FORMER BIOVAIL CAROLINA FACILITY
SABANA ABAJO INDUSTRIAL PARK
CAROLINA, PUERTO RICO

Remedial Action Work Plan

PROJECT NO. 05-0001E

Prepared for:

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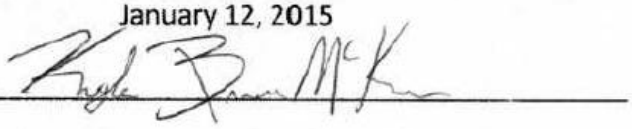
Signature 

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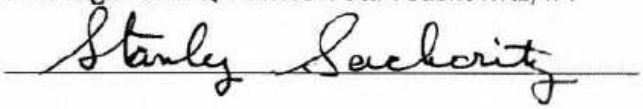
Signature: 

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Compliance with the EPA Policy and
The Uniform Federal Policy (UFP) for Quality Assurance Plans

The Environmental Protection Agency (EPA) requires that Quality Assurance Project Plans (QAPP)comply with the requirements of the *EPA Guidance on Quality Assurance Project Plans* CIO 2106-G-05 QAPP (QAPP Guidance). In addition to the QAPP Guidance, EPA also allows use of the *Uniform Federal Policy for Quality Assurance Project Plans*, (EPA-505-B-04-900A). The following table presents a cross reference description showing the compliance of the Work Plan Prepared by Radiation Data for this project with the requirements included in both the EPA and UFP guidance for the preparation of QAPPs.

CROSS REFERENCE TABLE
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Section 1.5, Figure 2	3 & 5	Project Organization and QAPP	2.2.3	Distribution List
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N/A	13	Secondary Data Uses and Limitations	Chapter 3	QAPP ELEMENTS FOR EVALUATING EXISTING DATA
Section 1.4, Section 2.4, 3.0	14&16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule
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1.0 INTRODUCTION:

Radiation Data was retained by International Process Plants (IPP) to conduct additional assessment and remediation activities at the former Biovail Laboratories International SRL (Biovail) facility on behalf of Valeant International Bermuda (Valeant), formerly Valeant International (Barbados) and Biovail Laboratories International SRL. The former Biovail facility is located within the Sabana Abajo Industrial Park (SAIP) in the Sabana Abajo Ward, Carolina, Puerto Rico. From here-on, the former Biovail facility will also be referenced as the subject site, the subject facility or the Site.

The U.S. Environmental Protection Agency (EPA) has conducted, overseen, or received various assessment activities within the Industrial Park and based upon the results of these assessment activities, the EPA has identified chlorinated volatile organic compounds (CVOC) in soil and groundwater underlying both the former Gillette and Biovail properties. According to the EPA reports, CVOC concentrations exceeding 400,000 micrograms per liter (ug/L) in groundwater and 2,700,000 micrograms per kilogram (ug/kg) in soil have been identified in the shallow subsurface on the former Gillette and Biovail properties. Radiation Data conducted communication testing at the subject site to determine the suitability of using sub-slab depressurization to mitigate the risk of future vapor intrusion to the building on site. Based on the results of the communications testing, which indicated greater than 1.5" WC depressurization across 20 ft. of the slab, using a diagnostic vacuum, Radiation Data proposes to install 3 sub-slab depressurization systems on site. A gap of approximately .25 cm was consistently observed between the bottom of the concrete slab, and the top of the soil below during communications testing, which further suggests that there will be sufficient communication for sub-slab depressurization to be an effective means for mitigating vapor intrusion concerns.

1.1 SITE BACKGROUND:

The Industrial Park includes a number of active and inactive manufacturing, pharmaceutical, storage and miscellaneous commercial facilities. The approximate location of the former Biovail facility is presented in Figure 1, which is a U.S. Geological Survey (USGS) 7.5 minute topographic quadrangle. The facility is located at Lot 34 of the Industrial Park and covers an area of approximately 4,965 square meters. The former Biovail facility is bound on the north by the former Gillette facility (Gillette) building (currently owned by Procter & Gamble); on the east by the B Street of the SAIP; on the south by the York facility; and on the west by the Suarez Drainage Ditch that flows northward into the Suarez Canal.

The Suarez Canal is located at approximately 775 meters to the north of the former Biovail facility and discharges into the Torrecilla Lagoon located at approximately 2,000 meters

northwest of the subject site. A sketch showing the former Biovail and the Gillette facilities within the Sabana Abajo Industrial Park is shown in Figure 2.

The subject site in Carolina has not been in operation since approximately 2008. It is our understanding that historical pharmaceutical operations involved water-based pharmaceutical manufacturing that did not require the use or management of chlorinated solvents. In May 2014, the property was sold by Carolina Property LLC to Accuprint, Inc. who presently operates a printing business at the location.

The available historical information indicates that the Gillette facility was previously occupied by a battery distributor. Prior to that, this facility was used for the manufacturing of pallets and wooden containers. A 1999 Phase I Environmental Site Assessment of the former Gillette property revealed that textile manufacturing operations were also carried out at that property.

At the time the former Biovail facility was in operation, the facility consisted of one Main Building, with the main manufacturing/production area on the central part of the building, the utilities area on the north and west sides of the building, engineering and maintenance areas on the northwest of the building, administrative areas to the east of the building, and amenities areas at the east, south and west of the building. Parking facilities were located to the south of the facility building. The total area covered by the main building and the warehouse is approximately 25,000 square feet. The site parcel occupies approximately 1.2 acres.

The site was being maintained it under controlled microbial growth environmental conditions until approximately February 1, 2014 . The facility was maintained under environmental control conditions, including keeping it cool and under humidity control conditions on a 24-hrs per day basis and sanitized once a week using alcohol until approximately February 1, 2014 as well. Also, the facility maintained operation of all the engineering systems including air conditioning, electrical transformers, etc until that time.

1.2 SITE CONDITIONS AND PHYSICAL SETTING

In May 2013 the EPA requested additional soil gas and indoor air sampling activities to further describe the CVOC presence at the Site. Caribe Environmental Services (CES) was retained by Valeant International Bermuda to conduct additional assessment activities at the former Biovail facility in Carolina, Puerto Rico. The sampling performed by CES identified concentrations of benzene, chloroform, cis-1,2-dichloroethene, vinyl chloride, tetrachloroethene (PCE) and trichloroethene (TCE) were detected exceeding EPA OSWER Screening Levels for Target Shallow Gas Concentrations in one or more of the Sub-Slab Soil Gas (SSSG) samples. PCE and its degradation products were also identified in shallow soil, between the confining layer which occurs at approximately 10 feet below ground surface and the ground surface, and groundwater across the site. As such, it appears that contaminated subsurface media is the source of elevated

concentrations of these VOCs in the SSSG samples. See Figure 3 for soil gas sample locations and results. As shown on Figures 4 and 5the sub-slab contamination appears to be confined to the northern portion of the building.

The Indoor Air sampling activities revealed concentrations above EPA Region 3 Carcinogenic and Non-Carcinogenic Regional Screening Levels (RSLs) for Industrial Air for 1,2-dichloroethane and benzene at IA-3 and IA-6, respectively. See Figure 3for IA sample locations. It is likely that the elevated concentration detected in IA-6 is due to background contamination associated with items stored and utilized in Room 42 and not due to vapor intrusion of benzene detected in the sub- slab soil gas sample. See Figure 3for IA sampling locations results.

1.2.1 TOPOGRAPHY

According to the San Juan USG Quadrangle (USGS, 1982) the Former Biovail site elevations vary from 1 to 2 meters-MSL. Field observations indicate that the facility main building area topography is relatively flat with a slight slope towards the west. Runoff at the southern parking area is also towards the west to the Suarez Canal drainage channel.

1.2.2 SOILS

According to the Soil Survey Map of the Humacao Area, Puerto Rico Eastern Part, prepared by the Department of Agriculture Soil Conservation Service (SCS, 2008), the soils in the Former Biovail facility area have not been classified.

1.2.3 CLIMATE

Carolina is located in the northern part of the Island. The climate of northeastern Puerto Rico falls into the tropical monsoon category. Distinguishing characteristics of this climate classification include significant humidity, a pronounced summer rainy season and a shorter winter dry season.
The prevailing winds, called trade winds, blow from east to west. Temperatures remain warm year round with little seasonal variation and few extremes. It never gets cold in Carolina; nor does the city suffer from the intense heat felt in parts of the southern U.S., thanks to the moderating effects of the surrounding ocean. Winter temperatures average 83 ^{0}F during the day and around 72 ^{0}F at night.

June through September comprises the hottest time of the year, with daily highs each month averaging 89 ^{0}F and mean overnight lows 78 ^{0}F. The annual precipitation is approximately 75 inches, having the heaviest rainfall seasons between April to May and from August to November.

1.2.4 GEOLOGY AND HYDROLOGY

1.2.4.1 GEOLOGY

According to the US Geological Survey (USGS) geologic map for the Carolina Quadrangle (USGS, 1977) the shallow geology at the Former Biovail facility is described as artificial fill (*af*)

(Holocene and Pleistocene) material from various sources hauled in and dumped in low, swampy places to provide foundation for housing and industrial development.

Based upon soil boring logs available for the facility the shallow geology at the site consists of a fill layer underlain by a clay layer. The clay layer is underlain by alternating sand and clay layers. It is believed that the alternating sand and clay layers may be underlain by a confining clay layer.

1.2.4.2 HYDROGEOLOGY

According to the information available the groundwater level at the area where the Former Biovail and Gillette facilities are located varies from approximately 2 ft to 5ft below the ground surface. Groundwater at the Former Biovail facility moves in a westerly direction towards the Suarez Canal.

1.3 CHEMICALS CONSTITUENTS OF CONCERN (CCOC)

According to previous investigations conducted or overseen by EPA the chemical constituents of concern for the Former Biovail facility are volatile organic compounds (VOCs) including the following chlorinated VOC constituents:

- Trichloroethene
- Tetrachloroethene
- Cis-1,2-Dichloroethene
- Vinyl Chloride

1.4 OBJECTIVES OF THE PROPOSED REMEDIAL ACTION

The remedial action to be performed at the Former Biovail facility will have the following objectives:

- To install sub-slab depressurization system(s) to prevent potential vapor intrusion into the Former Biovail Building.
- To assess the effectiveness of the sub-slab depressurization system(s) at prevention vapor intrusion at the site through system testing and air sampling.

1.5 DISTRIBUTION LIST

Copies of any subsequent revisions of this document and copies of the reports documenting the activities for this project will be submitted to the following personnel:

- Mr. David Rosoff, EPA On Scene Coordinator
- Mr. Stan Sackowitz, International Process Plants LLC., Project Manager
- Mr. Kyle Baicker-McKee, Radiation Data Project Manager, site QA Officer

2.0 TECHNICAL MANAGEMENT PLAN

2.1 GENERAL SEQUENCE OF FIELD ACTIVITIES

The anticipated sequence of field activities is as follows:
• Mobilization of field equipment
• Installation of vapor intrusion mitigation system inside the Former Biovail building.
• Indoor Air sampling
• Preparation of samples for delivery to the laboratory(ies)
The EPA will be notified of any field activities at least two weeks in advance of that activity to allow appropriate field oversight of the field work.

2.2 PROJECT ORGANIZATION

The mitigation and sampling will be conducted by Radiation Data under the direction of International Process Plants. The project organization chart is presented in Figure 6 The addresses and phone numbers of the project key personnel are presented in Table 1.
Day-to-day field activities will be directed by Radiation Data's project manager who will report to the Project Principal. The Health and Safety officer will interact with the field team members during drilling and sampling activities.
Two types of field teams will be used during the assessment activities:
• Sub-slab mitigation system installation teams
• Sampling Teams

The Radiation Data installation team will be composed of a lead senior professional mitigation specialist as well as installation assistants. This team will be responsible for installation of the mitigation system and site health and safety. It is expected that the Radiation Data Team leader would be Kyle Baicker-McKee or Jim Gibson. However, based upon Radiation Data work load at the time the project is initiated we reserve the right to substitute the team leader with other Radiation Data qualified personnel, which may be available, as long as resumes for such personnel have been previously provided to the EPA.
The Radiation Data Sampling Team will likely consist of Kyle Baicker-McKee. This team will be responsible for obtaining air samples following the completion of the installation, field physical measurements, and preparation of the soil and Quality Assurance/ Quality Control (QA/QC) samples for delivery to the laboratory. It is expected that the Sampling Team leader would also be Kyle Baicker-McKee. However, based upon Radiation Data's work load at the time the project is initiated we reserve the right to substitute the team leader with other qualified personnel, which may be available, as long as resumes for such personnel have been previously provided to the EPA.

2.3 PROJECT PERSONNEL

Mr. Stan Sackowitz, the Project Principal and designated QA/QC manager will have overall responsibility for the performance of the project. Mr. Baicker-McKee, the Radiation Data Project Manager, will be responsible for client communication, day-to-day direction of the project, and on-site activities performed by Radiation Data or any of Radiation Data's subcontractors. Mr. Baicker-McKee will also serve as the overall Project Health and Safety Officer.
Other Radiation Data professionals could be assigned to the project as needed based upon job requirements and personnel availability, as long as resumes for such personnel have been previously provided to the EPA. A list of potential field personnel for the project is also included in Figure 6

All personnel to be involved in this project are in compliance with the OSHA 29 CFR 1910.120 requirements including completion of the 40 hrs OSHA HAZWOPER training, the annual 8 hrs refresher and the supervisor training (as needed/applicable). Radiation Data personnel that will be conducting the work and their certifications and qualifications will be available upon EPA request.

The air samples laboratory analyses for this project will be conducted by EMSL Analytical Inc. located in Cinnaminson, New Jersey. Mrs. Daycia Scotton will be the laboratory quality assurance manager for this project. Mrs. Daycia Scotton will have overall responsibility for the performance of the air samples laboratory analytical work.

2.4 PROJECT SCHEDULE

The following table provides the proposed time schedule for the project:
Submittal of Final Work Plan to EPA: February3, 2015
Approval of Plan by EPA: To be determined

2.4.1 REPORTS TO THE EPA

- Initial Construction Report with photos, specifications and construction drawings to be turned in within 3 weeks of completion of installation
- Quarterly Submissions of sampling data including map, O&M form, and data table to be turned in within 3 weeks of receipt of sampling data from the lab.
- Final Report after 8 quarters of sampling which includes all quarterly reports and the initial construction report to be filed within 3 weeks of completion of work at the site.

The proposed timeline of the project is for the installation of the system to be performed starting February 2015. The confirmatory communication testing will also be performed following the installation. Following the installation of the system, air sampling will be performed once quarterly for the next 8 quarters. The sampling dates will be provided to the EPA in advance, to ensure an EPA representative can be onsite.. The preliminary schedule is as follows:

1st Sampling Event	March30, 31-26, 2015
2nd Sampling Event	June25-26, 2015
3rd Sampling Event	September 24-25, 2015
4th Sampling Event	December 15-16, 2015
5th Sampling Event	March, 2016
6th Sampling Event	June, 2016
7th Sampling Event	September, 2016
8th Sampling Event	December, 2016

2.5 PERSONAL PROTECTION

Information regarding the required levels of protection and personal decontamination procedures is provided in the Health and Safety Plan included in *Section 6.0* of this plan.

2.6 FIELD TECHNICAL GUIDANCE

The primary sources of technical procedures for field activities are:
• The USEPA's "Compendium of Environmental Response Team (ERT) Standard Operating Procedures (SOPs). These SOPs were obtained from the website www.ert.org and some of them are also available through the EPA Region II web site at http://www.epa.gov/region/qa/pdfs/fieldsamp-ertsops.pdf.

• RADIATION DATA SOPs
The technical procedures which will be used for this project are listed in Table *2*. Copies of the procedures to be used will also be available at the Former Biovail site during the field work. This Work Plan also provides technical guidance for specific tasks not included in the EPA documentation, as necessary.

2.7 PROJECT PLANNING SESSIONS

A project planning session will be conducted with all Radiation Data field teams that will be participating in the project. The objective of this session will be to provide each team member with a description of the work to be conducted, the procedures to be implemented in the field, to discuss the lines of communications during the field activities, discuss key decisions or agreements reached, and action items and health and safety considerations. This session will be conducted in person and if needed team personnel that will not be available will be reached by phone or web-conferencing. After project commencement project planning sessions will be conducted, as needed, to make sure that all personnel are familiar with the work to be conducted and the procedures to be implemented. Among other elements the following may be discussed during these meetings:
• Definition of the problem to be addressed by the investigation
• Discussion of the objectives of the investigation
• Discussion of the specific work tasks and the procedures to be implemented. What type of data will be collected and how should it be collected.
• Discussion of the chemical constituents of concern and sampling methods to be used.

• Discussion of the analytical requirements and packaging and shipment procedures

The planning session meetings and the participating personnel will be documented in the project field log book.

3.0VAPOR INTRUSION MITIGATION SYSTEM

3.1 SYSTEM DESIGN

Radiation Data is installing three protective vapor mitigation systems. The mitigation system will consist of 3 sub-slab depressurization systems, similar to those seen most commonly in radon reduction systems (Appendix E).

The design criteria was to depressurize the entire northern portion of the slab, which is the area with the highest concentrations of sub-slab contamination as seen on Figures 5 and 6. Radiation Data has conducted design testing in order to develop a preliminary design of the mitigation system and to determine system details such as the fan and stack location and electrical tie-ins. A system overview can be seen on Figure 7.

Pressure field extension tests (also referred to as communication tests) were performed to assess if sub-slab conditions are conducive to sub-slab depressurization, and if so, to determine the quantity and location of system suction points. Results of the design testing are documented on the Initial Design Visit Checklist provided in Appendix A.

Radiation Data conducted onsite communication testing and found that while the sub-slab material was almost exclusively clay to a depth of 1 foot below ground surface, there is sufficient communication to mitigate any potential vapor intrusion as seen on the Initial Design Visit Checklist. Based on the communication testing, to alleviate the potential for vapor intrusion, the suggested course of action will be to install three independent SDS systems will be installed along the northern portion of the property because the sub slab soil gas, indoor air, soil and groundwater sampling data from the additional site assessment activities conducted by CES strongly suggest that the plume is concentrated in the northern portion of the property. The underlying clay limits the potential for vapor intrusion pathways, and likely confines the risk of vapor intrusion to the northern portion of the property as well, as seen on Figures 5 and 6.

The goal of the system is to create a negative pressure envelope below the contaminated portion of the slab, and Radiation Data will inspect and seal any defects in the slab that would interfere with the operation of the SSD system. However, during the initial site visit, Radiation Data found the slab at the Site has been well maintained as seen on the Initial Design Visit Checklist, and there are minimal expected deficiencies in the slab.

The proposed systems consist of three suction points, each connected to a high suction blower. Radiation Data, on behalf of IPP will install a blower capable of producing 50 inches of Water Column of vacuum, and each capable of moving up to 53 cubic feet per minute. Each blower will be mounted on the exterior of the building to minimize the chances of re-entrainment of soil vapors. The results of the communication testing, as documented on the Initial Design Visit Checklist, were compared to the performance specifications for high suction fans provided by their manufacturers, historical PFE data obtained by Radiation Data at other sites, and guidance provided by the Air and Waste Management association (High Vacuum, High Airflow Blower Testing and Design for Soil Vapor Intrusion Mitigation in Commercial Buildings by T. Hatton

and B. Broadhead), in order to appropriately size the blowers and system piping to achieve sufficient depressurization as seen on Figure 9. The recovered soil vapor from each blower will be discharged through individual vent stacks. The vent stacks will terminate 18 inches above the roof line of the facility.

3.2 SYSTEM INSTALLATION

Each protective vapor mitigation system suction point will be installed with a pressure gage and an audible alarm that will alert the building occupants in the event of a system malfunction. Labels, placed on system components, will provide a telephone number of a Radiation Data contact that the occupant can call for questions and repairs. Slab cracks, holes, and other openings will be sealed, caulked, or covered. Floor drains that are not connected to the municipal sewer will be replaced with Dranjer-type devices that allow water to travel down the drain but do not allow vapors to migrate up the drain. Covers will be installed over the top of all sumps in order to limit potential vapor transport from the sump to indoor air. Building and electrical permits will be obtained, as required, in accordance with local building codes.

3.3 SYSTEM COMMISSIONING

Upon installation, each system will be commissioned to document that it was installed properly, is achieving the design criteria, and is performing in accordance with defined performance specifications, discussed in this subsection. Results of the commissioning will be recorded on the Installation and Operation Commissioning Checklist provided in Appendix B. An as-built drawing will be prepared (modification of the design drawing) for each commissioned system, showing locations of suction points, piping, and fans on a plan view of the depressurized slab, along with results of post-installation communication testing. This will be submitted to EPA in an Initial Construction Report and then in a Final Report once the project is complete.

Each protective vapor mitigation system will be designed and commissioned to achieve a measurable differential pressure of at least 0.004 inches of water (“wc) measured at each of four quadrants of the depressurized slab target area. Pressure field extension testing will be conducted to confirm that depressurization is occurring in four quadrants of the slab target area. This approach, to measure a differential pressure of 0.045“ wc while the building is vacant, is a Site-specific approach to ensuring that the slab remains depressurized under all conditions. Radiation Data’s Vapor Intrusion Guidance suggests that a slab differential pressure of 0.025 to 0.035“ wc would be sufficient to overcome most building’s depressurization but the proposed approach provides for extra depressurization in the event that the building becomes more depressurized during use. The static pressure at each suction point and at the fan inlet will be recorded. These measurements will define the operating performance of each system as it achieves depressurization across the entire slab. Radiation Data will describe and point out the system components to the current property owner. Radiation Data will give the current property ownerthe Mitigation System Instructions to Property Owners presented in Appendix C that instructs them how to check the system and how to request non-routine maintenance if they suspect a problem with the system.

