precision
Resolution	0.1% of reading or 0.1 µg/m^3, whichever is greater
Scattering coefficient range	10^{-7} to 0.4 m^{-1} (resolution: 3 significant digits, maximum)
Visual range (@⊠ = 550 nm)	0.001 to 337 km (resolution: 3 significant digits, maximum)
Angström coefficient measurement range	0.0 to 4.0
Particle sizing range	(log-normal, ⊠g = 2.0, m = 1.50) 0.05 to 4 µm
Particle size range for concentration measurements	0.08 to 10 µm
Temperature measurement range	5°F to 140°F (-15°C to 60°C); accuracy: 0.05°C
Relative humidity measurement range (@ 25°F)	0 to 100% noncondensing (accuracy: 2%)
Sampling flow rate range (user selectable)	1.0 to 3.0 liters/min. (accuracy: 0.05 liters/min., adjustability: 0.1 liters/min.)
Measurement/display integration time range	(user selectable) 1 to 60 sec. (selectable in 1-sec. steps)
Measurement/display update frequency	1 per sec.
HEPA filter cartridge replacement frequency	(typical) less than 1 per 5 yrs (@ < 1 mg/m^3)
Alarm level range	(user selectable) selectable over entire measurement range 0.001-400mg/m^3
Data logging averaging periods	(user selectable) 1 sec. to 24 hrs. (selectable in 1-sec. increments)
Data logging memory capacity	50,000 data points in up to 99 tags (data sets)
Programmable zeroing periods	(user selectable)1 to 168 hrs. (selectable in 1-hr increments; if enabled, logging period must be more than 10 min.)
Elapsed time readout range	1 sec. to 100,000 hrs. (over 11 yrs.), in sec., min., and hrs.
Digital communications	RS232/RS485; full duplex, 9600 baud, software-controlled, filtered
Computer requirements	IBM-compatible PC, Windows™ 95 or higher; 8 MB memory or more
Analog outputs	(user selectable) 0 to 5 V and 4 to 20 mA with selectable full scale ranges between 0.1 and 400 mg/m^3
Power	Internal battery; rechargeable, sealed lead-acid, 6.5 Ahr, 6 V, 20-hr run time between charges (typical) AC line: universal voltage charger / power supply (included) 100-250 V, 50-60 Hz (CE marked) Optional solar power system (Model DR-SOL)
Alarm Outputs	Alarm switch: 30 V (off,open), 2.5 A (on, closed) Alarm signal: 0 V (off), 5 V (on) (1 mA maximum load current) Audio alarm (back panel): More than 65 dB @ 1 m
Operating environment	14°F to 122°F (-10°C to 50°C); 10 to 95% RH, noncondensing
Storage environment	-4°F to 158°F (-20°C to 70°C)
Dimensions	5.28 in. (134 mm) H x 7.25 in. (184mm) W x 13.63 in. (346 mm) D
Weight	11.7 lbs (5.3kg)
Safety approvals and certificates	The DataRAM 4™ complies with US FCC rules (Part 15) and has received CE certification.
Standard accessories included	Universal voltage battery charger / power supply Standard HEPA filter cartridge Analytical filter holder PC communications software disk Digital output cable

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