3.4 POST-MITIGATION SYSTEM MONITORING

Radiation Data sampling personnel will conduct post-mitigation indoor air sampling quarterly within the building at locations to be determined by EPA as well as ambient air sampling at the site. The objective of the sampling is to evaluate the indoor air quality after the vapor pathway has been eliminated. Therefore, indoor air sampling will be conducted after the system is installed and commissioned. Post-remediation indoor air samples will be collected approximately one month following system commissioning. Indoor air sampling is not a standalone means to evaluate the effectiveness of a mitigation system, since indoor and outdoor air sources will be included in the results and may bias the sampling results high.
For this reason, a multiple lines of evidence approach will be used to verify the effectiveness of the protective vapor mitigation system. In addition to evaluating the analytical data collected at each indoor air sampling location, Radiation Data will utilize the commissioning testing described in Section 3.3 to demonstrate that the entire portion of the slab overlying contamination is depressurized and, therefore, is capturing all or nearly all of the sub-slab vapors before they can enter the indoor air. Post-mitigation indoor air data will be compared to the EPA's IASLs and the building survey will be reviewed for potential indoor air background sources. This is consistent with the multiple line of evidence approach that should be used when evaluating the possible impact of background sources to indoor air sampling results.
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3.5 SYSTEM MAINTENANCE

Radiation Data will conduct the following activities to support the long-term and effective operation of the protective vapor mitigation systems:

- Routine maintenance,
- Non-routine maintenance,
- Ongoing communication.

Routine maintenance will include regularly scheduled inspections of the protective vapor mitigation system and preventive maintenance. Radiation Data will inspect the systems quarterly for the first 24 months, at the time of air sampling, to verify the system's proper operation. During each inspection, the entire system will be inspected for proper installation (such as system components properly secured) and proper operation (such as system pressures). Results of each inspection will be documented on a Mitigation System Maintenance Field Forms as presented in Appendix D. The static pressure on each system suction point and fan inlet will be measured and recorded. If any static pressure deviates by more than 0.25" wc from its commissioned value, then additional investigations (such as pressure field extension testing) will be conducted to determine the affect of the change in performance. If the system needs to be modified, it will be re-commissioned (that is, depressurization will be re-verified) and documented accordingly. In addition, the floor slab will be inspected and any new significant cracks or other openings that are observed will be sealed with caulk, or other methods as appropriate.
Protective vapor mitigation systems are relatively simple and the only component that requires preventive maintenance is the fan, which typically has a 5-year manufacturer warranty and an expected life of at least 10 years. Radiation Data will monitor the fans and will conduct a fan replacement program as necessary.

The effectiveness of the system will be evaluated by measuring the differential vacuum across the floor slab, particularly focused on the portion of the building overlying the plume. The SSD system blowers will be serviced in accordance with the manufacturer's recommendations. Any additional necessary maintenance to ensure the effectiveness of the system will be performed, and the integrity of the slab will be monitored and maintained. The pressure gauges of the system will be monitored regularly to ensure that the system continues to operate as intended. If any problems with the system are observed, the unit will be inspected and repaired on a timely basis.
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3.6 SYSTEM MONITORING:

Performance and process monitoring will be conducted during SSD system operation to evaluate overall system effectiveness. The specific scope and objectives of the system installation and sampling program are summarized below. Sampling and analysis procedures are described in detail in Section 4.5.1.0. Analytical sampling parameters are summarized on Table 3.

3.6.1 PERFORMANCE MONITORING:

The objective of performance monitoring is to monitor and assess the mitigation performance of the SSD system. Performance monitoring includes:
1. Indoor Air Sampling: Performance monitoring data from the indoor air monitoring will be used to assess the effectiveness of the mitigation system. Monitoring will consist of:
a. Measurement of COC concentrations in the indoor air.
b. Measurement of COC concentrations in the ambient air surrounding the facility, to be used for comparison purposes.
If the indoor air concentrations of COCs are not satisfactory following the initial installation, or any of the sampling events, maintenance and adjustments to the system can be made in an effort to increase pressure field extension, or increase the differential vacuum across the slab.
The first step, should the EPA, Project Manager and QA Officer determine that additional work is needed to further lower the indoor air levels of the COCs, would be to perform communication testing to determine what portions of the slab are being kept depressurized, and to what extent. Following communication testing, the existing systems may be dampened if necessary. Additional steps could include, but are not limited to: further cleaning out of the suction pits, adding additional suction points, sealing any floor penetrations or cracks that may have developed since the initial install, replacing worn or damaged fans, or even the installation of additional systems. Upon completion of any necessary adjustments to the system, an additional round of sampling will be scheduled to confirm the effectiveness of the changes to the depressurization system. This sampling will be scheduled in conjunction with the EPA, and will occur in a timely manner.

3.6.2 PROCESS MONITORING:

The objective of process monitoring is to evaluate the mechanical performance of the system to ensure that equipment is operating as designed, track system operating conditions, and identify potential areas for system optimization. Process monitoring includes:
1. SSD system monitoring: Process monitoring data from the SSD system will be used to evaluate the mechanical performance of the equipment. SSD process monitoring will consist of:
a. Monitoring of system vacuums/pressures
b. During start up, vacuum/pressures will be monitored across the contaminated portions of the slab, to ensure that the entire portion of the slab overlying contamination is depressurized. Additional suction points may be added to the system to ensure depressurization if communication testing reveals insufficient suction.

4.0 SAMPLING EQUIPMENT AND PROCEDURES

This section of the Work Plan presents a detailed description of the field and analytical work to be conducted to assess air, soil and groundwater conditions at the site. Field sampling activities will be conducted following applicable Radiation Data and EPA ERT Standard Operation Procedures (SOPs).
Procedures and protocols applicable to the sampling activities include:
• Indoor air sampling will be conducted following the procedures of the United States Environmental Protection Agency (USEPA) Office of Solid Waste and Emergency Response (OSWER) *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Subsurface Vapor Intrusion Guidance), dated November 2002, for sampling methodology.
• QA/QC samples (non-disposable equipment decontamination blanks and duplicates) will be collected and analyzed for the same parameters as the samples being analyzed. Field and trip blanks will only be analyzed for the volatile fraction of the media being analyzed.
• Samples identification and Chain of Custody procedures will be conducted in accordance with Radiation Data policies, complemented by EPA Region 4 SOP.
• Samples preservation will be conducted following Radiation Data SOPs
• Samples packaging and shipping will be conducted following Radiation Data SOPs

4.1 SAMPLING APPROACH AND RATIONALE

The sampling rationale for this project has been developed to basically address the recommendations included by the EPA The rationale for each sampling activity is presented next:
• Indoor air sampling is proposed inside the Former Biovail Building to assess VOCs concentrations at the building inside, and the effectiveness of the vapor intrusion mitigation system. Indoor air quality will be monitored by conducting quarterly air sampling at

representative locations throughout the building. The quarterly monitoring will occur at sampling locations selected by the EPA.

4.2 INDOOR AIR SAMPLING ACTIVITIES

Radiation Data will collect at least six indoor air samples from different areas within the Former Biovail building.
The approximate location of the proposed indoor air samples is shown in Figure 4**.** The indoor air samples will be collected in locations approved by EPA .
In addition, at least one ambient air sample outside the building will be collected to assess outside
air concentrations, and assess the potential impact of background contamination.
We note that the exact locations will be determined in the field with EPA's representative concurrence and based upon site access and facility equipment location. Detailed sampling procedures are described in *Section 4.5.1***.** of this plan.

4.3 LABORATORY ANALYSES

As indicated in *Section 1.4* the air samples collected during this investigation will be analyzed for VOCs including the following chlorinated VOCs:

- Trichloroethene
- Tetrachloroethene
- Cis-1,2-Dichloroethene
- Vinyl Chloride

The following are the corresponding laboratories and laboratory analyses methods to be used:

Laboratory	**Matrix**	**Parameters**	**Lab analysis Method**
EMSL Analytical Inc. (EMSL)	Air samples	VOCs	TO-15

Contract Laboratory Program (CLP) protocols, as applicable, will be followed by EMSL for VOCs analyses. EMSL will produce Level IV data packages for the air samples laboratory analyses.
A complete description of the CCOCs, type of samples, required sampling containers and preservatives is presented in *Section 5.0* of this plan.
The laboratory will provide clean containers for placing the air samples.
Sample containers for the air samples (Summa(R) Canisters) will be depressurized by the laboratory.
Containers with the corresponding preservative, if needed, will also be provided by the laboratories.
Laboratory reports will not be required to be reviewed and certified by a chemist licensed in Puerto Rico.

4.4 REPORT PREPARATION

A report will be prepared documenting sampling activities conducted and laboratory results obtained. The report will include a summary of the field activities, laboratory reports, conclusions, and recommendations, if necessary. Two copies of the report will be provided to EPA.

4.5 AIR ASSESSMENT

4.5.1. INDOOR AIR SAMPLING PROCEDURES

The indoor air sampling methods and protocols to be followed by Radiation Data personnel during the assessment activities are described in the following sections:
Sampling Equipment:
The following is a list of sampling equipment that will be used during indoor air sampling activities:

- Laboratory-supplied Summa canisters for collection of ambient air samples targeted for laboratory analyses;
- Laboratory-supplied flow restrictors for collection of an eight-hour indoor air sample;
- Stool, table, and/or other item for placement of Summa canisters three to five feet above the floor;
- Lock and chain or other items as needed to secure Summa canister collecting ambient air;
- Laboratory supplied sample shipping containers (e.g., cardboard boxes); and,
- One 9/16-inch wrench for removal of brass caps on Summa canisters.

Indoor Air Sampling Procedures:
The associated canisters will be appropriately depressurized and cleaned prior to use. As part of the sampling procedures for indoor air sampling, the Summa canisters will be placed in the "breathing zone" three to five feet above the floor in the sampling areas shown on Figure 4**.** If preferential pathways are noted in the interior, including but not limited to, major cracks in the concrete floor, sumps, and conduit wire entrance points, sample locations may be relocated to those areas pending accessibility. The final location of the sampling points will be determined in the field in concurrence with the EPA representative.
The flow restrictors will be attached to the canisters, and the intake valve will be opened to begin the collection of ambient air. The canisters will be left in place to collect ambient air for eight hours.
During sample collection, Radiation Data will periodically document the vacuum gauge readings on the Summa canisters. After eight hours, Radiation Data will close the intake valves and ship the canisters to EMSL for analysis. The canister contents will be analyzed for VOCs via USEPA Method TO-15.
In addition to the indoor air samples, one sample of ambient (outdoor) air will be collected to aid in identification of ambient air emission sources of contaminants. The sampling procedure for the collection of the ambient air sample will be similar to the collection of the indoor air samples.

In addition, the Summa canisters may be secured via a chain and padlock or other means during sampling. One duplicate indoor air sample will also be collected for every round of confirmatory samples collected.

Sample containers will be provided by EMSL. Preservation techniques and holding times for constituents of concern will be maintained as outlined in EPA Compendium Method TO-15, titled *Compendium of Methods for the Determination of Toxic Organics Compounds in Ambient Air – Determination of VOCs in Air Collected in Specially- Prepared Canisters and Analyzed by GC/MS*. Samples containers will be kept at room temperature and out of direct sunlight.

Sample labels will be affixed to each sample container. The following information will be included on the sample label:

- Sample identification • Preservative (if any)
- Radiation Data project name and number
- Requested analyses
- Sample date and time
- Samplers initials

The Summa canisters will be packed in cardboard boxes and will be transported via overnight courier to the laboratory. Chain-of-custody documentation outlined as follows will accompany each shipment of samples to the laboratory.

Formal chain-of-custody begins when the pre-cleaned sample containers arrive to the sampler in a cardboard box or cooler from the laboratory. At the time of sample collection, the labeled samples will be placed into a cardboard box and a line item chain-of-custody form will be completed by the sampler.

Chain-of-custody allows the samples to be traced from the time of collection to receipt in the laboratory. Upon completion of all line items, the sampler will sign, date, list the time, and confirm the completeness of all descriptive information contained on the form. One copy of the completed chain-of-custody will then be retained by the sampler, with the others being returned with the samples. A final copy of the chain-of-custody indicating receipt by the laboratory will be returned with the laboratory analytical data reports. Each individual who subsequently assumed responsibility for the samples will sign the chain-of-custody record. The following items are included on the chain-of-custody:

- Sample identification • Analytical parameters requested
- Date and time of sample collection
- Preservative (if any)
- Sample type (i.e., liquid/solid/soil/etc.)
- Dates/time of relinquishment and receipt
- Sample location
- Signature of all in possession of samples
- Number, size and type of containers

Radiation Data field personnel will document the field activities (with corresponding times) and pertinent information in a dedicated project field logbook. Information recorded will include names and companies of on-site personnel (Radiation Data, client, subcontractors, etc); weather conditions; purpose of activities; and, details of fieldwork (e.g., sampling locations, etc.). Field book(s) and notes will be kept on-file in Radiation Data's project files.

5.0 QUALITY CONTROL PLAN

5.1 INTRODUCTION

This project consists of the installation of a vapor intrusion mitigation system and sampling of air at the Former Biovail facility in Carolina, Puerto Rico. The work is being performed as a result of the presence of CCOCs, likely as a result of vapor intrusion at the assessed areas. This activity is being conducted as agreed with the Environmental Protection Agency (EPA) in the Administrative Settlement Agreement and Order on Consent, or AOC (Index Number CERCLA-02-2014-2021). Project activities will employ sound scientific, engineering, and construction practices and will be consistent with applicable federal, local, and state Law. The remediation activities will be conductedin general accordance with U.S. EPA Region II requirements and standard operating procedures.

The Quality Control Plan (QCP) presented herein describes the procedures that will be used at the site. This plan describes policy, organization, functional activities, data quality objectives and measures necessary to achieve adequate data for use in site evaluation and hazard evaluation activities, including the effectiveness of the remediation proposed in this Work Plan. The overall scope of the assessment and field activities specific to the site are described in Section 3.0 of this plan. A Health and Safety Plan (HASP) for the assessment is provided in Section6.0. The Project Manager and/or the Project Principal will insure that each individual involved in the project understand his/her respective responsibilities.

5.2 DATA QUALITY OBJECTIVES PROCESS

The Data Quality Objectives (DQOs) process for this project has been developed following EPA's guidance as described in the EPA GA/G-4 Guidance for the Data Quality Objective Process (EPA,2000). The DQOs process is designed to specify the assessment objectives, to define the appropriate type of data and the tolerable levels of potential errors, in order to establish a basis for the quality and quantity of data needed to supports decisions. The objectives of the samples to be obtained for this project are listed in Table 4.
The main elements of the systematic planning process for this project include:
• ***Problem Definition and Decision Identification*** – ***Sections 1.0 and 2.0*** of this Work Plan presents a detailed discussion of the site conditions that need to be addressed and presents a brief summary of the strategy developed to address site conditions.
• ***Identification of Project Inputs***: ***Section 4.0***presents a detailed discussion of the data needed to address the identified site conditions. Also it describes the way the data are going to be obtained and describes in detail the sampling methods to be implemented. This section of the plan presents a detailed description of the analytical methods to be used by the laboratory.
• ***Definition of Study Boundary***: ***Section 4.0*** of the plan describes in detail the boundaries of the study. The study boundaries were determined based upon the EPA's previous investigations.
• ***Decision Rule:*** The objective of this activity is to prevent vapor intrusion at the Former Biovail facility. To assess the significance of the air quality data, the laboratory results will be compared to threshold values found in the following criteria:
•Parameters Comparison Criteria
Air samples EPA Regional Screening Levels (RSL) Tables dated

November 2014 (Industrial Air)

A summary of the comparison criteria for some of the CCOC is presented in the following table:

Constituent of Concern (COC)	Comparison Criteria RSL (Industrial Air) (ub/m^3)
Trichloroethene	**3.0**
Tetrachlororethene	**47.2**
Cis-1,2-Dichloroethene	**NA**
Vinyl Chloride	**2.8**
1,1-Dichloroethene	**880**
Acetone	**140,000**
Trans-1,2-Dichloroethene	**260**
1,1-Dichloroethane	**7.7**
Chlorobenzene	**220**
1,2-Dichlorobenzene (o-dichorobenzene)	**880**
Benzene	**1.6**

The comparison criteria included in this section will be used to assess the significant of the data collected and to determine whether further site remedial actions may be necessary.

• ***Specify Tolerable Limits:*** This section of the plan describes the control limits for the laboratory analyses and the field measurements.

• ***Data Design Optimization***: The information included in this work plan represents a well thought out process, which has been discussed with the EPA Region II, to obtain data of sufficient quality and quantity to meet the objectives of the investigation. This Work Plan documents the agreements made by the Former Biovail and the EPA under the AOC.

5.3 SAMPLING AND ANALYSES

The following sections describe the sampling and analytical programs to be performed.

5.3.1 SAMPLE NETWORK AND RATIONALE

Air will be sampled to determine the effectiveness of the vapor intrusion mitigation system at preventing entry of CCOCs. The CCOCs identified are listed in ***Section 1.4***. They include VOCs including chlorinated VOCs. The sample network design and rationale for sampling locations is described in detail in ***Section 3.0*** of this plan.

5.3.2 ANALYTICAL PROGRAM FOR LABORATORY ANALYSIS OF FIELD SAMPLES

The air samples laboratory analysis will be conducted using method TO-15 for analysis of VOCs. Level IV data packages will be delivered for the air samples data.

The analytical methods and the laboratory reporting Limits for the CCOC identified for the Site are presented in Table 5. Quality control samples will be collected at the frequency specified in ***Section 5.15.2*** of this document in accordance with USEPA guidelines. Sample matrices, analytical parameters and frequencies of sample collection are presented in Table 5.

Field analytical procedures will include air monitoring using a PID in the work areas for health and safety purposes.

5.4 QUALITY CONTROL PROJECT ORGANIZATION AND RESPONSIBILITY

5.4.1 PROJECT ORGANIZATION AND QA STRUCTURE

As previously indicated the project organization chart is presented in Figure 6 In addition to the responsibilities described in this plan, the key project personnel will also have responsibility for the quality control aspects of the project as described in the following sections.

5.4.1.1 PROJECT PRINCIPAL/ PROJECT QA/QC MANAGER

Mr. Stan Sackowitz, the QA Officer will have the following QA/QC responsibilities:
• Provide review of this work plan, the quality assurance procedures and other project documents and plans.
• Review of final data.
• Manage Performance and System Audits conducted during the course of the assessment activities, if any.
Mr. Stan Sackowitz will have overall project responsibility, and Mr. Baicker-McKee will have direct responsibility for the management of the staff who will be involved in this project.
As the QA/QC Manager Stan Sackowitz will also be responsible for:
• Implementation of the QCP.
• Management of inter-laboratory and intra-laboratory testing (if any).
• Establishment of statistical analysis and data validation procedures to ensure accuracy of raw data, calculations, and results and to identify data discrepancies and uncertainties.
• Technical review of all reports and products.
• Communication with the property owner representatives.

5.4.1.2 PROJECT MANAGER

The Project Manager for this project, Mr. Stan Sackowitz, will be responsible for all field, analytical, subcontracting, and health and safety activities for the project. These activities include:
• Preparation for field activities.
• Coordination of subcontractor activities.
• Implementation of field activities as specified in this Work Plan.
• Review and evaluation of field QC records.
• Review QC needs with Project Principal, Analytical Laboratory QA Officer, and the Project QA/QC Manager.
• Preparation of technical reports.

5.4.1.3 ANALYTICAL LABORATORY QA MANAGER AND PROJECT MANAGER

The laboratory QA process begins with the chemist performing the analysis. The laboratory uses a tiered review process where the analyst provides for primary review of the data, a second analyst provides for secondary review of the data, as well as the final reporting /QC forms. The assigned Laboratory Project Manager performs a final review while writing the final case narrative. The calculated results from the quality control samples analyzed during the analysis are to be recorded on the appropriate QC summary forms. These forms, along with the raw data,

are then reviewed and the data is verified by a designated person within each analytical group. The verified data, including all routine laboratory QC results, are incorporated into the laboratory project report and the Laboratory Project Manager ensures that those QC results designated for this project are included in the laboratory project report. Possible deviation or data discrepancies are to be reported by the Laboratory(ies) to the QA Officer and to the Project Manager. If corrective action is required, the appropriate steps will be taken as described in the Corrective Action Section of this plan. The lab will provide appropriate analytical reports for all analyses performed in accordance with EPA established requirements.

5.4.1.4 RADIATION DATA'S ROLE

Kyle Baicker-McKee of Radiation Data will operate as the QA Manager for the project. Jim Gibson will be the field team leader for the installation of the systems, and Kyle Baicker-McKee will likely be the sampling team leader for Radiation Data.

5.4.2 DATA VALIDATION, VERIFICATION AND

Data Validation
A level-IV data assessment will be performed on all analytical data. The data quality objectives (DQOs) specified in the work plan will be used as criteria for determining the usability of the data.
The sampling events data will be assessed using the assessment criteria set forth in the following USEPA documents as they apply to the analyses performed. Data assessments will be performed using the USEPA *National Functional Guidelines.*

- USEPA 2008, Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA 540/R-08/01
- USEPA 2010 Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540-R-10-001

Data will be accepted if they meet the following criteria:

- Field data sheets are complete.
- Field data and laboratory data were validated.
- Actual sample locations and collection procedures match the proposed sample locations and collection procedures.
- Sample handling procedures documented on chain-of-custody forms, the field activity report, and case narrative match the proposed sample handling procedures required by the method (e.g., water samples were acid preserved, holding time of six months not exceeded for metals analysis).
- Field and laboratory QC were conducted as planned and meets the acceptance criteria established in the methods.

Based upon the review of the analytical data, an analysis quality assurance report will be prepared which will state in a technical, yet "user friendly" fashion the qualitative and quantitative reliability of the analytical data. The report will consist of a general introduction section, followed by qualifying statements that should be taken into consideration for the analytical results to best be utilized. Based upon the quality assurance review, qualifier codes

will be placed next to specific sample results on the sample data tables. These qualifier codes will serve as an indication of the qualitative and quantitative reliability of the data.
During the course of the data review, an analysis support documentation package will be prepared which will provide the backup information that will accompany all qualifying statements presented in the quality assurance review.
Once the review has been completed, the Quality Assurance Officer will verify the accuracy of the review and will then submit these data to the Field Team Leader and Project Leader. These approved data tables and quality assurance reviews will be signed and dated by the Quality Assurance Officer. All validated data and laboratory certificates of analysis can be provided for USEPA review, if requested.

Verification and Validation Methods

Prior to release of the data from the laboratory, the lab QA Officer and Analytical Project Manager will be responsible for assuring that the data met all QC requirements associated with the method and the QAPP. Any deviations will be detailed in a Case Narrative with each analytical report that not only list the problems encountered, but the overall effect on data quality. The National Functional Guidelines for data review listed in the previous section form the basis for data validation. Specific items reviewed during the data validation are given in the following Table.

Items Reviewed During the Data Validation

Area Examined

Field and Laboratory Chains of Custody (Traffic Reports, Field Notes, etc)
Holding Times
Extraction/Digestion Logs
Blanks – field and laboratory (accuracy)
Instrument Tune
Standards
Linearity
Sensitivity/Stability
Selectivity/Specificity
USEPA Criteria (SPCC & LCS)
Variability of Technique (internal standards)
Analyte Breakdown
Analytical Sequence
Control Standards
Samples
Detection Limits
Instrument Printouts
GC/MS data
ICP data
GC data
Qualitative Identification
Mass spectra
Tentatively identified compounds
Retention Time Windows
Quantitative Reliability
Calculations/Equations
Matrix spikes and Post Digestion spikes (accuracy)

Bias
Matrix spike duplicates
Bias
Accuracy & Precision
Surrogate Spikes
Bias
Duplicates (field and laboratory)
Precision
Representativeness

Reconciliation with User Requirements

At the conclusion of the data validation and after a review of any field and laboratory audits, as well as the usability report, the Quality Assurance Officer will make an overall conclusion as to whether the project met the requirements for precision, accuracy, representativeness, and completeness.

5.5 QA OBJECTIVES FOR MEASUREMENTS DATA

5.5.1 MANAGEMENT OBJECTIVES

The Management Objectives for this QCP are to establish the systematic procedures which will be used:

• To monitor the quality of data generated by the study to verify that the goals of the remedial action are met.

• To review the validity and integrity of the data and results of the assessment activities, laboratory analyses, and technical reports.

• To control the quality of work performed by subcontractors and support services so that they maintain the same performance quality standards as those defined by this Quality Control Plan.

Field activities will be performed in accordance with EPA's recommended sampling protocols which are used by EPA and industry on a nationwide basis. These sampling protocols provide samples which are collected in a uniform manner throughout the project and assure that samples have similar integrity. Samples will be preserved following U.S. EPA protocols as described in Table 2. In most cases, samples will be shipped to the laboratory(ies) the same day they are collected. In situations where same-day shipment is not possible, samples will be preserved on ice and shipped within the following two days. Access to the samples will be controlled following chain-of-custody procedures. We note that air samples are not required to be cooled. They will be stored at room temperature and out of direct sun light until they are shipped to the laboratory.

The assessment activities for this project include air, soil and groundwater sampling. Review of the assessment results, and the sample collection and QA/QC documentation will be performed to confirm that the results are representative and that the data quality objectives set forth in this document were achieved.

5.5.2 QUALITY ASSURANCE OBJECTIVES FOR ANALYTICAL MEASUREMENTS

Radiation Data will perform the sampling activities to meet the overall project objectives. The QA objectives will establish the guidelines which define the quality of the environmental measurements required to meet the objectives of this Work Plan and the DQOs for the project. The specific analytical procedures are discussed earlier in this plan. This section expands on the DQOs by establishing objectives for precision, accuracy, completeness, representativeness, and comparability.

QA objectives for precision, accuracy, and completeness for each major measurement parameter have been established for this project and are detailed in the following sections. Measurements are to be representative of the materials tested. Calculations will be done as necessary and reported in units consistent with similar data measurements from the site for comparison purposes. Definitions for precision, accuracy, completeness, representativeness and comparability are as follow:

• ***Precision*** is a measure of mutual agreement among replicate measures. Precision is expressed in terms of not only the standard deviation but also in relative percent difference.

Sampling precision is assessed by the analysis of field duplicates whereas laboratory precision is assessed through the collection of matrix spike/matrix spike duplicate samples.

• ***Analytical accuracy*** is expressed as percent recovery (%R) of an analyte which has been added to the environmental sample at a known concentration before analysis. Sample accuracy is assessed by collecting field quality control samples which include a trip blank and/or rinsate blank.

• ***Completeness*** is expressed as a percentage of the number of valid measurements that was planned to be collected. For data to be considered valid, it must meet all the acceptance criteria, including accuracy and precision, as well as any other criteria specified by the analytical method used.

• ***Comparability*** expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QCP, are expected to provide comparable data.

• ***Representativeness*** is assessed by collecting field replicate samples. By definition, the field replicates are equally representative of a given point in space and time. The sampling network was designed to provide data representative of site conditions. Representativeness will be achieved by insuring that the work procedures are followed, proper sampling techniques are used, proper analytical procedures are followed and holding times of the samples are not exceeded.

Representativeness will be assessed by evaluating project accuracy, precision, comparability and completeness of the data.

5.5.3 SUMMARY OF MEASUREMENT PERFORMANCE CRITERIA

A summary of the quantitative measurement performance criteria, for each matrix to be analyzed, in terms of precision, bias, and sensitivity for the laboratory measurements is presented in Table 8.

5.5.4 DATA QUALITY OBJECTIVES FOR FIELD MEASUREMENTS

The accuracy of field measurements of volatile organic compounds will be assessed through pre-measurement validation and post-measurement verifications in the field. To be considered calibrated, each measurement will be within + 10% of the calibration concentrations. Precision will be assessed through replicate measurements. The standard deviation of three replicate measurements must be less than or equal to 0.1 standard unit. The calibration and verification will be done in the field before initiating the field work. The instrument will be capable of providing measurements of 0.1 ppm.

5.6 SAMPLING PROCEDURES

The proposed sampling activities will be performed in order to collect the data required to meet the project goals. This Work Plan addresses:

- Field Activities
- Sampling objectives
- Sample location and frequency
- Sampling procedures as found in Appendix F.

5.7 SAMPLE CUSTODY PROCEDURES

5.7.1 SAMPLE CONTAINER PREPARATION

The chain-of-custody program, designed to prevent inadvertent contamination, misidentification, and tampering, begins with carefully monitored sample container cleaning procedures conducted in accordance with EPA protocols.

Glassware or sampling containers meeting EPA requirements is purchased by the laboratory from suppliers who provide certificates of compliance with these requirements. Upon completion of any additional required cleaning by the laboratory, sample containers will be sealed and placed in storage or shipping cases. These cases will be sealed and labeled to indicate the type and date of cleaning. Cleaning of the sample containers by the laboratory will be conducted using the EPA procedure as set forth in the Office of Solid Waste, Emergency Response Directive 9240.0-05A.

The laboratory will provide all the necessary sample containers to meet the sampling requirements of the study. The cleanliness of a batch of containers is to be verified by the laboratory prior to use. The laboratory will supply the necessary preservation solutions and detailed instructions as to how to use them, and ship these with the sample containers. Table 7 lists the sample containers, preservation methods, and holding times applicable to the project. A call by the Radiation Data Project Manager will be made to confirm receipt of all samples into the laboratory.

5.7.2.3 CHAIN OF CUSTODY

Sample custody will be initiated at the time of sample collection by placing the labeled samples into cardboard boxes for shipping. The same boxes are used to ship from the laboratory and back

to the laboratory. The chain of custody form as provided by the analytical laboratory may be used. All items on the field chain-of-custody record will be filled out. The completed form will be signed by the sampling technician. The field chain-of-custody record is used to track custody of samples during transport and shipping. Upon completion of all line items, or upon sample pick-up, the sampling technician will sign, date, and list the time and will confirm the completeness of all descriptive information contained on the form. The chain-of-custody form will accompany the samples. Each individual who subsequently assumes responsibility for the samples will sign the chain-of-custody record. The field chain-of-custody record terminates upon laboratory receipt of samples. All entries will be recorded in ink.
The chain-of-custody record for a given sample is to be started before sampling is initiated by the sampling team. In cases where the samples leave the immediate control of the sampling team (e.g., shipment via a common carrier) the shipping container must be sealed with custody tape. Each sample must have a corresponding entry on a chain-of-custody record. The following information will be recorded:

- Site name
- The unique sample I.D. name or number
- Sample type
- Date and time of the collection
- Number of containers
- Parameters for which analyses are requested
- Signature of sampler(s)
- Signature of persons involved in the chain of custody and inclusive dates and times of possession

A sample or other physical evidence is in custody if:

- It is in the field investigator's or the transferee's actual possession.
- It is in the field investigator's or the transferee's view, after being in his/her physical possession.
- It was in the field investigator's or the transferee's physical possession and then he/she secured it to prevent tampering.
- It is placed in a designated secured area.

5.8 SAMPLE DESIGNATION

Each sample collected during the project will be assigned a unique designation code number. The sample designations will consist of a sample matrix code and sample location code.

5.8.1 SAMPLE MATRIX CODE

Each sample will be identified by an alpha code corresponding to the sample matrix. The alpha code designations are:
IA - Indoor Air
AA- Ambient Air

5.8.2 SAMPLE LABLES

Sample labels will be placed on each sample container. At a minimum the following information will be placed in the labels:
• The unique sample I.D. name or
• Sample type
• Date and time of the collection
• Sampler name initials
• Analysis to be performed

5.9 SAMPLE PACKAGING AND SHIPPING

Samples will be packaged and shipped in according to EPA, Department of Transportation (DOT) and International Air Transport Association (IATA) procedures. The Laboratory(ies) will be contacted the day of each shipment of samples and provided with the following information:
• Sample shipping date
• Sample types
• Number of samples
• Air-bill and sample shipper numbers

5.10 LABORATORY SAMPLE CUSTODY PROCEDURES

From the moment a sample is collected until the final assessment is complete, custody of the sample will be controlled. Custody is routinely maintained on all samples collected by Radiation Data and received by the laboratory. Sample custody will be maintained in the laboratory by assuring that one of the following conditions exists:
• It is in the actual possession of an authorized laboratory staff member.
• It is in the view of any authorized laboratory staff member.
• It is placed in a secure location, after being in the possession of an authorized laboratory staff member.
• The sample is kept in a secured area which is restricted to authorized laboratory staff members.
A designated sample custodian will be responsible for samples received at the laboratory. The sample custodian will be aware of custody requirements and potential hazards. In addition to receiving samples, the sample custodian is responsible for documentation of sample receipt, storage before and after sample analysis, and the proper disposal of samples. An assistant sample custodian is assigned to assist the sample custodian and perform all duties in the event the sample custodian is absent.
Samples will be inspected upon receipt at the laboratory. Any breakage or other damage will be documented and brought to the attention of the Project Manager. Documentation related to the samples will be filled out, signed, and dated by the sample custodian. Field chain-of-custody forms sent with samples will be signed by the sample custodian and a copy will be provided to the Project Manager. Samples will be identified by labels attached to the sample bottle. Sample information on the field chain-of-custody record will then be verified against the sample bottle information by the sample custodian to ensure the accuracy and completeness of documentation.

Sample information will be logged into the laboratory automated sample management system including:

- Unique laboratory number
- Field sample number
- Project/batch number (assigned by laboratory project manager)
- Sample matrix
- Parameter(s) of interest
- Sample receipt date/time
- Sampling site or organization
- Sample/batch comments

Laboratory and batch numbers will be assigned by the sample custodian in numerical sequence. This information will also be logged into a permanent logbook as a backup to the automated system.

Samples will then be placed in designated storage areas prior to analysis.

The laboratory contains secured areas with restricted access. Locks are present on all entrance ways to protect the security of laboratory areas as well as the security of samples stored. The sample custodian places the samples in assigned storage areas prior to analysis.

After completion of sample analyses and the shipment of the batch data report, the samples will be boxed and removed to the laboratory storage area. Here the samples will be stored at appropriate temperatures for one month before being discarded. Provisions for longer storage periods can be made when required by specific programs.

5.11 FINAL EVIDENCE FILE

A centralized project file will be maintained by Radiation Dataof data and records. This file will include original data, field chain-of-custody records, correspondence between the client, Radiation Data and the laboratory, reports issued for the project, maps and drawings, calculations, and quality assurance data and any other data or documentation pertaining to the project. The Radiation Data Project Manager and/or Principal will be responsible for maintaining the project file. The project file will be maintained for a period of *five years* after the completion of the remedial activity. At any event, Radiation Data will offer to IPP the complete file prior to its disposal.

5.12 CALIBRATION PROCEDURES

5.12.1 LABORATORY CALIBRATION STANDARDS

Commercial sources of standards and reagents will be checked for purity, and approved, prior to their use in analysis. Standards prepared for use throughout the laboratory will be assigned a code number. The standard code number will be entered in a bound standard notebook with information regarding the preparation of that standard (i.e., date, technician, name of each compound and amount used, final volume, and solvent used). Standard containers will be labeled with the standard's identification, lot number, code, manufacturer, and date.

The instrument response obtained for each compound in a newly prepared standard will be compared to the response obtained from the previous standard. The two standards will agree

within 15% (for all but a few compounds recognized as chromatographically atypical) or the new standard will not be used until the discrepancy has been resolved.

5.12.2 LABORATORY INSTRUMENT CALIBRATION

Laboratory instruments will be calibrated before being put into service and re-calibrated at regular specified intervals consistent with the manufacturer's recommendations. Instrument response is subjected to checks between the regular re-calibrations. The laboratory maintains adequate records of calibrations, re-calibrations, and in-service checks of instruments. The schedule of checks depends on the experience of the laboratory's maintenance needs. All calibrations will be traceable to primary standards of measurement. Where the concept of traceability of measurements to primary standards is not applicable, the laboratory will provide satisfactory evidence of correlation or accuracy of test results.
The analysts, laboratory supervisor, and the laboratory's QA Manager will periodically inspect calibration data for completeness and validity. Forms will be checked for arithmetic and procedural errors. Recurring errors caused either by individual operators or by ambiguously worded instructions, will be brought to the attention of the department senior laboratory staff or laboratory management for corrective action.

5.12.2.1 GC/MS AND GC CALIBRATION

At the beginning of each 12-hour shift, each GC/MS will be tuned using decafluorotriphenyphosphine (DFTPP). The mass spectra obtained from DFTPP will meet the key ion and ion abundance criteria described by the CLP protocols. The GC/MC is tuned when it has met these criteria.
Calibration curves for Gas Chromatography (GC) and Gas Chromatography/Mass Spectrometry (GC/MS) analysis will be generated as outlined in the analytical protocols. After the initial calibration curve has been established, the calibration will be verified each shift by injecting at least one standard solution. If significant drift has occurred, a new calibration curve will be constructed.
The drift is defined in the analytical protocol.

5.12.3 FIELD ANALYSIS EQUIPMENT CALIBRATION

Volatile organics will be determined with a calibrated Photoionization Detector (PID, Brand Mini RAE 2000, Model PGM-7600) provided with a 10.6 eV lamp or similar device. The PID will be calibrated at the beginning of each day of sampling using standard gas vials with 100 ppm concentrations. The meter reading produced by the standard gas will be between 90 and 110% of the reported concentration of the standard gas.

5.13 ANALYTICAL PROCEDURES

5.13.1 LABORATORY PROGRAM PROCEDURES

The environmental samples collected for the analysis of chemical constituents of concern at the facility will be analyzed following the CLP protocols for the identified VOC chemical constituents.
The air samples will be analyzed by the methods listed in Table 5.
Data obtained from analysis of the samples will be released only after each sample batch has been reviewed to verify that the sample results meet the established criteria for the specific analyses.
The laboratory anticipates meeting the accepted precision and accuracy criteria specified in the Level IV data protocols, as applicable. If a significant number of samples, greater than 5% of the total number of samples collected for the matrix type, do not meet QA/QC requirements, the Project Manager, the analytical laboratory and the CES QA/QC Manager will discuss possible corrective actions necessary to insure that subsequent analytical results meet the Data-Quality Objectives.

5.14 DATA REDUCTION, VALIDATION AND REPORTING

The laboratory's general procedures for analytical data validation are based on results of internal quality control procedures discussed in detail in Section 5.15.
The laboratory will report compounds tentatively identified by GC/MS in addition to the CCOCs. Each tentatively identified compound (TIC) will have a peak height or peak area at least 10% as great as the closest internal standard. The laboratory will supply mass spectra of both the tentatively identified compounds and the NBS library standards.
No data, other than the PID VOCs will be obtained in the field. These data will be verified in the field by the Project Manager as it is obtained. The data generated during the sample collection and analysis will be centralized into one project file. The project file will include instrumental data which are organized by a table of contents, as well as the sample injection sheets. The injection sheets will also contain information about the instrument conditions.
The laboratory will maintain custody of its notebooks and instrument logs and will maintain them at their facilities. Records of samples maintained by the laboratory include:
• Sample receiving logbook - to log the samples when they are received and assigned a batch number.
• Instrument logbook - to record the preparation and use of standards in the laboratory.
• QC logbook - to record day-to-day QC data obtained from the analysis of a batch. Quality control summary sheets are used as a convenient method to file batch QC information by parameter.
• Chemist's notebook - to record the raw data and final data for every batch.
• Quality control charts - to track performance on individual analyses and instruments and to give early indication of analyses that may be going out of control.
At every stage of data processing at which a permanent collection of data will be stored established procedures will be used to protect data integrity and security. Data transcriptions at the laboratory for analytical reports will be subjected to a final technical review. Data

transcription requirements will be monitored in accordance with the CLP protocols for accuracy and legibility.
Any issues associated with data verification, incomplete records, data non-compliance or data review corrective actions will be communicated to the Project Principal by the data validator. However, the data validator will address the encountered issue directly with project personnel that conducted the investigation or the laboratory, as appropriate.

5.15 INTERNAL QUALITY CONTROL CHECKS

5.15.1 PRINCIPAL REVIEW OF REPORTS, PLANS AND SPECIFICATIONS

Radiation Data requires that all work performed by Company personnel be reviewed by persons qualified in the necessary field of science or engineering. Any documents transmitted which have not been reviewed according to this policy will be labeled "Preliminary Submittal Subject to Final Review."

5.15.2 LABORATORY ACTIVITIES

The following laboratory control samples will be conducted on Former Biovail samples, at a rate of one per batch of samples for each matrix type and concentration level or one per 20 samples, whichever is more frequent (control limits and corrective actions are specified in the CLP protocols):
• Duplicate sample - to check laboratory analytical and sampling precision.
• Laboratory or method blank - to check for potential laboratory contamination.
Alternatively, the laboratory will provide for matrix spike analysis for samples where it is requested and sufficient sample is provided.
In addition, for this project the following QC samples from the field will be submitted for analysis:
• Blind duplicates - Two samples from a single source will be prepared, labeled with unique sample numbers, and submitted to the laboratory without cross- referencing data and without sample source identification as duplicates on the parameter request sheet. One blind duplicate will be collected for every 20 environmental samples collected for each medium being sampled, or once per round of sampling, whichever is more frequent.
• Trip Blanks - Trip blanks will be prepared at the laboratory and sent with each sample shipment with applicable sample types. The trip blank samples will not be opened at the field. One trip blank will be sent to the laboratory for analysis with each sample shipment.
The results of analyses of these QC samples are used as independent, external checks on laboratory and field contamination and the precision of analyses.

5.16 PERFORMANCE AND SYSTEM AUDITS

The Laboratory(ies) are routinely subject to independent audits of their processes and equipment by government and commercial organizations. For purposes of the following section, the term audit is defined as the systematic checks employed to determine the level of quality inherent in the operation of laboratory activities.
Typically, the project systematic checks are comprised of the following:

• Field Performance Evaluations
• Laboratory Performance Audits
• System audits

5.16.1 FIELD PERFORMANCE EVALUATIONS

Field performance evaluations will be performed on an ongoing basis during the project as field data are generated, reduced, and analyzed. The field performance evaluations will be conducted by the Project Quality Assurance Manager and/or the Project Manager. All numerical analyses, including manual calculations, will be documented. All records of numerical analyses will be legible, of reproduction-quality, and supporting data will be complete to permit logical reconstruction by a qualified individual other than the originator.
Other indicators of the level of field performance are the analytical results of the blank, duplicate and replicate samples. Each blank analysis is an indirect audit of effectiveness of measures taken in the field to ensure sample integrity (e.g., field decontamination procedures). The results of the field duplicate and replicate analyses are an indirect audit of the ability of each field team to collect representative sample portions of each matrix type.

5.16.2 PERFORMANCE – LAB AUDITS

Procedures used to assess the effectiveness of the quality control system are as follows:

Internal Performance Audits

The laboratory through the use of control samples, replicate measurements and use of reference materials accomplish Internal Performance Audits. Internal audits and yearly assessments are conducted as per the SOP Internal Laboratory Audit. Sample analysis systems are reviewed by the QA Officer and include the following:
• Verification of written procedures and analyst(s) understanding
• Verification and documentation of procedures and documents
• Review of analytical data and calculations

External Performance Audits
External Performance Audits are accomplished by the laboratory(ies) periodic participation in round robin check sample analysis such as:
• Participation in the National Environmental Laboratory Accreditation Program (NELAP) laboratory evaluations program.
• Twice yearly participation in the privatized Water Supply PE single blind check samples.
• Twice yearly participation in the privatized Water Pollution (including DMR) PE single blind check samples.
• Analysis of QC samples submitted by private clientele upon request of the client.

5.16. 3 NATIONAL ENVIRONMENTAL LABORATORY ACCREDIATION PROGRAM ON-SITE AUDITS

The Laboratory(ies) follow guidelines as established by the National Environmental Laboratory Accreditation Program (NELAP) and meet all requirements as set forth by this document. The laboratory(ies) are audited every two years by a NELAP assessment team to measure or establish the performance, effectiveness, and conformance of the quality system to defined criteria.

5.16.4 ADDITIONAL ON-SITE AUDITS

Assessment teams from private clientele audit the laboratory, upon request of the client. These audits may be targeted to specific projects (as defined in a Quality Assurance Project Plan) or be general quality system assessments. Private client audit results and resolutions are not made accessible to other agencies without the express written consent of the client.

5.17 PREVENTATIVE MAINTENANCE

5.17.1 FIELD EQUIPMENT

Field monitoring equipment will be maintained in accordance with the manufacturers' recommended schedules and procedures. Maintenance activities will be documented by field personnel. Calibration of field equipment will be performed in accordance with manufacturer's specifications and as otherwise required. Field equipment will also be routinely re-calibrated, as needed, and calibrating procedures will be documented on the log-book. Routine inspection of equipment is intended to identify concerns requiring maintenance before they cause a major disruption of the field monitoring activities or adversely affect the validity and precision of the data being measured.

5.17.2 LABORATORY EQUIPMENT

The laboratory(ies) will maintain a relationship with the GC/MS manufacturer in order to minimize downtime of the GC/MS systems. A service engineer may perform preventive maintenance twice per year. In the event that the GC/MS system used in this study is unable to perform the necessary analyses, a second GC/MS owned by the laboratory will be reconfigured and dedicated to complete the scheduled analytical laboratory work. A supply of spare parts will also be maintained to minimize downtime. This stockpile will include ion sources, columns, separators, filaments, and injectors.

Each analyst will be responsible for conducting a daily inspection of critical systems on instruments under his charge. Inspections include vacuum lines and pumps for GC/MS, automatic injection systems, controlled reagent-feed motors, temperature controlled ovens in GCs, capillary columns, detectors and support systems, gas control system for AAs, and many others. Wear-dependent items such as septa on GC injection systems will be replaced as needed. The performance of instruments will be checked against known standards at the beginning of each working day or shift. Failure to achieve proper performance indicates a system problem which will be dealt with by laboratory personnel or by the manufacturer's service representative.

In addition, working systems will be serviced according to a fixed schedule by laboratory personnel or the manufacturer's service representative. A record of service and repairs, whether accomplished by laboratory personnel or by the manufacturer's service representative, will be maintained in a logbook kept with each instrument.

5.18 PROCESS TO ASSESS DATA FOR PRECISION, ACCURACY AND COMPLETENESS

This QCP provides the necessary formal QA/QC procedures for assurance that the proposed assessment is performed properly, and that the data generated will meet the overall DQOs and the project objectives for precision and accuracy as discussed in Section 5.5. This QCP provides the traceable sampling and analysis procedures, the personnel requirements, the chain-of-custody and documentation requirements, and specific criteria for determination of the acceptance of the data generated. This QCP also establishes the procedures that Radiation Data will follow to address data deficiencies, data reduction and evaluation, and preparation of field investigation reports which are accurate and technically sound.
The data produced will be compared with the QA objectives and criteria for precision and accuracy to verify that they meet those objectives and criteria. These data assessment activities will be an ongoing process coordinated with data production to determine whether the data produced during the project will be acceptable for use in subsequent evaluations. Acceptable data will be released for use in subsequent evaluations and to the data management system.
Precision is a measure of mutual agreement among replicate measures. Precision will be assessed using the relative percent difference. The relative percent difference will be calculated as follows:
RPD = [(S - SD)/S](100)
Where: RPD = Relative Percent Difference
S = The analyte concentration determined experimentally from the sample.
SD = The analyte concentration determined experimentally from the sample duplicate.
Accuracy will be assessed using reference samples and percent recovery. The percent recovery will be calculated as follows:
R = [(A - B)/S](100)
Where: R = Percent Recovery.
A = The analyte concentration determined experimentally from the spike sample.
B = The background level determined by a separate analysis of the unspiked sample.
S = The amount of the spike added.
The data completeness of the laboratory analyses results will be assessed based upon the analytical requirements set forth in the Work Plan. The completeness is calculated as follows:
$C = (P_c)/(P_p)x(100)$
Where: C = Completeness.
P_c = Number of Data Points Collected
P_p = Number of Data Points Planned
Other procedures to assess the quality of the data from the standpoint of consistency with physical-chemical principles are discussed in Section 6.19.

5.19 CORRECTIVE ACTION

One of the critical functions of the QA/QC Program is the implementation of corrective actions in the event that a problem is encountered. It is the primary responsibility of the Project Manager to take the appropriate corrective action. If the problem is discovered internally, it may be corrected by technical staff or through consultation with the relevant parties such as the QA staff to determine the proper course of action. If the problem is discovered by external audit, the Project Manager must consult with the QA staff prior to implementing corrective measures. Remedial procedures will be documented and, along with the initial report, become a part of the permanent project file.

Corrective action will be required when analytical data fail to meet the predetermined limits for data acceptability or when the Project QA/QC Manager or the laboratory's QA Manager determines that other QCP or project-specific QA/QC procedures and policies are not being adequately followed. Corrective action within the laboratory(ies) will be required when:

- The RF (Response Factor) of any calibration check compound in the daily standard deviates from the established calibration values as specified by the analytical protocol.
- The recovery of any component in the QC check standard falls outside the designated range for recovery (as established in the applicable method).
- The recovery of the surrogate standards in a sample falls outside the ranges specified in this plan.

Corrective action will also be initiated as a result of negative findings during the following quality assurance activities:

- Performance audits
- System audits
- Laboratory or field spot inspections
- Scheduled QA audits conducted by the Project QA/QC Manager or Laboratory QA/QC Manager

Individuals responsible for initiating corrective action within the laboratory will consist of the laboratory analysts under the supervision of the Laboratory QA Manager. The quality of samples collected in the field will be assessed according to the following criteria prior to submission of the samples to the analytical laboratory:

- Sampling procedures indicated in this Work Plan were used.
- Appropriate sample containers were used and sampling equipment properly prepared.
- No apparent tampering occurred with sampling equipment that would interfere with sample collection.
- Field data sheets were properly completed.
- Strict chain-of-custody compliance was maintained.

The Project Manager or designated sampling team supervisor will conduct the evaluation. If deficiencies are found, the Project Manager and the Project Principal will be informed. The Project Manager will be responsible for corrective action, including a review of procedures with the staff and additional training as appropriate. The Project Principal and his technical staff will determine whether the deficiencies observed will substantially affect the results of laboratory analyses. They will determine if the deficiencies require the collection of new samples.

Data collected during the soil boring drilling and lithological descriptions will be used to develop a representation of the site stratigraphy. The representation will be consistent with physical principles in several respects such as:

• Borehole logs and stratigraphic mapping results should show stratigraphy correlating with the known geology, or an explanation of the differences will be presented.

If any inconsistencies appear in the evaluation of data, the data collection procedures will be checked for errors and the raw data sheets will be checked for transcription errors. Any errors will be corrected as needed. If no errors in data collection or transcription are found, the technical staff will seek explanations in known physical processes and will pose and check hypotheses by standard scientific methods (including statistical procedures) until reasonable explanations in physical-chemical processes are found. If no satisfactory explanations can be found for the inconsistencies, they will be noted in the final assessment report as unexplained but, nevertheless, verified observations.

Other data collected for this project will be subjected to similar tests of reasonableness with respect to known processes. Inconsistencies between observations and known processes will initiate a series of checks of the data collection and data transcription procedures. Data errors will be corrected by appropriate action including replacing or repairing the faulty measurement system, and if judged necessary by the Project Principal and the Project Manager discarding the erroneous data, and collecting new data.

Specific corrective actions will be devised to eliminate the problem(s) affecting project quality. Each corrective action will be developed on a case-by-case basis. The Project QA/QC Manager will maintain records of corrective actions, including the dates approved and initiated, and the results. In cases where the quality assurance program defines a need for a corrective action, the Project QA/QC Manager, upon notification, will formally instruct the Project Manager of the need for such corrective activities. The Project Manager, in conjunction with the technical staff, will see that the necessary corrective actions are developed and that a satisfactory implementation schedule is established. In many instances, the selection of an appropriate corrective action will be made in concert with the Project Principal and the CES technical staff. The findings requiring any corrective action will be notified to the Project QA/QC manager within 24 hrs of the finding. The response for any corrective action needed should be provided to the QA/QC manager within 5 days of the finding notification.

5.20 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Analytical laboratory quality control reports will be summarized for the Project Manager at appropriate times by the laboratory QA Manager. All plans, specifications, and written reports for the client will be reviewed by qualified technical staff. The reviewed documents, with the reviewers' marks, will be given to the Project Manager for his review and appropriate modification. The assessment report for this project will be submitted to the EPA and may contain a separate QA section summarizing the project’s quality assurance program. This section may include the following information:

• An assessment of measurement data accuracy and precision.
• Results of performance audits, if any.
• Significant QC problems and solutions enacted.

• Inconsistencies discovered in data evaluation and interpretation.

5.21 QA MANAGEMENT REPORTS

QA management reports will be prepared to ensure that project personnel are updated on project status and results of all QA assessments. Efficient communication of project status and problems will allow project managers to implement timely and effective corrective actions so data generated can meet PQOs. For this project a QA management report will be prepared by the QA/QC manager at the beginning and completion of the field activities. The reports will include as needed the evaluation of the activities conducted, compliance with the QAPP procedures, corrective action requirements and the corrective response.
As appropriate the following issues should be considered during the QA Management report preparation:
• Summary of project QA/QC activities and trainings conducted during the project
• Conformance of project activities to QAPP requirements and procedures
• Status of project and schedule delays
• Deviations from the approved QAPP and approved amendments to the QAPP
• Required corrective actions and effectiveness of corrective action implementation

6.0 HEALTH AND SAFETY PLAN

6.1 PLAN OBJECTIVE

The health and safety of site personnel and the public is a primary concern during remedial work at potentially hazardous sites. Thus, a comprehensive, carefully managed, and thoroughly documented Health and Safety Plan (HSP) is crucial for successful project completion.
This plan is based on available background information and describes field implementation of the HSP, specific responsibilities, training requirements, protective equipment, site operating procedures, emergency procedures, and medical monitoring. Its flexibility allows unanticipated site specific problems to be addressed while assuring adequate and suitable worker protection. The HSP will be used by the Field Team Manager as a field reference manual for safety, health and emergency response procedures. The HSP will also be discussed with site personnel and made available for review through the Field Team Manager to assure sufficient awareness of potential hazardous conditions and safety procedures on the site.

6.2 SITE SURVEILLANCE

6.2.1 HAZARDS ASSESSMENT AND RISK ANALYSIS

Generally, potential hazards at the site may include:
• Exposure to air concentrations of organic compounds as well as airborne dust particles containing organic compounds
• Physical Hazards such as heat stress.

The chemical exposure hazards for this investigation are expected to be associated with VOCs mainly the following chlorinated VOCs:

- Trichloroethene
- Tetrachloroethene
- Cis-1,2-Dichloroethene
- Vinyl Chloride

Some of the system installation will be performed outside the Former Biovail building, in ventilated areas, where it is anticipated that any potential exposure will be by inhalation of airborne particles during drilling activities, samples handling, and by dermal contact with soil and groundwater samples. However, based upon the existing site conditions and the historical data obtained, the exposure of personnel to these contaminants during the outside the building field sampling activities is expected to be minimal.

Other field sampling activities such as indoor and sub-slab air sampling, drilling and soil and groundwater samples collection will be performed inside the Former Biovail building, in enclosed conditioned areas, where it is anticipated that any potential exposure will be by inhalation of airborne particles during drilling activities, samples handling, dermal contact with soil and groundwater samples and handling of air samples. Based upon this information field activities inside the building will be conducted using the necessary level of personal protection as described in ***Section 6.3*** below.

A *wet-vac* type vacuum cleaner will be used to collect dust that may be generated during drilling activities conducted inside the building. In addition, to promote ventilation at the work areas inside the building air extractors and/or ventilation fans will be placed at the work areas.

Table 9 presents a summary of the physical, chemical and health hazards associated with the main CCOC at the Former Biovail site.

6.3 PERSONAL PROTECTIVE EQUIPMENT

Based upon the expected site contaminants and their minimal exposure, all field activities may be conducted using Level D, modified Level D or Level C personal protective equipment (PPE), at the discretion of the project health and safety officer (HSO) and Project Manager. Upgrade or use of Level B PPE is not anticipated for any of the field activities. No confined space conditions are expected to be encountered during the proposed assessment activities. Prior to starting and during all drilling activities, the air within the working areas will be monitored with a PID instrument.

Level D, modified Level D and Level C PPE requirements are described below:

6.3.1 LEVEL D (Primary Use)

- Distinct work clothing
- Safety goggles or glasses (as required)
- Neoprene or rubber chemical resistant boots or sturdy work boots
- Disposable outer boots (as required)
- Gloves

6.3.2 MODIFIED LEVEL D

- Distinct work clothing
- Hard hat (optional)
- Safety goggles or glasses (as required)
- Neoprene or rubber chemical resistant boots or sturdy work boots
- Disposable outer boots (as required)
- Chemical resistant gloves with latex undergloves
- Hearing protection (as required)
- *Tyvek* or *Saranex*-coated *Tyvek* coveralls

Level D and modified Level D provide no respiratory protection and moderate skin protection. The atmosphere must contain at least 19.5 percent oxygen, and ambient air concentrations must be at the levels established in ***Section 6.4.1*** below. Field activities to be conducted outside the building will be conducted wearing Level D, as there is ample ventilation.

6.3.3 LEVEL C

- Full-face air-purifying respirator, fitted with a HEPA/Organic Vapor/combination cartridge (NIOSH approved)
- Tyvek or Saranex-coated Tyvek coveralls (chemical resistant)
- Chemical resistant gloves, with inner latex gloves
- Neoprene or rubber chemical resistant safety boots
- Disposable outer boots (optional)
- Hard-hat (optional)

All field personnel should have been fit-tested prior to field activities for their individual respirators, using positive and negative pressure checks and qualitative fit tests, such as an irritant smoke test. A positive and negative pressure fit check will be performed prior to site activity when a respirator is to be worn. Any facial hair which interferes with the face to face-piece seal will not be permitted on personnel required to wear such equipment. Contact lenses will not be allowed to be worn in conjunction with the use of respiratory protection. Spectacle kits for respirators will be obtained prior to mobilization for those who need them. Cleaning, maintenance, and storage of respirators are discussed in ***Section6.10.1***.
In order to continue use of the respirators, atmospheric concentrations must not exceed the maximum use concentrations for the cartridges. Air-purifying respirators shall not be used for Immediately Dangerous to Life and Health (IDLH) levels. The atmosphere must contain at least 19.5 percent oxygen. Field personnel will be briefed at the health and safety meeting on contaminant breakthrough times for organic cartridges. Full-face respirators provide a protection factor of 50 (i.e., they will provide protection at concentration levels up to 50 times the OSHA PEL-TWA).

6.4 MONITORING EQUIPMENT

The following subsections describe the methods and equipment that may be used to monitor the ambient air within the working zone (i.e., breathing zone of personnel) for airborne concentrations of hazardous substances, using direct-reading (real-time) air monitoring and to monitor personnel for heat stress. The breathing air zone will be monitored periodically and with every change in task or location. Action guidelines for each instrument/method are also outlined in respective subsections.

6.4.1 PHOTO IONIZATION DETECTOR

Volatile organics will be determined with a calibrated Photoionization Detector (PID, Brand Mini RAE 2000, Model PGM-7600) provided with a 10.6 eV lamp or similar device. Prior to initiating site activities, the calibration for the PID will be checked using 100 ppm Span Gas and the calibration will be recorded in the field log book. Readings are referenced to above background and reflect those sustained for greater than five seconds in the breathing zone.
The action levels for determining the PPE using the PID readings will be as follows:

PID Reading Level of PPE
(ppm above background)
0-10 Level D
10-100 Level C
> 100 Stop work and provide ventilation until levels are reduced

6.5 HEAT STRESS

Signs of heat stress include heat rash, heat cramps (muscle spasms), and heat exhaustion (pale, cool, moist skin, heavy sweating, dizziness, nausea, and fainting). Extreme heat stress can result in heat stroke, as temperature regulation fails and the body temperature rises to critical levels. Symptoms of heat stroke include red, hot, usually dry skin; lack of or reduced perspiration; nausea, dizziness, and confusion; strong, rapid pulse and coma.
If symptoms of heat stress are exhibited by the workers or the temperature increases significantly, the pulse rate and body temperature will be monitored during all tasks (as deemed necessary or appropriate by the HSO or PM). The action guidelines are as follows:
Pulse Rate
• Determine normal resting pulse rate.
• Monitor pulse rate as soon as possible at beginning of rest period.
• If the rate is greater than 40 beats per minute (BPM) above the normal rate, shorten the next work period by one-third (1/3) without changing the rest period.
• If the pulse rate is greater than 40 BPM above normal at beginning of next rest period, shorten the following work cycle again by 1/3.
• Repeat.
Body Temperature
• Determine body temperature at the end of the work cycle and before drinking.

• If the temperature is greater than 99.6oF (37.6oC), shorten the next work cycle by 1/3 without changing the rest cycle.
• Repeat.
Do not permit a worker to wear semi permeable or impermeable clothing when his/her body temperature exceeds 100.6oF (38.1oC).

6.6 SITE PERSONNEL AND RESPONSIBLITIES

The HSO and/or the PM serve as the Site Health and Safety Supervisors and are responsible for formulating and enforcing health and safety requirements. Those responsibilities are outlined in detail in the OSHA standards (29 CFR 1910.120) and the "Occupational Health and Safety Guidance Manual for Hazardous Waste Site Activities" (NIOSH/OSHA/USCG/EPA, 1985). These responsibilities include ensuring the following:
• All site-team members have received the OSHA-required, 40-hour health, safety, and emergency response training and an annual 8-hour refresher course.
• Team members have completed the required medical examination and have met the qualification criteria for site work as specified in 29 CFR 1910.120.
• Site workers (including subcontract personnel) have received appropriate site-specific training, which will include a briefing on the HSP.
• Equipment, including safety equipment, is suitable and adequate for its purpose.
• Supervisors and the PM regularly review past activities to plan ahead for new or changed operations and to establish safe working procedures.
• A site-safety meeting with all site personnel is held at least biweekly.
• Site standard operating procedures are followed as outlined in Section 6.8
The HSO and/or the PM will have direct responsibility for administering the HSP relative to site activities. The PM also has the overall responsibility for the project.
Subcontractors and visitors entering designated work areas will be subject to applicable health and safety requirements during field operations at the site. The HSO and/or the PM are responsible for briefing subcontractor personnel regarding potential contamination that may be encountered on the site, site safety, and the emergency response plan. Subcontractors (if any) and visitors will be under the direct supervision of the HSO, PM or designated representative who will report directly to the HSO or the PM. Subcontractors must meet OSHA certification and health standards (i.e., fitness for work) as described in Sections 6.7 and 6.13.
All personnel to be involved in this project are in compliance with the OSHA 29 CFR 1910.120 requirements including completion of the 40 hrs OSHA HAZWOPER training, the annual 8 hrs refresher and the supervisor training (as applicable).

6.7 PERSONNEL HAZARD TRAINING

A thorough understanding of the types of hazards most likely to be encountered at sites containing hazardous materials and the personal protection measures needed to protect on-site personnel is the first requirements of a complete Health and Safety Plan. The following sections outlines the training requirements needed for workers at the site.

6.7.1 COMPREHENSIVE TRAINING

Each project team member is required to have completed at a minimum a 40-hour comprehensive training course which complies with OSHA 29 CFR 1910.120. Annual refresher training is also an integral part of the overall hazardous materials awareness.

6.7.2 PRE-INVESTIGATION HEALTH AND SAFETY BRIEFING

Prior to the start of the field activities, the HSO and the PM will meet with workers and subcontractors, if any. The purpose of this meeting is to discuss in detail the hazards specific to the site, the tasks to be performed, and to specify the proper level of protection for each work area. As part of this meeting, the Standard Operating Procedures for activities at the site will be outlined. It is the responsibility of the HSO and the PM to assure that all workers are thoroughly familiar with specific SOPs and the overall chain of command at the site.

6.8 SITE OPERATING PROCEDURES

A combination of site operating procedures and PPE shall be used to prevent accidents and injuries and to reduce possible worker exposure to contaminants as required by OSHA 29 CFR 1910.120. The site-operating procedures include safety plan responsibilities; site safety procedures to be followed prior to site entrance, while on-site, and upon exiting the site; site control procedures; and decontamination procedures as described below.

6.8.1 SAFETY PLAN RESPONSIBLITIES

The HSO and/or the PM will assure that each member of the field team is aware of all components of the safety plan. The HSO and/or the PM, or his designated team member:

- Instructs all workers on safety procedures at the work site
- Supervises decontamination, inspection, maintenance and storage of the safety equipment
- Controls entry and exit for the work area (site security)
- Observes the work party for signs of stress or illness and removes affected individuals from work
- Monitors on-site conditions (weather, PID, etc.)
- Enforces the buddy system
- Knows emergency procedures, evacuation routes and emergency telephone numbers
- Assures that directions to the hospital are readily available and that local hospital and emergency response personnel are alerted to specific hazards associated with the field operations
- Coordinates emergency medical care
- Characterizes the site and alerts field personnel to the presence of low-lying areas, barriers, ditches, trenches or hollows with potential to present dangerous conditions
- Notifies fire department/emergency response personnel in the event of an accident or emergency

6.8.2 SITE SAFETY PROCEDURES

The following items are requirements to protect the health and safety of field workers and will be discussed in the safety briefing prior to initiating work on the site.

6.8.2.1 GENERAL SAFETY OPERSATING PROCEDURES

The following are general procedures to be followed:
• A buddy system will be used. Hand signals (see Table 10) will be established to maintain communication.
• During site operations, each worker will consider himself/herself as a safety backup to his/her partner. Off-site personnel provide emergency assistance. Personnel will be aware of dangerous situations that may develop.
• Visual contact will be maintained between buddies on-site when performing hazardous duties.
• Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of hazardous material is prohibited in the exclusion zone.
• Prescription drugs will not be taken by personnel where the potential for contact with toxic substances exists. Alcoholic beverage intake is prohibited during the work day. Illegal drug use is prohibited.
• Any facial hair which interferes with the face to face-piece seal of the respirator will not be permitted on personnel required to wear such equipment. Contact lenses will not be allowed to be worn in conjunction with the use of respiratory protection. Arrangements should be made prior to site mobilization to obtain spectacle kits for those who need them. Each staff member should have been fit-tested for respirators using an approved technique (i.e., irritant smoke) prior to the onset of field activities. Level D and modified Level D protection initially specified at the site do not require the use of respirators. Respirators and spare cartridges will be available on-site.
• Work areas for various operational activities (equipment testing, decontamination) will be established if higher levels of protection are implemented at the site.
• Procedures for leaving any contaminated area will be planned and reviewed prior to going on-site.
• Work areas and decontamination procedures have been established based on prevailing site conditions and are subject to change if site conditions change.
• No personnel will be admitted to the site without proper safety equipment and training. Subcontract personnel must have proper safety equipment and training and will be briefed on proper work and safety procedures. Authorized visitors will be briefed on the site safety plan and emergency procedures before entering work areas.
• Personnel must comply with established safety procedures. Any staff member who does not comply with the safety policies, as established by the HSO and/or the PM, will be immediately dismissed from the site.
• Any medical emergency supersedes routine safety and decontamination requirements. A plan will be in place to determine if decontamination is necessary prior to medical treatment or transport to a medical facility, as discussed in ***Section 7.12***.

6.8.2.2 BEFORE BEGINNING WORK DAY

Before beginning work, the following shall be completed:
• Field personnel shall review site information and work procedures for:
- Expected hazards
- Special conditions such as natural disasters or multiple personnel injuries
- Sampling procedures
- Location of telephones and emergency equipment
- Emergency medical information including hospital location
- Level(s) of personnel protection required
• Check safety gear and equipment. The following equipment may be used at the site, or may be available for issue, depending on site-specific conditions. The safety gear and equipment will be available on-site in a support vehicle.
- Standard Tyvek or Saranex-coated Tyvek coveralls
- Hard hats
- Goggles or Safety Glasses
- Chemical-resistant and Neoprene gloves
- Full-face, air-purifying respirator with fitted with a HEPA/Organic Vapor/Acid Gas combination cartridge (NIOSH approved)
- Ziplock baggies (quart and gallon size) to store clean, spare equipment
- Field standard operating procedures and safety references
- Latex glove liners, disposable
- Hearing protection (optional)
- Eye wash station
- Fire extinguisher
- Backup equipment and spares will be maintained and may include:
- Disposable paper towels
- Alcohol swabs or respirator wipes
- Extra Tyvek suits and gloves
- Duct tape
- Trash barrel for disposal of contaminated gear and equipment
- Wash and rinse tubs for decontamination
- Extra respirator cartridges
- Scrub brushes
- Plastic trash bags and drop cloths

6.8.2.3 BEFORE ENTERING SITE

The following procedures will be followed before entering the site:
• No eating/drinking/smoking is allowed except in the designated areas away from the work site. Use good sanitary practices and wash hands and face thoroughly before eating/drinking/smoking. An eating/drinking/smoking area will be set up in a clean area.
• Place sample containers in field sample carrier (backpacks or carrier). Do not place containers or equipment on potentially contaminated surfaces.
• Check location of telephones.

• Check alternate safety gear.
• Check respirator (even if it is not going to be worn immediately).
• Check gear for rips/tears/malfunctions before, during, and after use.
• Set up buddy system prior to proceeding.
• Preliminary site survey.
• Characterize physical conditions of site.
• Use caution - go slowly.

6.8.3 SAMPLING

During sampling activities, the following will be complied with:
• No eating/drinking/smoking while sampling.
• Use standard, specified sampling techniques as described in this plan or discuss with PM or HSO.
• Use appropriate care in collecting samples. Use remote sampling or long handled tools to obtain samples if possible. If the sampling site is not accessible with available gear, don't take a sample. Confer with buddy and team leader about alternate sampling locations.
• Promptly wipe or wash off splashes, dirt, and site residue from sample collection materials.
• If any gear or equipment damage develops, immediately repair or replace.
If a field worker develops any physical discomfort, such as headache, the worker must stop work, notify his/her buddy, return to the designated Support Zone and report to the HSO and/or the PM.

6 .9 SITE CONTROL

Delineation of work zones, communications procedures, and site illumination requirements are discussed below.

6 .9.1 WORK ZONES

For safety purposes, the work area is generally divided into three specific zones on the basis of contamination potential:
• Zone 1 - Exclusion Zone
• Zone 2 - Contamination Reduction Zone
• Zone 3 - Support Zone
The Exclusion Zone is the area of greatest suspected environmental contamination and presents the greatest potential for worker exposure. For the purpose of this plan, the Exclusion Zone will be the areas where the floor will be drilled. The HSO or the PM may extend this zone based on prevailing wind direction, ambient PID readings detected and/or proximity to site personnel and facilities. Personnel entering the area must wear the mandated level of protection. The Contamination Reduction Zone serves as a transition area between the Exclusion Zone and the Support Zone. Decontamination facilities are located in the Contamination Reduction Zone. All areas will be defined and marked as appropriate.
The Support Zone serves as a clean control area (rest and dressing area, supplies and equipment

storage, eating/drinking area, office, etc.).
The Contamination Reduction Zone will be established between the Exclusion and Support Zones and will serve as the decontamination area. The Support Zone will be considered any area outside the Exclusion Zone and the Contamination Reduction Zone. Field personnel will be instructed about activities and protective equipment requirements for each zone.

6.9.2 COMMUNICATIONS

The hand-signal communication system (Table 10) and voice communication will be used by field personnel in the event of noisy working conditions on the site. The HSO and/or the PM will coordinate with field personnel on the use of hand signals during on-site safety meetings.

6.9.3 ILLUMINATION

No supplemental illumination will be required, as all work is scheduled to be performed during daylight hours. The building is provided with internal and external illumination.

6.10 DECONTAMINATION

Personnel must complete appropriate decontamination procedures in a manner that is responsive to actual site conditions prior to leaving the site.
Trash receptacles will be provided for all disposable clothing. Each individual shall conduct proper personal hygiene, which includes washing any exposed skin prior to eating, smoking, or leaving the site.

6.10.1 DECONTAMINATION PROCEDURES

Decontamination procedures for Level C protection for the removal of contaminants from personnel and equipment are discussed in the following sections. The same procedures, with the exception of respirator decontamination, will be followed for Level D and modified Level D.
Personnel Decontamination
Procedures for decontamination of personnel are as follows:
• Field equipment should be placed at the first drop area (designated at the Contamination Reduction Zone) for later decontamination.
• Boots and gloves should be brushed and scrubbed with a detergent solution and rinsed in clear water.
• Boots and disposable clothing can now be removed. Boots will be deposited at a designated second drop area. Disposables will be thrown away.
• Gloves and hard hats will also be removed and left at the second drop area.
• Street shoes can be put on.
Equipment Decontamination
Decontamination of equipment will be carried out as follows:
• Respirators
- Remove filters and cartridges and carefully wipe clean as much as possible. If prefilters (outside filters in snap-on rings) are dirty, replace them with fresh ones.

Clean surfaces with isopropyl alcohol and water. Wipe internal surfaces with alcohol. Use packaged alcohol wipes for daily nominal disinfection. Each individual will be issued his/her own respirator; further daily disinfection of respirators will be at the discretion of the individual user. Once cleaned, the respirator should be stored in dedicated zip-lock bags for protection in a suitable designated location.

• Other Equipment

- Wash gloves and boots with detergent solution and rinse with clean water. Then, rinse with isopropyl alcohol and twice with clean water.
- Hang boots and gloves to dry on drying rack. Dry other equipment with white paper towels.

• Heavy Equipment

- Prior to leaving the site, heavy equipment will be cleaned of gross contamination.

Heavy equipment, if necessary, will also be thoroughly decontaminated by steam cleaning or any other suitable method within the Contamination Reduction Zone.

6.10.2 PERSONNEL HYGIENE

Personal hygiene primarily entails washing and is not strictly considered decontamination. Hands, face and any other exposed skin surfaces should be thoroughly washed and rinsed under running water for three to five minutes.

6.11 DISPOSAL OF INVESTION DERRIVED (IDW)

Wastes generated during the assessment activities will be placed in DOT approved containers and stored at a designated area at the Former Biovail site pending determination as to their appropriate method of disposal.

6.12 EMERGENCY PROCEDURES

Emergency telephone numbers and reporting instructions for ambulance, physician, hospital, fire and police shall be conspicuously posted at the work site. All field personnel will be briefed concerning the people and equipment which will be summoned during an emergency. Directions to the nearest hospital with proper emergency room facilities will be conspicuously posted and all field personnel briefed concerning their responsibilities during an emergency situation requiring hospitalization. Hospital and emergency telephone numbers specific to the site are provided in Table 11. Figure 8 shows the route to the Carolina Regional Hospital.

6.12.1 Accidents/Injuries

Depending upon the severity of the injury, first aid treatment may be given at the site by trained personnel. Additional assistance from emergency medical technicians may be required at the site, or the victim may have to be transported to a hospital.

In life-threatening situations, care must begin without considering decontamination. Outside protective clothing can be removed if it does not cause delay or aggravate the problem. Respirators must always be removed. Normal decontamination procedures will be followed

when possible. It will be the responsibility of the HSO and/or the PM to thoroughly investigate the details of any accident or injury. Based on his/her findings, he/she will recommend any corrective action relative to field procedures to prevent recurrence.

6.12.2 SITE EVACUATION

Three stages of evacuation have been determined:
• Withdrawal from immediate work area
• Evacuation of site
• Evacuation of nearby area facilities

6.12.2.1 WITHDRAWAL FROM WORK AREA

Withdrawal to a safe upwind location outside the exclusion zone will be required should any of the following occur:
• If concentrations of volatile organic gases exceed the concentrations as discussed in Section 6.4.1regarding upgrade to Level C PPE, the work will be temporarily stopped until the upgrade is made.
• If a minor accident occurs, field operations will resume after first aid and/or decontamination procedures have been administered.
• Equipment malfunctions

6.12.2.2 OCCASIONS OF EVACUATION

The site will be evacuated in the following cases:
• Excessive contaminant levels are detected.
• A major accident or injury occurs.
• Fire and/or explosion occurs.

6.12.3 RECORD KEEPING

Safety-inspection reports, accident/incident reports, site-safety training and site-monitoring results will be entered into the HSO or PM's daily log and will become a part of the permanent record.

6.12.4 HAZARD COMMUNICATION

Provisions of the Hazard Communication Standard (29 CFR 1910.120) will be complied with, including maintaining Material Safety Data Sheets for any chemical carried onto the site.

6.12.5 EMERGENCY EQUIPMENT

The following emergency equipment will be available on the site during field operations:

6.12.5.1 FIRST AID KIT

A first aid kit with sufficient supplies will be readily available within the support area. Smaller kits may be kept in the clean areas and with field crews, if necessary. The contents of the first aid kits will be checked by the HSO and the PM before being sent out to the job site and rechecked at least once weekly while work is in progress to assure that expended items are replaced.

6.12.5.2 FIRE EXTINGUISHER

To prepare to address the possibility of fire and explosion at the work area, a portable fire extinguisher will be readily available (within 100 feet) to field personnel. Foam, dry chemical or CO_2 type extinguisher will be inspected for proper charge, pressure and physical integrity before field operations begin.

6.12.5.3 EYE WASH

A portable eyewash (meeting the minimum ANSI Z 358.1 requirements) and sufficient potable water for copious flushing (for 15 minutes) will be readily available throughout the investigation. The eye-wash unit will be stationed in the support area.

7.0 REFERENCES

Uniform Federal Policy for Implementing Quality Systems ("UFP-QS"), EPA-505-F-03-001, March,
2005.
Uniform Federal Policy for Quality Assurance Project Plans ("UFP-QAPP"), Parts 1, 2, and 3, EPA-
505-B-04-900A, B, and C, March, 2005.
USEPA, "EPA QA/G-4 Guidance for the Data Quality Objective Process", EPA/600/R-96/055, August 2000
EPA Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance
Manual, November 2001.
EPA Compendium Method TO-15, titled *Compendium of Methods for the Determination of Toxic
Organics Compounds in Ambient Air – Determination of VOCs in Air Collected in Specially-Prepared Canisters and Analyzed by GC/MS*.
U.S. Department of Agriculture, Soil Conservation Service (SCS), "Soil Survey of San Juan Area,
Puerto Rico Eastern Part", August, 2008
Geologic map of the Carolina Quadrangle, by Watson H. Monroe (1977)
Topographic map of the Carolina and San Juan Quadrangles, by U.S. Geological Survey, 1969 (Photo revised 1982).
US Geological Survey, "Geology and Hydrogeology of the Caribbean Islands Aquifer System of the

Commonwealth of Puerto Rico and the U.S. Virgin Islands", Robert A. Renken, Fernando Gómez-
Gómez, Jesús Rodríguez-Martinez and others, Professional Paper 1419.
Environmental Protection Agency, "Sabana Abajo Industrial PCE Site: Source Location Identification, Work Assignment 0-111 Trip Report", November 3, 2005.
Environmental Protection Agency, "Sabana Abajo Industrial Site Phase II: Source Location Identification, Work Assignment 0-111 Trip Report", October 5, 2006.
Environmental Protection Agency, "Sabana Abajo Industrial Site Phase III: Seasonal Groundwater
Sampling and Groundwater Elevation Assessment, Work Assignment 0-111- Trip Report", May 14,
2007

TABLES

TABLE 1

ADDRESSES AND PHONE NUMBERS OF KEY PERSONNEL

Stan Sackowitz

International Process Plants

609-903-1510

Radiation Data

403 Skillman Road

Skillman, NJ 08558

609-466-4300

Radiation Data Personnel

Kyle Baicker-McKee	412-225-6467
Jim Gibson	609-6517610

EMSL Analytical, Inc

200 Route 130 North

Cinnaminson, NJ 08077

Attn: Daycia Scotton

800-220-3675

856-786-5971 (fax)

TABLE 2

SAMPLING PROCEDURES

Indoor air sampling	EPA Office of Solid Waste and Emergency Response (OSWER) *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soil*

TABLE 3

ANALYTICAL METHODS

AIR SAMPLING	TO-15

TABLE 4
DATA OBJECTIVES

Sample Matrix	Objectives	Field	Laboratory Parameters	Rationale
Air	Data to be used to determine potential for exposure of on-site workers during assessment activities.	PID	N/A	Health and Safety
Air	Data for characterization of the effectiveness of the sub-slab depressurization systems at preventing vapor intrusion at the former Biovail facility	NA	VOCs	Confirmatory Sampling

TABLE 5
ANALYTICAL METHODS AND LABORATORY REPORTING LIMITS
(INDOOR AIR SAMPLES)

Compound	CAS Number	Method Reference	Indoor Air LDL (ug/m^3)	Indoor Air MDL (ug/m^3)
Trichloroethene	79-01-6	TO-15	0.54	0.142
Tetrachloroethene	127-18-4	TO-15	0.69	0.157
Cis- 1,2 Dichloroethene	156-59-2	TO-15	0.4	0.116
Vinyl Chloride	75-01-4	TO-15	0.13	0.070

TABLE 6

LABORATORY PRECISION AND ACCURACY REQUIREMENTS

(INDOOR AIR SAMPLES)

COMPOUND	INDOOR AIR RECOVERY	INDOOR AIR PRECISION
VOCs	65-135 %	30 %

TABLE 7

SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES

Parameter	Container	Preservation	Analytical Holding Time
VOCs	Summa Canisters	None	30 days

TABLE 8

MEASUREMENT PERFORMANCE CRITERIA AND QA/QC REQUIRENTS AIR/VAPOR SAMPLES

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Internal Standard Responses	Data Quality Indicator	Measurement Performance Criteria
Method Blank	Once every analytical batch of 20 or fewer samples	No analyte detected equal to or above the MRL (DoD: No analytes > ½ MRL; common lab contaminants none detected > MRL)	1) Reanalyze blank 2) Identify and correct problem 3) Reanalyze blank and affected samples 4) Qualify data	60-140%	Accuracy/Bias - Contamination	No analytes detected less than half the RL
LCS	Once every analytical batch of 20 or fewer samples	Percent recovery (%R) within 65-135%	1) Reanalyze 2) Identify and correct problem 3) Qualify data *DoD projects require corrective action for all exceedances	60-140%	Accuracy/Bias	Recoveries within 65-135% recovery
Surrogate	Every analytical sample	A minimum of two surrogates must pass QAQC limits	Reprep and reanalyze all samples processed with the non-conforming surrogate. Dilute sample if necessary.	60-140%	Accuracy/Bias	4-Bromofluorobenzene: 77-127% Toluene-d8: 78-125% 1,2-Dichloroethane-d4: 76-134%
Sample Duplicate	One field Sample duplicate each day	Main analytes of concern must meet precision requirements	Re-collect and analyze sample	60-140%	Precision	RSD must be equal or less than 50%
MS/DS	Not Applicable					

Initial Calibration

5 points minimum
RSD <30%, 2 analytes with RSD <40% allowed
2nd Source Verification

Daily Calibration (CCV)

BFB Tune Valid for 24 Hr
%D <30% (Flag analytes >30% %D as appropriate)

Definitions:

%D = % deviation (from initial calibration)
BFB = Bromofluorobenzene
CCV = Continuing calibration verification (daily calibration)
DoD= Department of Defense
LCS = Laboratory control spike

MRL = Method reporting limit

MS/MSD = Matrix spike and matrix spike duplicate
RSD = Relative standard deviation

Table 9
Main CCOC Physical, Chemical and Health Hazards

Chemical or Constituent Name	Odor (O) and Odor Threshold (OT)	Permissible Exposure Limits (PELs)	Health Hazards/ Symptoms	Flash Point (FP) LEL UEL	Reactivity/ Incompatibility
Trichloroethylene (aka: ethylene trichloride, TCE, trichloroethene, trilene)	**O**= sweet smell. Colorless liquid (unless dyed blue) with a chloroform-like odor **OT**= N/A	**TWA**= 100 PPM **STEL**= N/A **C**= 200 PPM **IDLH**= 1,000 PPM	**Exposure Routes:** Inhalation, skin absorption, Ingestion, skin and/or eye contact **Symptoms:** Irritation to eyes, skin, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomit, dermatitis, cardiac arrhythmia, paresthesia, **Target Organs:** Eyes, skin respiratory system, heart, liver, central nervous system,	**FP**: NA **LEL**: 77 °F (8%) **UEL**: 77 °F 10.5 % Combustible liquid but burns with difficulty	-Strong caustics and alkalis; chemically active metals, Oxidizers, Nitric Acid
Tetrachloroethylene (aka: perchloroethylene, perk)	**O**= mild chloroform-like odor. Clear colorless liquid. **OT**= N/A	**TWA**=100 PPM **STEL**= NA **C**= 200 ppm **IDLH**= 150 PPM	**Exposure Routes:** Inhalation, skin absorption, Ingestion, skin and/or eye contact **Symptoms:** Irritation to eyes, skin, nose, throat, respiratory system, nausea, flush face, neck; dizziness, incoordination, head, drowsiness, skin redness, **Target Organs:** Eyes, skin respiratory system, liver, kidneys, central nervous system	**FP**: NA **LEL**: NA **UEL**: NA Noncombustible liquid, but decomposes in a fire to hydrogen chloride and phosgene.	- Strong oxidizers, chemically active metals such as: lithium, beryllium, & barium; caustic soda, sodium hydroxide, potash.
1,2-Dichloroethylene (aka: acetylene dichloride, cis-Acetylene dichloride, trans-Acetylene dichloride, sym-Dichloroethylene	**O**= slightly acrid (sharp or biting to the taste or smell; bitterly pungent), chloroform-like odor. Colorless liquid (usually a mixture of the cis & trans isomers). **OT**= N/A	**TWA** = 200 PPM **STEL**= N/A **C**= N/A **IDLH**= 1000 PPM	**Exposure Routes:** Inhalation, Ingestion, skin and/or eye contact **Symptoms:** Irritation to eyes, respiratory system, central nervous system depression, **Target Organs:** Eyes, respiratory system, central nervous system.	**LEL**: 5.6% **UEL**: 12.8 % Class IB Flammable liquid	- Strong oxidizers, strong alkalis, potassium hydroxide, copper.

Table 9 (Continued)

Main CCOC Physical, Chemical and Health Hazards

Chemical or Constituent Name	Odor and Odor Threshold	Permissible Exposure Limits (PELs)	Health Hazards & Symptoms	Flash Point (FP) LEL UEL	Reactivity/ Incompatibility
Vinyl Chloride (aka: chloroethene, chloroethylene, Ethylene monochloride, monochloroethene, monochloroethylene, VC, vinyl chloride monomer)	**O** = pleasant odor. Colorless gas or liquid **OT** = N/A	**TWA**= 1 PPM **STEL**= NA **C**= N/A **IDLH** = NA	**Exposure Routes**: Inhalation, Ingestion, skin and/or eye contact (liquid) **Symptoms**: Lassitude (weakness, exhaustion), abdominal pain, gastro intestinal bleeding, enlarged liver, pallor or cyanosis (appearance of a blue or purple coloration of the skin or mucous membranes due to the tissues near the skin surface being low on oxygen) of extremities, **Target Organs**: Liver, central nervous system, blood, respiratory system, lymphatic system (liver cancer)	**LEL**: (3.6%) **UEL**: (33.0%) Flammable gas	- copper, oxidizers, aluminum, peroxides, iron, steel. Polymerizes in air, sunlight, or heat unless stabilized by inhibitors such as phenol. Attacks iron and steel in presence of moisture

TABLE 10

HAND-SIGNAL COMMUNICATION SYSTEM

SIGNAL	MEANING
Hands on top of head	Need assistance
Grip partner's wrist or place hands around partner's arm	Leave area immediately
Thumbs up	OK; I'm alright
Thumbs down	No; negative
Hand gripping throat	Cannot breathe; out of air
Pointed finger on extended arm	Look in that direction
Wave hands over head from side to side	Attention; stand-by for next signal
Swing hand from direction of person receiving signal to directly overhead and through in circle	Come here

TABLE 11

EMERGENCY TELEPHONE NUMBERS

Agency	Telephone Number
Police Department	(787) 257-7500/701-1690
Hospital: Hospital Regional Carolina (Emergency)	(787) 757-1800
Fire Department	787) 769-2330/768-0015
Environmental Quality Board (Emergency Line)	(787) 766-2823 (787) 274-8037 (787) 274-0124
Environmental Protection Agency (National Response Center, Emergency Line)	1-800-424-8802
Environmental Protection Agency (Puerto Rico)	1-800-424-9346 1-800-424-8802
Poison Control Center (New Jersey)	1-800-962-1253

FIGURES


LA TORRECILLA
ALBROUPRTO INTERNACIONAL
ISLA VERDE
GANGREJO ARRIBA
Isleta Num 2
Los Angeles
CANAL
APPROXIMATE SITE LOCATION
SABANA ABAJO
Excelsior Country Club
Country Club Extension
Sabana Abajo
Campo Rico
SOURCE: USGS TOPOGRAPHIC MAP OF CAROLINA AND SAN JUAN QUADRANGLES 1969, (PHOTOREVISED 1982)
SCALE: 1: 20,000
ADDITIONAL ASSESSMENT ACTIVITIES REPORT
FORMER BIOVAIL CAROLINA FACILITY
SABANA ABAJO INDUSTRIAL PARK
CAROLINA, PUERTO RICO
SITE LOCATION MAP
PROJECT NO. 05-0001E
FIGURE 1

FIGURE 2

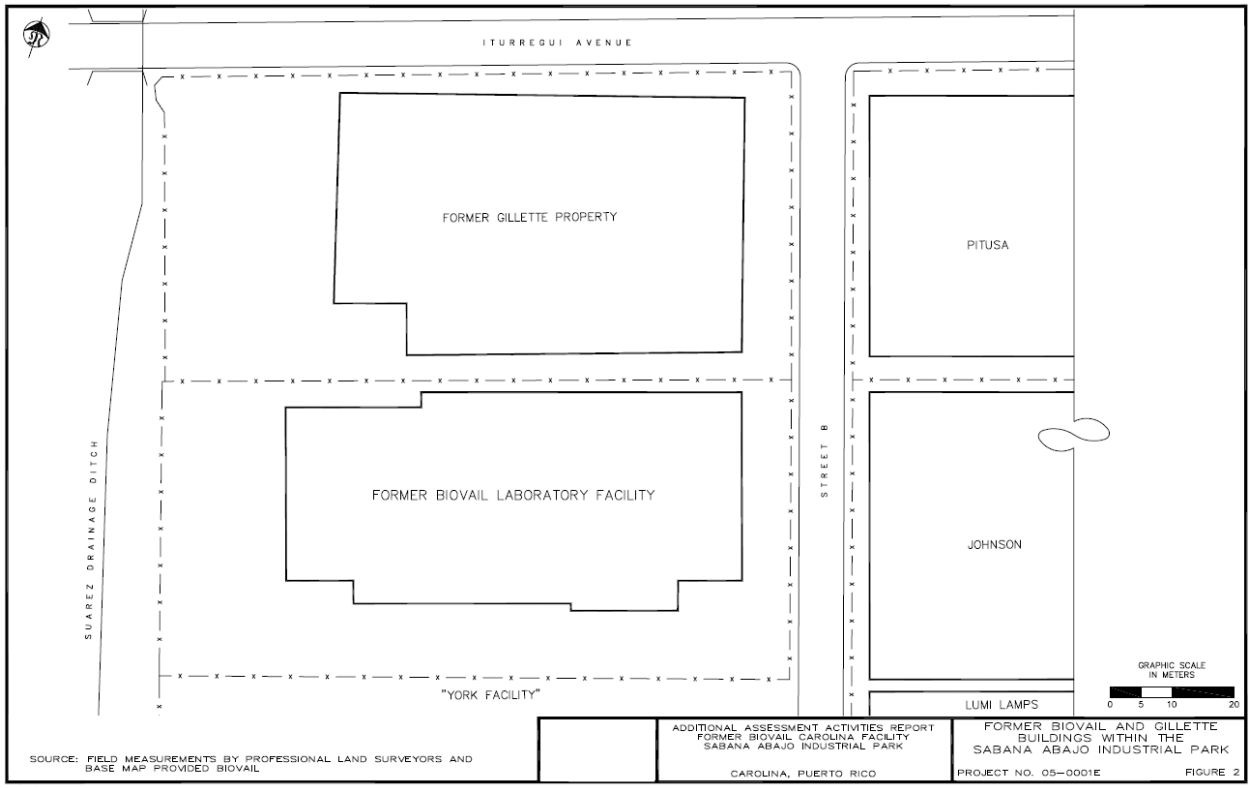

ITURREGUI AVENUE
FORMER GILLETTE PROPERTY
PITUSA
FORMER BIOVAIL LABORATORY FACILITY
JOHNSON
SUAREZ DRAINAGE DITCH
STREET B
"YORK FACILITY"
LUMI LAMPS
GRAPHIC SCALE IN METERS
0 5 10 20
SOURCE: FIELD MEASUREMENTS BY PROFESSIONAL LAND SURVEYORS AND BASE MAP PROVIDED BIOVAIL
ADDITIONAL ASSESSMENT ACTIVITIES REPORT
FORMER BIOVAIL CAROLINA FACILITY
SABANA ABAJO INDUSTRIAL PARK
CAROLINA, PUERTO RICO
FORMER BIOVAIL AND GILLETTE BUILDINGS WITHIN THE SABANA ABAJO INDUSTRIAL PARK
PROJECT NO. 05-0001E
FIGURE 2

FIGURE 3

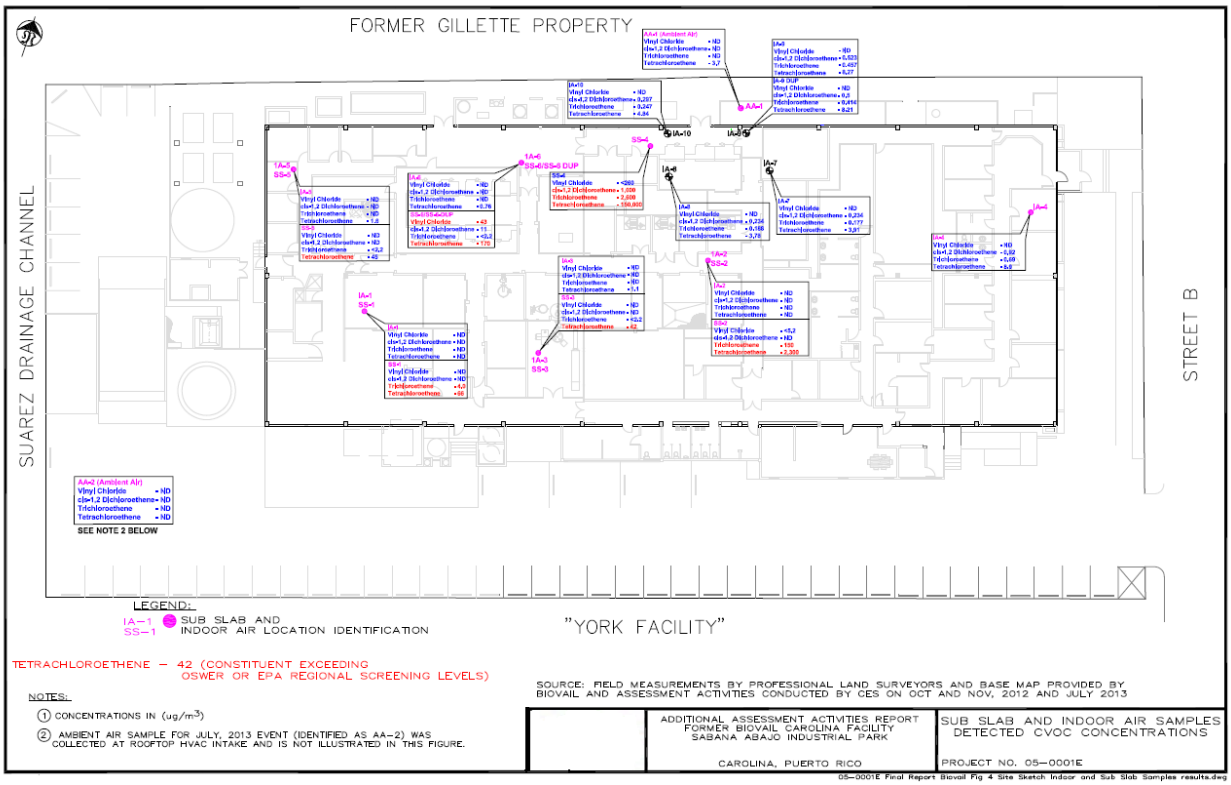

FORMER GILLETTE PROPERTY
SUAREZ DRAINAGE CHANNEL
STREET B
"YORK FACILITY"
SEE NOTE 2 BELOW
LEGEND:
IA-1
SS-1
SUB SLAB AND
INDOOR AIR LOCATION IDENTIFICATION
TETRACHLOROETHENE – 42 (CONSTITUENT EXCEEDING
OSWER OR EPA REGIONAL SCREENING LEVELS)
NOTES:
1 CONCENTRATIONS IN (ug/m3)
2 AMBIENT AIR SAMPLE FOR JULY, 2013 EVENT (IDENTIFIED AS AA-2) WAS COLLECTED AT ROOFTOP HVAC INTAKE AND IS NOT ILLUSTRATED IN THIS FIGURE.
SOURCE: FIELD MEASUREMENTS BY PROFESSIONAL LAND SURVEYORS AND BASE MAP PROVIDED BY BIOVAIL AND ASSESSMENT ACTIVITIES CONDUCTED BY CES ON OCT AND NOV, 2012 AND JULY 2013
ADDITIONAL ASSESSMENT ACTIVITIES REPORT
FORMER BIOVAIL CAROLINA FACILITY
SABANA ABAJO INDUSTRIAL PARK
CAROLINA, PUERTO RICO
SUB SLAB AND INDOOR AIR SAMPLES
DETECTED CVOC CONCENTRATIONS
PROJECT NO. 05-0001E
05-0001E Final Report Biovail Fig 4 Site Sketch Indoor and Sub Slab Samples results.dwg

FIGURE 4

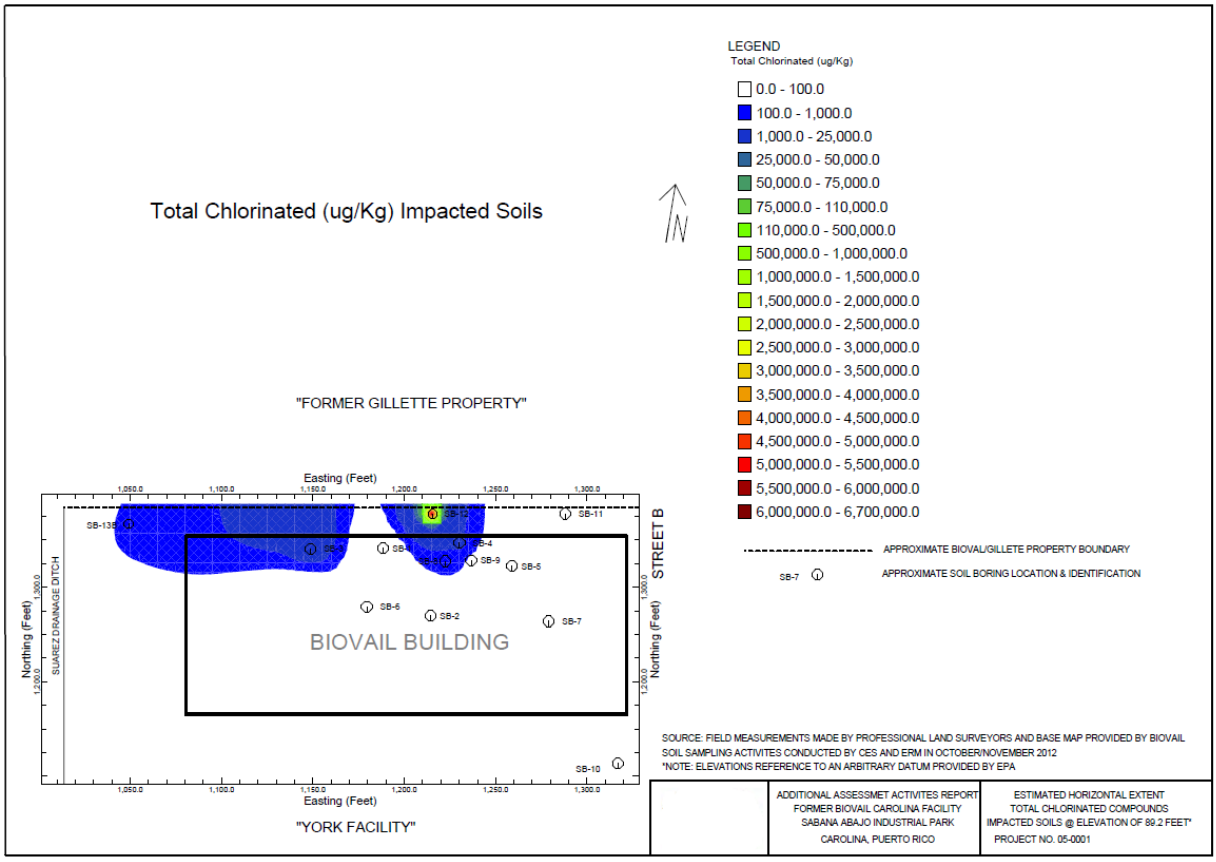

Total Chlorinated (ug/Kg) Impacted Soils
LEGEND
Total Chlorinated (ug/Kg)
0.0 - 100.0
100.0 - 1,000.0
1,000.0 - 25,000.0
25,000.0 - 50,000.0
50,000.0 - 75,000.0
75,000.0 - 110,000.0
110,000.0 - 500,000.0
500,000.0 - 1,000,000.0
1,000,000.0 - 1,500,000.0
1,500,000.0 - 2,000,000.0
2,000,000.0 - 2,500,000.0
2,500,000.0 - 3,000,000.0
3,000,000.0 - 3,500,000.0
3,500,000.0 - 4,000,000.0
4,000,000.0 - 4,500,000.0
4,500,000.0 - 5,000,000.0
5,000,000.0 - 5,500,000.0
5,500,000.0 - 6,000,000.0
6,000,000.0 - 6,700,000.0
APPROXIMATE BIOVAL/GILLETE PROPERTY BOUNDARY
APPROXIMATE SOIL BORING LOCATION & IDENTIFICATION
"FORMER GILLETTE PROPERTY"
Easting (Feet)
Northing (Feet)
SUAREZ DRAINAGE DITCH
STREET B
BIOVAIL BUILDING
SB-1
SB-2
SB-3
SB-4
SB-5
SB-6
SB-7
SB-9
SB-10
SB-11
SB-13B
"YORK FACILITY"
SOURCE: FIELD MEASUREMENTS MADE BY PROFESSIONAL LAND SURVEYORS AND BASE MAP PROVIDED BY BIOVAIL
SOIL SAMPLING ACTIVITES CONDUCTED BY CES AND ERM IN OCTOBER/NOVEMBER 2012
*NOTE: ELEVATIONS REFERENCE TO AN ARBITRARY DATUM PROVIDED BY EPA
ADDITIONAL ASSESSMET ACTIVITES REPORT
FORMER BIOVAIL CAROLINA FACILITY
SABANA ABAJO INDUSTRIAL PARK
CAROLINA, PUERTO RICO
ESTIMATED HORIZONTAL EXTENT
TOTAL CHLORINATED COMPOUNDS
IMPACTED SOILS @ ELEVATION OF 89.2 FEET*
PROJECT NO. 05-0001

FIGURE 5

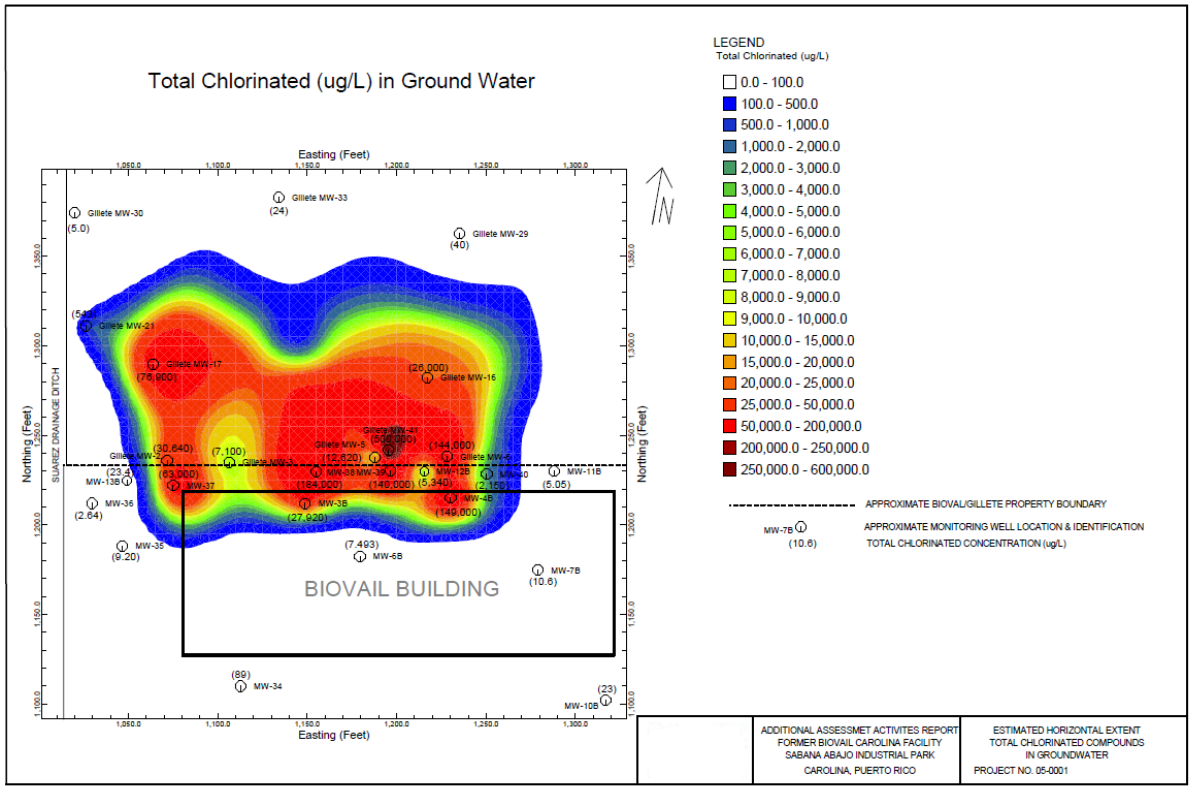

Total Chlorinated (ug/L) in Ground Water
Easting (Feet)
Northing (Feet)
SUAREZ DRAINAGE DITCH
BIOVAIL BUILDING
Gillete MW-30 (5.0)
Gillete MW-33 (24)
Gillete MW-29 (40)
Gillete MW-21 (5.43)
Gillete MW-17 (76,900)
Gillete MW-16 (26,000)
Gillete MW-45 (530,000)
Gillete MW-5 (12,620)
Gillete MW-6 (144,000)
Gillete MW-2 (30,640)
Gillete MW-1 (7,100)
MW-13B (23.4)
MW-37 (63,000)
MW-38 (164,000)
MW-39 (149,000)
MW-12B (5,340)
MW-40 (2,150)
MW-11B (5.05)
MW-36 (2.64)
MW-3B (27,920)
MW-4B (149,000)
MW-35 (9.20)
MW-6B (7,493)
MW-7B (10.6)
MW-34 (89)
MW-10B (23)
LEGEND
Total Chlorinated (ug/L)
0.0 - 100.0
100.0 - 500.0
500.0 - 1,000.0
1,000.0 - 2,000.0
2,000.0 - 3,000.0
3,000.0 - 4,000.0
4,000.0 - 5,000.0
5,000.0 - 6,000.0
6,000.0 - 7,000.0
7,000.0 - 8,000.0
8,000.0 - 9,000.0
9,000.0 - 10,000.0
10,000.0 - 15,000.0
15,000.0 - 20,000.0
20,000.0 - 25,000.0
25,000.0 - 50,000.0
50,000.0 - 200,000.0
200,000.0 - 250,000.0
250,000.0 - 600,000.0
APPROXIMATE BIOVAL/GILLETE PROPERTY BOUNDARY
MW-7B (10.6)
APPROXIMATE MONITORING WELL LOCATION & IDENTIFICATION
TOTAL CHLORINATED CONCENTRATION (ug/L)
ADDITIONAL ASSESSMET ACTIVITES REPORT
FORMER BIOVAIL CAROLINA FACILITY
SABANA ABAJO INDUSTRIAL PARK
CAROLINA, PUERTO RICO
ESTIMATED HORIZONTAL EXTENT
TOTAL CHLORINATED COMPOUNDS
IN GROUNDWATER
PROJECT NO. 05-0001

FIGURE 6

ORGANIZATION CHART

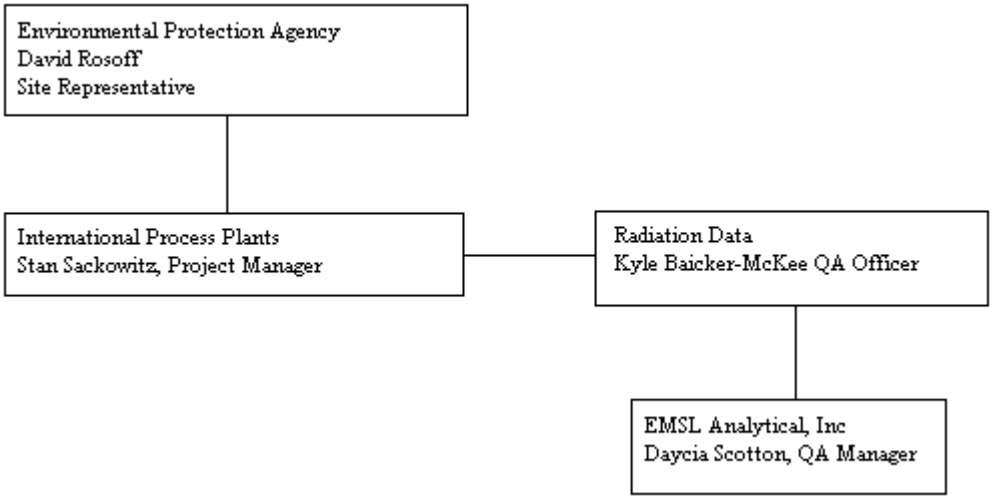


Figure 7

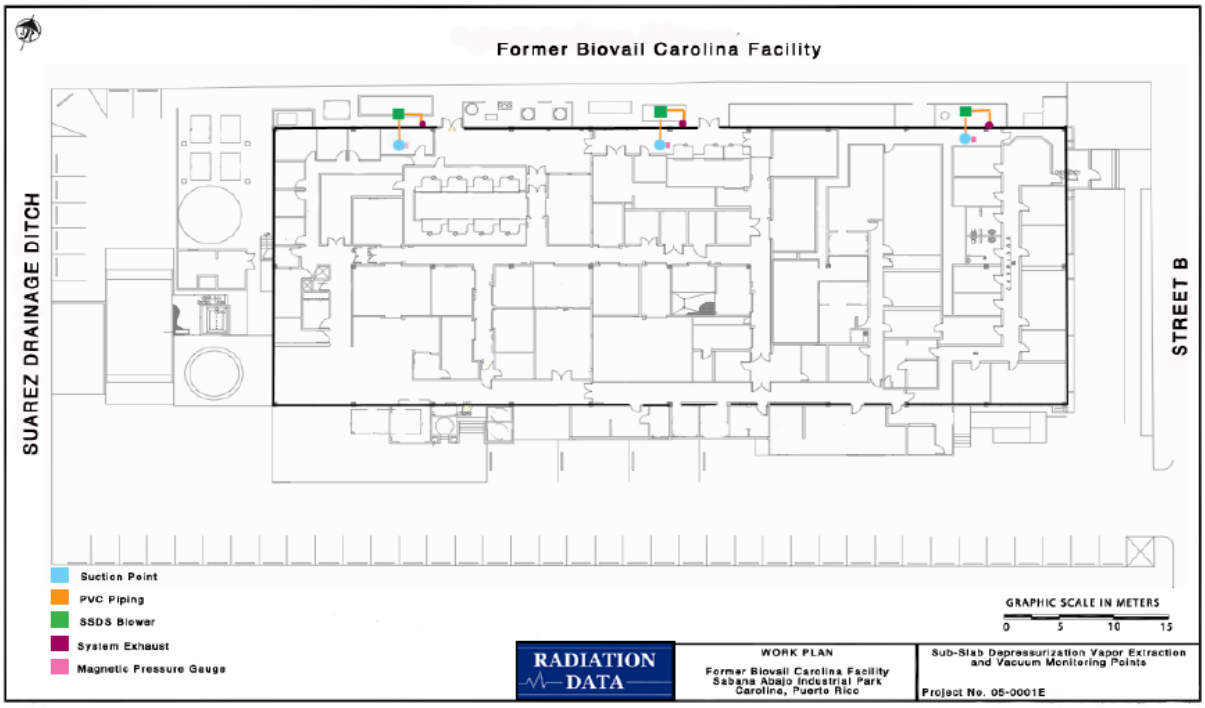
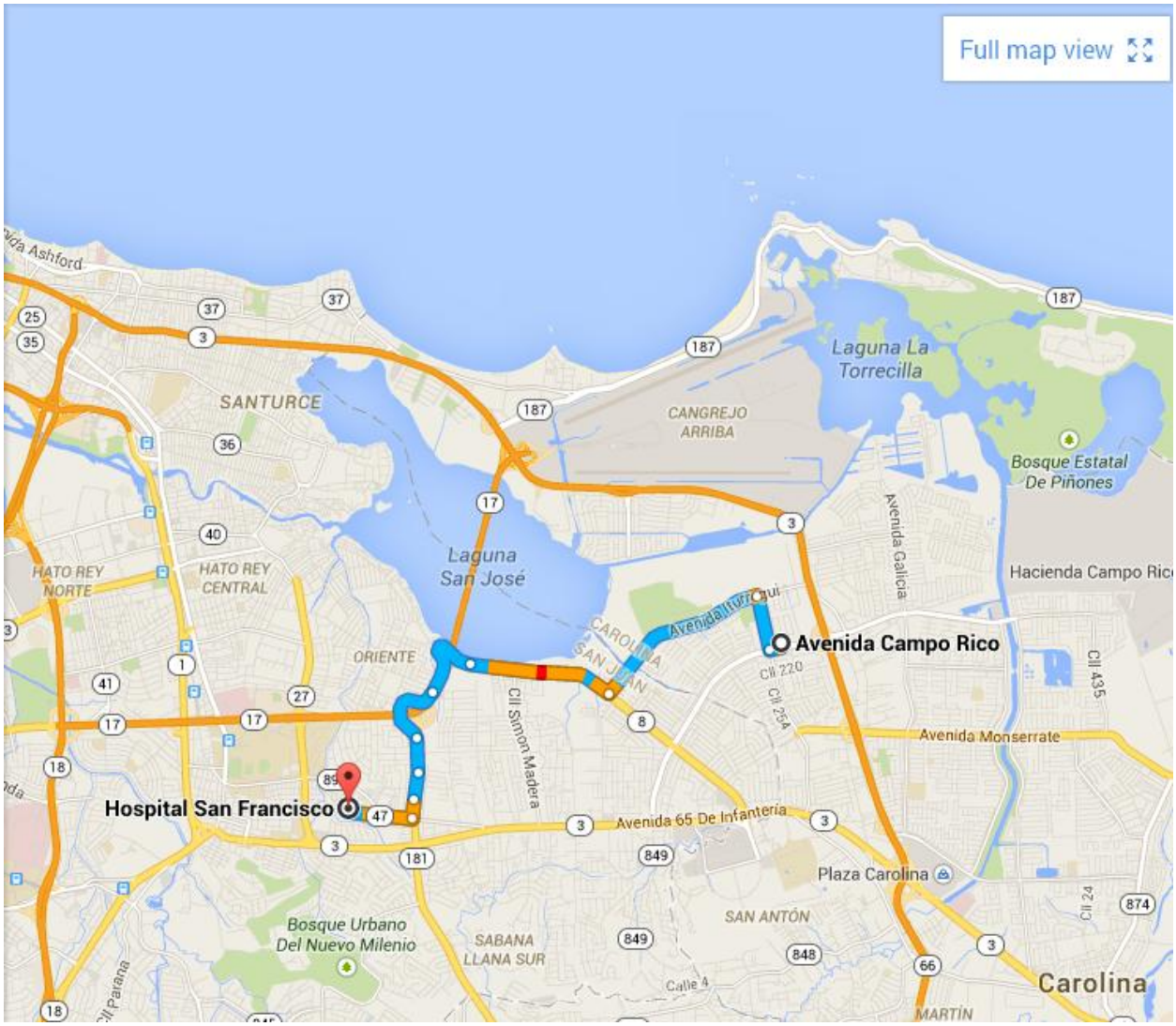

Former Biovail Carolina Facility
SUAREZ DRAINAGE DITCH
STREET B
Suction Point
PVC Piping
SSDS Blower
System Exhaust
Magnetic Pressure Gauge
GRAPHIC SCALE IN METERS
0 5 10 15
RADIATION DATA
WORK PLAN
Former Biovail Carolina Facility
Sabana Abajo Industrial Park
Carolina, Puerto Rico
Sub-Slab Depressurization Vapor Extraction and Vacuum Monitoring Points
Project No. 05-0001E

FIGURE 8



Hospital San Francisco

371 Calle José De Diego Río Piedras, Puerto Rico 00923, Puerto Rico
Drive 8.2 km, 11 min

Avenida Campo Rico

Carolina, 00983, Puerto Rico

Take Avenida Iturregui to Puerto Rico 8 in San Juan

2.9 km / 4 min

Head west on Avenida Campo Rico toward Avenida El Comandante
140 m

Take the 1st right onto Avenida El Comandante
650 m

Turn left onto Avenida Iturregui
2.1 km

Continue on Puerto Rico 8 to Río Piedras. Exit from Expreso Manuel Rivera Morales/Expreso Trujillo Alto/Puerto Rico 181

4.3 km / 5 min

Turn right onto Puerto Rico 8
1.7 km

Keep right at the fork and merge onto Puerto Rico 17/Puerto Rico 181
1.0 km

Take the exit toward Expreso Manuel Rivera Morales/Expreso Trujillo Alto/Puerto Rico 181
950 m

Continue onto Expreso Manuel Rivera Morales/Expreso Trujillo Alto/Puerto Rico 181
400 m

Take the exit toward Expreso Manuel Rivera Morales/Expreso Trujillo Alto
300 m

Drive to Calle José de Diego/Puerto Rico 47

1.0 km / 2 min

Continue onto Expreso Manuel Rivera Morales/Expreso Trujillo Alto
230 m

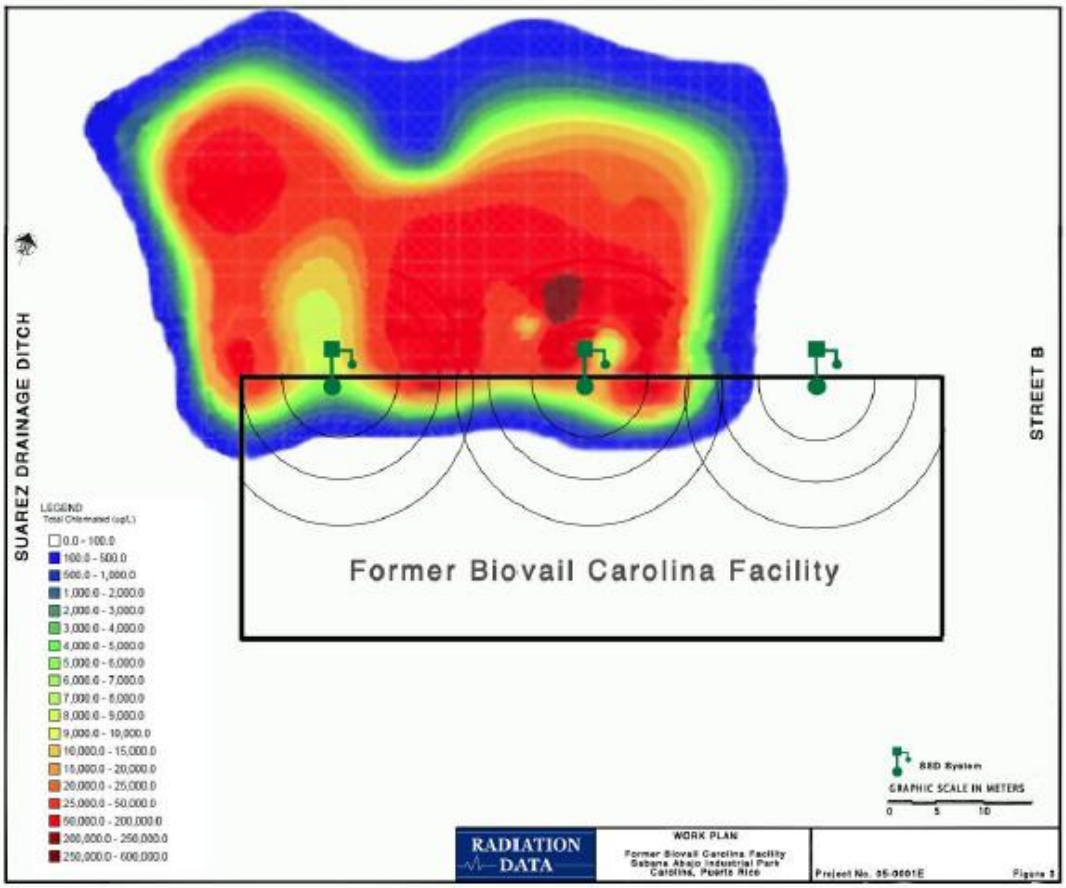
Turn right onto Calle José de Diego/Puerto Rico 47

Destination will be on the right
750 m

Hospital San Francisco

371 Calle José De Diego Río Piedras, Puerto Rico 00923, Puerto Rico

FIGURE 9



Based on the results of communications testing, the interior circle is predicted to have pressure differentials greater than 1.5" WC. The secondary circle is predicted to have pressure differentials of greater than 1.0" WC. The final region of influence is anticipated to have pressure differentials of greater than 0.2" WC.

Appendices

Appendix A

Initial Design Visit Checklist

Structure Address: Former Biovail — **Date of Design Visit:** _____
Structure ID #: 05-0016
Design Team: KBM + Jim Gibson

Diagnostic Communication Test Results

Test Point Location	Sub-slab Pressure - Vacuum Off ("Hg.)	Sub-slab Pressure - Vacuum On ("Hg.)	Sub-slab Pressure Differential ("Hg.)
001	+.01	-0.7	0.8
002	+.02	-0.9	1.1
003	-.01	-1.85	1.86
004	0.00	-1.3	1.3

· EXPOSED SLAB NOT (N) WELL.

Initial Backdraft Test Checklist

Was an initial backdraft test performed? ☐ Yes ☐ No

On what combustion appliances was a backdraft test performed? ☐ Hot Water Heater ☐ Furnace / Boiler ☐ Dryer
Other: NONE OBSERVED

Is there is an existing backdraft on any appliance? ☐ Yes ☒ No
(If yes, explain)

Were winter conditions simulated during tests? ☐ Yes ☐ No NO WINTER CONDITIONS IN PR
(Doors/windows closed, heating appliances running)

Was there precipitation during the previous 24 hours? ☐ Yes ☒ No

What is the apparent wind speed? ☒ Calm ☐ Light ☐ Strong

Documentation Checklist

Were digital photographs taken of existing conditions? ☒ Yes ☐ No

Is there visual pre-existing structure damage? ☐ Yes ☐ No MINIMAL

Was the site cleaned-up and left as found? ☒ Yes ☐ No

Comments:
SMALL LIP BELOW SLAB POINTS TO ABND MONITR COMMUNICATION. CLAY BELOW SLAB LIKELY LIMITS AREA.

Appendix B

Installation and Operation Commissioning Checklist

Structure Address: _____ **Date of Commissioning Visit:** _____

Structure ID #: _____

Commissioning Team: _____

System Performance Data

Fan Inlet Static Pressure (vacuum)

Fan System	1	2	3	4	5
Fan Model					
U-Tube Reading ("w.g)					

Is each fan mounted securely? ☐ Yes ☐ No

SSP Static Pressure (vacuum)

SSP#	Static Pressure ("w.g.)	Fan System

Final Communication Test Results

Communication test point						
Manometer reading ("w.g.)						
Distance to closest SSP (ft.)						

Communication test point						
Manometer reading ("w.g.)						
Distance to closest SSP (ft.)						

Were all fans in operation during final communication test? ☐ Yes ☐ No

Were 10% of all pipe joints smoke tested?	☐ Yes	☐ No	
Are manometers installed at each suction point?	☐ Yes	☐ No	
Are audible alarms installed and working at each suction point?	☐ Yes	☐ No	

Slab/Wall Repair Performance

Was each identified slab/wall crack repair smoke tested?	☐ Yes	☐ No	☐ NA

Labeling Inspection

Are the appropriate labels applied in the proper locations?	☐ Yes	☐ No

System Design

Are all vent pipe exhausts installed:	☐ Yes	☐ No
Above the eave of the roof?	☐ Yes	☐ No
At least 10 ft above ground level?	☐ Yes	☐ No
At least 10 ft away from any adjoining or adjacent buildings, or structure opening or HVAC intake?	☐ Yes	☐ No

Documentation

Were digital photographs taken of post-installation conditions?	☐ Yes	☐ No

Comments:

Electrical System Installation Inspection

Are all electrical connections secure? ☐ Yes ☐ No

Are all switches locked on? ☐ Yes ☐ No

Electric meter # _____

Pipe System Performance

Are all pipe runs properly supported? ☐ Yes ☐ No

Appendix C

GENERAL INSTRUCTIONS FOLLOWING MITIGATION/REMEDIATION SYSTEM INSTALLATION

Typical installations encompass sealing and ventilation techniques performed in a sequential order at the same time. Please read and use the following as guidelines for action following the installation:

SEALING TECHNIQUES:

The materials used are urethane sealants and epoxies. These materials are used for the bonding properties, flexibility and life. It will take 3 to 5 days for these materials to cure. During that time, windows on the lowest level of the property should be left open, if possible, for proper ventilation and dissipation of any odors.

Prior to the cure, if sealing materials come in contact with skin, they can cause irritation and we advise small children and elderly adults not be permitted in the area.

VENTING TECHNIQUES:

The system installed consists of mechanisms designed to prevent further vapor intrusion. However, this does not mean that immediately upon completion of the system all potential vapors have been removed. Ventilating the exposed areas will lessen the amount of time it takes for the existing vapors to dissipate but it is recommended to wait at least one week, and preferably longer before initiating any confirmatory testing.

GENERAL MAINTENANCE INSTRUCTIONS

1: The system must run uninterrupted as often as possible. Do not switch the system off for any reason other than to perform maintenance on the system. The more frequently the fans are turned on and off, the less durable they become.

2: Your system's suction gauge currently is reading _____

This should be monitored weekly. Variations of more than .3 inches of water column could be indicative of a change in the system functionality. Please call us at 609-466-4300 if such a change is observed.

Appendix D

System Inspection Field Form

PIPING, SLAB AND WALL

Routine or Non-Routine (circle one)

Address: _____ **Tracking Number:** _____

Piping Check	As Found	As Left
Glue is evident?		
System suction points are sealed?		
Each component is installed?		
Piping system is properly supported?		
Valves and manometers installed at proper locations?		
Excessive noise is heard in piping joints?		
Smoke test piping modifications and 10% of old joints?		
Did smoke enter joints?		
If Yes: Was joint sealed?		
Did smoke enter sealed joint?		
Slab Check		
Smoke each identified slab crack, repair, or modification?		
Did smoke enter?		
If Yes: Was area sealed with approved sealant?		
Did smoke enter sealed area?		
Checked/cleaned Dranjer(s)?		
Smoke Dranjer(s)?		
Wall Check		
Smoke each visible wall crack?		
Movement is observed at wall cracks?		
If yes: Crack was sealed with approved sealant?		
Smoke enters sealed crack?		
Smoke open course of top wall?		
Smoke enters top course?		
If yes: Open block sealed with approved sealant?		
Smoke enters open block tops?		

Comments

_____

_____

_____

_____

_____

Performed by: _____ **Date:** _____

Appendix E

RadonAway™

The World's Leading
Radon Fan Manufaturer

HS Series

Installation & Operating Instructions

RadonAway
3 Saber Way | Ward Hill, MA 01835
www.radonaway.com

P/N IN007-REV J 9/13

RadonAway

RadonAway Ward Hill, MA

HS Series Fan Installation & Operating Instructions

Please Read and Save These Instructions.

DO NOT CONNECT POWER SUPPLY UNTIL FAN IS COMPLETELY INSTALLED. MAKE SURE ELECTRICAL SERVICE TO FAN IS LOCKED IN "OFF" POSITION. DISCONNECT POWER BEFORE SERVICING FAN.

1. **WARNING!** Do not use fan in hazardous environments where fan electrical system could provide ignition to combustible or flammable materials.
2. **WARNING!** Do not use fan to pump explosive or corrosive gases.
   See Vapor Intrusion Application Note #AN001 for important information on VI applications. RadonAway.com/vapor-intrusion
3. **WARNING!** Check voltage at the fan to insure it corresponds with nameplate.
4. **WARNING!** Normal operation of this device may affect the combustion airflow needed for safe operation of fuel burning equipment. Check for possible backdraft conditions on all combustion devices after installation.
5. **NOTICE!** There are no user serviceable parts located inside the fan unit.
   Do NOT attempt to open. Return unit to the factory for service.
6. All wiring must be performed in accordance with the National Fire Protection Association's (NFPA)"National Electrical Code, Standard #70"-current edition for all commercial and industrial work, and state and local building codes. All wiring must be performed by a qualified and licensed electrician.
7. **WARNING!** In the event that the fan is immersed in water, return unit to factory for service before operating.
8. **WARNING!** Do not twist or torque fan inlet or outlet piping as Leakage may result.
9. **WARNING!** Do not leave fan unit installed on system piping without electrical power for more than 48 hours. Fan failure could result from this non-operational storage.
10. **WARNING!** TO REDUCE THE RISK OF FIRE, ELECTRIC SHOCK, OR INJURY TO PERSONS, OBSERVE THE FOLLOWING:

    a) Use this unit only in the manner intended by the manufacturer. If you have questions, contact the manufacturer.

    b) Before servicing or cleaning unit, switch power off at service panel and lock the service disconnecting means to prevent power from being switched on accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.

INSTALLATION & OPERATING INSTRUCTIONS (Rev J)
for High Suction Series
HS2000 p/n 23004-1
HS3000 p/n 23004-2
HS5000 p/n 23004-3

1.0 SYSTEM DESIGN CONSIDERATIONS

1.1 INTRODUCTION

The HS Series Fan is intended for use by trained, certified/licensed, professional Radon mitigators. The purpose of this instruction is to provide additional guidance for the most effective use of the HS Series Fan. This instruction should be considered as a supplement to EPA/Radon Industry standard practices, state and local building codes and state regulations. In the event of a conflict, those codes, practices and regulations take precedence over this instruction.

1.2 ENVIRONMENTALS

The HS Series Fan is designed to perform year-round in all but the harshest climates without additional concern for temperature or weather. For installations in an area of severe cold weather, please contact RadonAway for assistance. When not in operation, the HS Series Fan should be stored in an area where the temperature is never less than 32 degrees F. or more than 100 degrees F. The HS Series Fan is thermally protected such that it will shut off when the internal temperature is above 104 degrees F. Thus if the HS Series Fan is idle in an area where the ambient temperature exceeds this shut off, it will not restart until the internal temperature falls below 104 degrees F.

1.3 ACOUSTICS

The HS Series Fan, when installed properly, operates with little or no noticeable noise to the building occupants. There are, however, some considerations to be taken into account in the system design and installation. When installing the HS Series Fan above sleeping areas, select a location for mounting which is as far away as possible from those areas. Avoid mounting near doors, fold-down stairs or other uninsulated structures which may transmit sound. Insure a solid mounting for the HS Series Fan to avoid structure-borne vibration or noise.

The velocity of the outgoing air must also be considered in the overall system design. With small diameter piping, the "rushing" sound of the outlet air can be disturbing. The system design should incorporate a means to slow and quiet the outlet air. The use of the RadonAway Exhaust Muffler, p/n 24002, is strongly recommended.

1.4 GROUND WATER

Under no circumstances should water be allowed to be drawn into the inlet of the HS Series Fan as this may result in damage to the unit. The HS Series Fan should be mounted at least 5 feet above the slab penetration to minimize the risk of filling the HS Series Fan with water in installations with occasional high water tables.

In the event that a temporary high water table results in water at or above slab level, water will be drawn into the riser pipes thus blocking air flow to the HS Series Fan. The lack of cooling air will result in the HS Series Fan cycling on and off as the internal temperature rises above the thermal cutoff and falls upon shutoff. Should this condition arise, it is recommended that the HS Series Fan be disconnected until the water recedes allowing for return to normal operation.

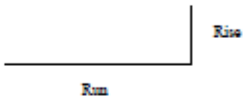
1.5 CONDENSATION & DRAINAGE

(*WARNING!*: Failure to provide adequate drainage for condensation can result in system failure and damage the HS Series Fan).

Condensation is formed in the piping of a mitigation system when the air in the piping is chilled below its dew point. This can occur at points where the system piping goes through unheated space such as an attic, garage or outside. The system design must provide a means for water to drain back to a slab hole to remove the condensation.

The use of small diameter piping in a system increases the speed at which the air moves. The speed of the air can pull water uphill and at sufficient velocity it can actually move water vertically up the side walls of the pipe. This has the potential of creating a problem in the negative pressure (inlet) side piping. For HS Series Fan inlet piping, the following table provides the minimum recommended pipe diameters as well as minimum pitch under several system conditions. Use this chart to size piping for a system.

Pipe Diam.	Minimum Rise per Foot of Run*		
	@ 25 CFM	@ 50 CFM	@ 100 CFM
4"	1/32 "	3/32 "	3/8 "
3"	1/8 "	3/8 "	1 1/2 "



*Typical operational flow rates:

HS3000, or HS5000	20 - 40 CFM
HS2000	50 - 90 CFM

All exhaust piping should be 2" PVC.

1.6 SYSTEM MONITOR AND LABEL

A properly designed system should incorporate a "System On" indicator for affirmation of system operation. A Magnehelic pressure gauge is recommended for this purpose. The indicator should be mounted at least 5 feet above the slab penetration to minimize the risk of filling the gauge with water in installations with occasional high water tables. A System Label (P/N 15022) with instructions for contacting the installing contractor for service and also identifying the necessity for regular radon tests to be conducted by the building occupants, must be conspicuously placed where the occupants frequent and can see the label.

1.7 SLAB COVERAGE

The HS Series Fan can provide coverage of well over 1000 sq. ft. per slab penetration. This will, of course, depend on the sub-slab aggregate in any particular installation and the diagnostic results. In general, sand and gravel are much looser aggregates than dirt and clay. Additional suction points can be added as required. It is recommended that a small pit (2 to 10 gallons in size) be created below the slab at each suction hole.

1.8 ELECTRICAL WIRING

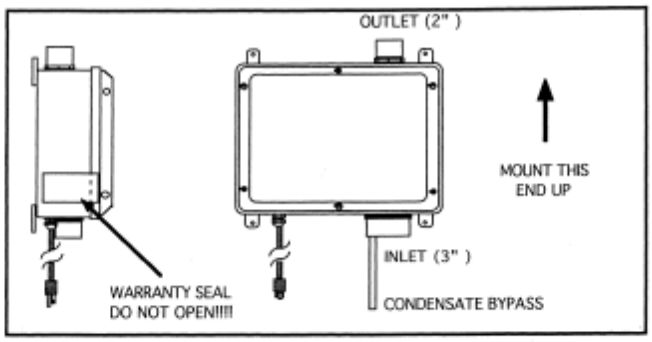
The HS Series Fan plugs into a standard 120V outlet. All wiring must be performed in accordance with the National Fire Protection Association's (NFPA)"National Electrical Code, Standard #70"-current edition for all commercial and industrial work, and state and local building codes. All wiring must be performed by a qualified and licensed electrician. Outdoor installations require the use of a U.L. listed watertight conduit. Ensure that all exterior electrical boxes are outdoor rated and properly caulked to prevent water penetration into the box. A means, such as a weep hole, is recommended to drain the box.

1.8a ELECTRICAL BOX (optional)

The optional Electrical Box (p/n 20003) provides a weather tight box with switch for outdoor hardwire connection. All wiring must be performed in accordance with the National Fire Protection Association's (NFPA)" National Electrical Code, Standard #70"-current edition for all commercial and industrial work, and state and local building codes. All wiring must be performed by a qualified and licensed electrician. Outdoor installations require the use of a U.L. listed watertight conduit. Ensure that all exterior electrical boxes are outdoor rated and properly caulked to prevent water penetration into the box. A means, such as a weep hole, is recommended to drain the box.

1.9 SPEED CONTROLS

Electronic speed controls can **NOT** be used on HS Series units.



2.0 INSTALLATION

2.1 MOUNTING

Mount the HS Series Fan to the wall studs, or similar structure, in the selected location with (4) 1/4" x 1 1/2" lag screws (not provided). Insure the HS Series Fan is both plumb and level.

2.2 DUCTING CONNECTIONS

Make final ducting connection to HS Series Fan with flexible couplings. Insure all connections are tight. Do not twist or torque inlet and outlet piping on HS Series Fan or leaks may result.

2.3 VENT MUFFLER INSTALLATION

Install the muffler assembly in the selected location in the outlet ducting. Solvent weld all connections. The muffler is normally installed above the roofline at the end of the vent pipe.

2.5 OPERATION CHECKS & ANNUAL SYSTEM MAINTENANCE

____ Make final operation checks by verifying all connections are tight and leak-free.

____ Insure the HS Series Fan and all ducting is secure and vibration-free.

____ Verify system vacuum pressure with Magnehelic. Insure vacuum pressure is within normal operating range and less than the maximum recommended as shown below:

HS2000	14" WC
HS3000	21" WC
HS5000	40" WC

(Above are based on sea-level operation, at higher altitudes reduce above by about 4% per 1000 Feet.) If these are exceeded, increase number of suction points.

____ Verify Radon levels by testing to EPA protocol.

Addendum

PRODUCT SPECIFICATIONS

Model	Maximum Static Suction	Typical CFM vs Static Suction WC (Recommended Operating Range)						Power* Watts @ 115 VAC
		0"	10"	15"	20"	25"	35"	
HS2000	18"	110	72	40	-	-	-	160-270
HS3000	27"	40	33	30	23	18	-	105-195
HS5000	50"	53	47	42	38	34	24	180-320

*Power consumption varies with actual load conditions

Inlet: 3.0" PVC

Outlet: 2.0" PVC

Mounting: Brackets for vertical mount

Weight: Approximately 18 lbs.

Size: Approximately 15"W x 13"H x 8"D

Minimum recommended inlet ducting (greater diameter may always be used):

HS3000, HS5000 --- 2.0" PVC Pipe

HS2000 --- Main feeder line of 3.0" or greater PVC Pipe

Branch lines (if 3 or more) may be 2.0" PVC Pipe

Outlet ducting: 2.0" PVC

Storage temperature range: 32 - 100 degrees F.

Thermally protected

Locked rotor protection

Internal Condensate Bypass

IMPORTANT INSTRUCTIONS TO INSTALLER

Inspect the HS Series Fan for shipping damage within 15 days of receipt. Notify **RadonAway of any damages immediately**. RadonAway is not responsible for damages incurred during shipping. However, for your benefit, RadonAway does insure shipments.

There are no user serviceable parts inside the fan. **Do not attempt to open.** Return unit to factory for service.

Install the HS Series Fan in accordance with all EPA standard practices, and state and local building codes and state regulations.

Provide a copy of this instruction or comparable radon system and testing information to the building occupants after completing system installation.

WARRANTY

Subject to any applicable consumer protection legislation, RadonAway warrants that the HS Series Fan (the "Fan") will be free from defects in materials and workmanship for a period of one (1) year from the date of manufacture (the "Warranty Term"). Outside the Continental United States and Canada the Warranty Term is one (1) year from the date of manufacture.

RadonAway will repair any fan which fails due to defects in materials or workmanship. The Fan must be returned (at owner's cost) to the RadonAway factory. Proof of purchase must be supplied upon request for service under this Warranty.

This Warranty is contingent on installation of the Fan in accordance with the instructions provided. This Warranty does not apply where any repairs or alterations have been made or attempted by others, or if the unit has been abused or misused. Warranty does not include damage in shipment unless the damage is due to the negligence of RadonAway.

RadonAway is not responsible for installation, removal or delivery costs associated with this Warranty.

EXCEPT AS STATED ABOVE, THE HS SERIES FANS ARE PROVIDED WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

IN NO EVENT SHALL RADONAWAY BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR RELATING TO, THE FAN OR THE PERFORMANCE THEREOF. RADONAWAY'S AGGREGATE LIABILITY HEREUNDER SHALL NOT IN ANY EVENT EXCEED THE AMOUNT OF THE PURCHASE PRICE OF SAID PRODUCT. THE SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY SHALL BE THE REPAIR OR REPLACEMENT OF THE PRODUCT, TO THE EXTENT THE SAME DOES NOT MEET WITH RADONAWAY'S WARRANTY AS PROVIDED ABOVE.

For service under this Warranty, contact RadonAway for a Return Material Authorization (RMA) number and shipping information. No returns can be accepted without an RMA. If factory return is required, the customer assumes all shipping cost to and from factory.

RadonAway
3 Saber Way
Ward Hill, MA 01835
TEL (978) 521-3703
FAX (978) 521-3964

Record the following information for your records:

Serial No._____
Purchase Date_____

Appendix F

1. Objective

This document defines the standard operating procedure (SOP) and necessary equipment for collection of indoor air samples using canisters.

2. Equipment

Personnel implementing this guideline must ensure that the following are in place:

- Field book
- Gloves
- Ultra-fine permanent marker
- Paper towels or Kimwipes
- Sampling logs
- Canisters with flow controllers (project specific appropriate size, supplied by the laboratory) or equivalent
- Watch or timer
- Safety equipment (e.g. first aid kit, eye wash, 20lb fire extinguisher, etc.)
- Standard field tools (e.g., ratchet set, safety cutting tools, wrenches, zip-ties, etc.)
- Shipping supplies (e.g., UN boxes, shipping labels, hazard labels, packing tape)

3. Ambient Air Sampling

Prior to mobilizing to perform indoor air sampling, ensure the following:

- Access has been granted for the building in question for the period necessary for installation;
- Perform daily safety meeting, reviewing weather, procedures, and location concerns (access, animals, etc.)
- Verify that all necessary parties are present and informed of the sampling activity to be conducted.
- Perform walk through assessment survey.
- Perform canister vacuum check.
- Assemble a canister with the appropriate flow controller.

• Choose sampling locations related to the purpose of the work plan. Ensure that each location for the sample media and equipment is available so as to reduce potential harm to the sample or personal injury to building occupants or field personnel.
• Record Sample identification, canister number and initial vacuum on the sample data sheet and the canister sample tag.
• Remove the brass cap from the inlet of the flow controller.
• Place the canister in the appropriate sample location and open the canister valve one turn and record the sample start time on the sampling data sheet and the canister sample tag. For a 6-Liter canister set at -28 inches mercury (Hg) over a 24-hour period the flow rate is set by the analytical laboratory at 3.5 ml/min.
• Record a detailed description of the sample location on the data sheet.
• Allow canister to sample for chosen sample duration. The final vacuum reading should be between 5 and 10 inches of mercury. Do not allow the canister to equilibrate with the atmosphere. When the appropriate duration has elapsed, shut the valve.
• Remove flow controller from canister, obtain final canister pressure readings, and replace brass cap on the canister, per the steps listed in Section 4 of this SOP.
• Record the stop time and final vacuum reading on the sampling data sheet and the canister sample tag.
• Record sample information of the Chain of Custody and prepare sample for transportation to the laboratory.
4. Quality Control
Quality control procedures have been developed to verify equipment integrity, sample quality, and sample repeatability.
In addition to the procedures listed below, the following items are also of concern:
• Care should be taken to keep all sampling equipment, especially the canisters, safe from damage.
Canister Vacuum Check
The canister vacuum check will be performed for 100% of the canisters.
Prior to Sampling
• Attach pressure gauge to the canister inlet.
• Open valve completely. SOP No. 46 Indoor Air Sampling with Canisters

• Record reading. The canister should show a vacuum of approximately -28 inches of Hg.
If the canister has a vacuum of less than -25 inches of Hg (adjusted for any elevation effects), then:
1: Label the canister with “Insufficient vacuum – No Sample”;
2: Set canister aside for return to the laboratory; and
3: Contact project manager and lab coordinator if canister failures affect field work.
• Close valve completely.
• Remove the pressure gauge.
After Sampling
• Attach a pressure gauge to the canister inlet.
• Open valve completely.
• Record reading. There should still be a slight vacuum in the canister. If the canister does not show a significant net loss in vacuum after sampling, evaluate and document the problem. If necessary, contact the project manager immediately to determine the value of using another canister to recollect the sample.
• Close valve completely.
• Remove the pressure gauge.
• Seal canister with plug (cap).
5. Shipping
• Sample information shall be recorded on a chain of custody for the laboratory following procedures.
• Samples will be shipped to the laboratory following DOT regulations.

Appendix G

1. Objective:

This document defines the standard procedure for the control and custody of environmental samples.

2. Equipment

The following equipment will be needed for sample control and custody procedures:

- Waterproof coolers (hard plastic or metal)
- Custody Seals
- Field forms such as a Chain of Custody (COC) or sample collection sheet
- Field Notebook
- Ice
- Sample Log-in Book
- Clear Tape
- Duct Tape
- Zip-Loc Bags
- Waterproof pens
- Permanent Markers.

3. Sample Control and Custody Procedures

Once the samples are collected, they must remain in the custody of the sampler or another worker from the site. The samples can also remain unattended in a locked vehicle or jobsite trailer so tampering with the samples will not be possible. Right before shipment, a custody seal should be placed over the opening of the cooler and then the cooler should be taped all the way around with clear packing tape to prevent tampering with the samples. Samples will be hand delivered or shipped via overnight express carrier for delivery to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific holding times. This may require daily shipment of samples with short holding times. Each cooler will contain a chain of custody (COC) form.

During field sampling activities, traceability of the samples must be maintained from the time the samples are collected until the laboratory data is issued. Initial information concerning the collection of the samples will be recorded in the field log book. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. If the COC is not three-part (minimum) carbon-copy

form, then photocopy the COC after signatures have been obtained, before the samples and original copy leave the site.

COC forms will be used to document the transport and receipt of samples from the field to the lab. Information required on a COC includes the following:

• Samplers signature and affiliation

• Project Number

• Date and time of collection

• Sample identification number

• Sample Type

• Analyses requested.

• The total number of containers being sent to the lab for each sample

• The appropriate preservative used

• If any samples are to be placed on hold at the laboratory, this should be clearly indicated on the COC in the comments section

Signature of person(s) relinquishing custody, dates, and times

• Signature of person(s) accepting custody, dates, and times

• Method of shipment

• Shipping air bill number (if appropriate).

The person responsible for delivery of the samples to the laboratory will sign the COC form, retain the last copy of the three-part COC form, document the method of shipment, and send the original and the second copy of the COC form with the samples. Upon receipt at the laboratory, the person receiving the samples will sign the COC form. The original COC will remain with the samples until final disposition of the samples by the laboratory. The laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting.

Appendix H

Safety Data Sheet

Issue Date: 01-Sep-2000 **Revision Date:** 20-Nov-2013 **Version** 1

1. IDENTIFICATION

Product Identifier
Product Name GORILLA PVC Cement for Plastic Pipe

Other means of identification
SDS # GPVC-001

Recommended use of the chemical and restrictions on use
Recommended Use PVC cement.

Details of the supplier of the safety data sheet
Supplier Address
Gorilla PVC
PO Box 848969
Hollywood, FL 33084

Emergency Telephone Number
Company Phone Number 1-888-367-4583
Emergency Telephone (24 hr) INFOTRAC 1-352-323-3500 (International)
1-800-535-5053 (North America)

2. HAZARDS IDENTIFICATION

Appearance Clear, medium bodied syrupy liquid **Physical State** Liquid **Odor** Amine

Classification

Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 2
Reproductive toxicity	Category 1B
Specific target organ toxicity (single exposure)	Category 3

Hazards Not Otherwise Classified (HNOC)
May be harmful if swallowed

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May damage fertility or the unborn child
May cause respiratory irritation. May cause drowsiness or dizziness

Precautionary Statements - Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Wear eye/face protection
Avoid breathing dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area

Precautionary Statements - Response
If exposed or concerned: Get medical advice/attention
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
IF ON SKIN: Wash with plenty of soap and water
If skin irritation occurs: Get medical advice/attention
Take off contaminated clothing and wash it before reuse
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Precautionary Statements - Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No	Weight-%
N-methyl-2-pyrrolidone	872-50-4	>85
Polyvinyl Chloride Resin	Proprietary	Proprietary

If Chemical Name/CAS No is "proprietary" and/or Weight-% is listed as a range, the specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. FIRST-AID MEASURES

First Aid Measures

General Advice — If exposed or concerned: Get medical advice/attention.

Eye Contact — Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. If eye irritation persists: Get medical advice/attention.

Skin Contact — Wash affected areas thoroughly with soap and water for at least 15 minutes. Take off contaminated clothing. Wash contaminated clothing before reuse. Get medical attention if irritation occurs.

Inhalation — Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion — Dilute by giving a large amount of water. Induce vomiting, but only if victim is fully conscious. Call a physician or poison control center immediately.

Most important symptoms and effects

Symptoms — Vapors may cause dizziness or nausea. Contact with eyes causes irritation and temporary corneal clouding. May cause skin irritation and defatting of skin with repeated/prolonged contact. Ingestion may cause nausea, vomiting and abdominal pain.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Water. Water spray (fog). Foam. Carbon dioxide (CO2). Dry chemical.

Unsuitable Extinguishing Media Not determined.

Specific Hazards Arising from the Chemical
Can react with oxidizing materials.

Hazardous Combustion Products Carbon oxides. Nitrogen oxides (NOx).

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal Precautions ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Avoid contact with eyes. Ventilate area of leak or spill.

Environmental Precautions Prevent product from entering drains.

Methods and material for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for Clean-Up Absorb or cover with dry earth, sand, or other non-combustible material and transfer to containers. Flush area with water.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on Safe Handling Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wash thoroughly after handling. Use personal protection recommended in Section 8. Avoid breathing vapors or mists. Use only in well-ventilated areas. Observe precautions found on the label. Keep away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity). Avoid contact with skin, eyes or clothing. Train employees on all special handling procedures before they work with this product.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place. Store locked up. Store in the shade between 40°F-110°F (5°C-43.7°C).

Incompatible Materials Moisture. Strong acids. Oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines No exposure limits noted for ingredient(s)

Appropriate engineering controls

Engineering Controls Eyewash stations. Showers. Ventilation systems. Use explosion proof equipment.

Individual protection measures, such as personal protective equipment

Eye/Face Protection Splash proof chemical safety goggles.

Skin and Body Protection Butyl rubber or Fep teflon gloves. Impervious apron. Boots as necessary.

Respiratory Protection If vapors or mists are generated, wear a NIOSH/MSHA approved organic vapor/mist respirator or an air supplied respirator as appropriate. Use only SCBA for emergencies.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State	Liquid		
Appearance	Clear, medium bodied syrupy liquid	**Odor**	Amine
Color	Not determined	**Odor Threshold**	Not determined

Property	Values	Remarks • Method
pH	Not determined	
Melting Point/Freezing Point	Not determined	
Boiling Point/Boiling Range	204.3 °C / 401 °F	
Flash Point	95.6 °C / 204 °F	ASTM D-93-73 Based on UL
Evaporation Rate	Not available	
Flammability (Solid, Gas)	n/a-liquid	
Upper Flammability Limits	9.5%	
Lower Flammability Limit	1.3%	
Vapor Pressure	<1 millibar	@ 20°C (68°F)
Vapor Density	3.4	(Air=1)
Specific Gravity	1.10±0.040	
Water Solubility	Solvent: complete; Resin: precipitates	
Solubility in other solvents	Not determined	
Partition Coefficient	Not determined	
Auto-ignition Temperature	Not determined	
Decomposition Temperature	Not determined	
Kinematic Viscosity	Not determined	
Dynamic Viscosity	Not determined	
Explosive Properties	Not determined	
Oxidizing Properties	Not determined	
VOC Content	VOC as manufactured: 920 g/L Maximum VOC emission per SCAQMD Rule 1168, Test Method 316A: 510 g/L	

10. STABILITY AND REACTIVITY

Reactivity
Not reactive under normal conditions.

Chemical Stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
None under normal processing.

Hazardous Polymerization Hazardous polymerization does not occur.

Conditions to Avoid
Hygroscopic (absorbs moisture from the air).

Incompatible Materials
Moisture. Strong acids. Oxidizing agents.

Hazardous Decomposition Products
Carbon oxides. Nitrogen oxides (NOx).

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information

Eye Contact Causes serious eye irritation.

Skin Contact Causes skin irritation.

Inhalation Avoid breathing vapors or mists.

Ingestion May be harmful if swallowed.

Component Information

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
N-methyl-2-pyrrolidone 872-50-4	= 3598 mg/kg (Rat)	= 8 g/kg (Rabbit)	= 3.1 mg/L (Rat) 4 h
Polyvinyl Chloride Resin	> 90 mL/kg (Rat)	-	-

Information on physical, chemical and toxicological effects

Symptoms Please see section 4 of this SDS for symptoms.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Carcinogenicity This product does not contain any carcinogens or potential carcinogens as listed by OSHA, IARC or NTP.

Reproductive toxicity May damage fertility or the unborn child.

STOT - single exposure May cause respiratory irritation. May cause drowsiness or dizziness.

Numerical measures of toxicity
Not determined

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12. ECOLOGICAL INFORMATION

Ecotoxicity

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Chemical Name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
N-methyl-2-pyrrolidone 872-50-4	500: 72 h Desmodesmus subspicatus mg/L EC50	832: 96 h Lepomis macrochirus mg/L LC50 static 1072: 96 h Pimephales promelas mg/L LC50 static 1400: 96 h Poecilia reticulata mg/L LC50 static		4897: 48 h Daphnia magna mg/L EC50

Persistence/Degradability

Not determined.

Bioaccumulation

Not determined.

Mobility

Chemical Name	Partition Coefficient
N-methyl-2-pyrrolidone 872-50-4	-0.46

Other Adverse Effects

Not determined

13. DISPOSAL CONSIDERATIONS

Waste Treatment Methods

Disposal of Wastes Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated Packaging Disposal should be in accordance with applicable regional, national and local laws and regulations.

14. TRANSPORT INFORMATION

DOT Not regulated

IATA Not regulated

IMDG Not regulated

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15. REGULATORY INFORMATION

International Inventories
Not determined

US Federal Regulations

SARA 313

Chemical Name	CAS No	Weight-%	SARA 313 - Threshold Values %
N-methyl-2-pyrrolidone - 872-50-4	872-50-4	100	1.0

US State Regulations

California Proposition 65
This product contains the following Proposition 65 chemicals.

Chemical Name	California Proposition 65
N-methyl-2-pyrrolidone - 872-50-4	Developmental

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
N-methyl-2-pyrrolidone 872-50-4	X	X	X

16. OTHER INFORMATION

NFPA	**Health Hazards**	**Flammability**	**Instability**	**Special Hazards**
	2	0	0	Not determined
HMIS	**Health Hazards**	**Flammability**	**Physical Hazards**	**Personal Protection**
	2	0	0	H

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Revision Date: 20-Nov-2013
Revision Note: New format

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet