SITE MANAGEMENT PLAN

Former Manufactured Gas Plant Site
10 Waterfront Place
Port Chester, NY
NYSDEC Voluntary Agreement Site # V00516-3

Prepared for:

Village of Port Chester
222 Grace Church Street
Port Chester, NY 10573

Prepared by:

JM Sorge, Inc.
environmental consultants

57 Fourth Street
Somerville, NJ 08876

JMS Project # 2002.095

April 2011

I certify that this Site Management Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER 10).

Joseph M. Sorge, President, JM Sorge, Inc., QEP, LSRP (NJ)

Table of Contents

TABLES

FIGURES

APPENDICES

Site Management Plan

Former Port Chester Manufactured Gas Plant Site
10 Waterfront Place, Port Chester, New York
NYSDEC Site ID Number V00516-3

1.0 INTRODUCTION

The Village of Port Chester entered into a Voluntary Cleanup Agreement (VCA) on April 9, 2002 with the New York State Department of Environmental Conservation (NYSDEC) to effect the remediation of the Site. The Site is part of a larger redevelopment area known as the Port Chester Marina Redevelopment Project (Figure 1).

Historic information confirmed that between approximately 1862 and 1895 a manufactured gas plant operated at the site. The manufacturing portions of the operations ceased by 1895 and the facility was demolished completely by 1902. Since the early 1900's, the Site was occupied by various industrial and commercial operations such as a warehouse, an iron works, a waste reclamation company, a machine shop, and a retail gasoline station.

An extensive investigation of the site was completed under the VCP program. The Site investigation included the completion of a thorough soil and groundwater investigation for the site to support the development of an approvable site remediation plan. The investigation results confirmed that the site was impacted with metals, volatile, and semi-volatile organic compounds predominantly associated with the former use of the site as an MGP plant. Limited groundwater and soil gas contamination was also identified.

Detailed descriptions of the history of the Site, the nature and extent of the contamination identified, and the subsurface structures present is provided in the JMS Remedial Investigation Report (December 2001) and the JMS Site Investigation Report (SIR) submitted to the NYSDEC in February 2004 and subsequently approved under the VCP program. The SIR also included a complete review of the geology and hydrology of the site area.

A Remedial Action Work Plan (RAWP) was developed for the Site and submitted to NYSDEC in June 2004 for review and approval. The RAWP was approved by NYSDEC on June 4, 2004 and subsequently implemented. The approved RAWP required the removal of all coal tar residue and significantly impacted soils from the site. Following remediation of the site, institutional and engineering controls were installed in accordance with the approved RAWP.

The RAWP also established requirements for future site use restrictions and future site monitoring to insure the protection of human health and the environment following the return of the site to productive use as a commercial retail facility. The remedial activities conducted at the site were completed in accordance with the approved RAWP (and subsequent addendums) and under the oversight of the NYSDEC and the New York State Department of Health (NYSDOH).

A Final Engineering Report detailing the completion of remediation was submitted to NYSDEC in May 2011. The report includes a summary of site excavation and remediation activities, installation of institutional and engineering controls, and provides a summary of post remediation groundwater and related investigation results. The remedial actions completed at the Site are protective of human health and the environment. Observations and analytical data collected during the remedial activities confirm that the minor MGP related impacts were localized to the Site. The soil removal program and subsequent engineering controls effectively eliminate potential future exposure pathways at this Site.

Based on the results of the site investigations conducted from 2000 through 2004, and the data gathered during and after the remediation at the site, a proposal was submitted to the Department in September 2009 to modify the VCA defined site boundary slightly to accommodate revised property lines.

This Site Management Plan (SMP) has been prepared to document routine site operation and maintenance requirements. The SMP also provides a schedule for routine inspections of the site engineering control and vapor control systems.

This Site Management Plan (SMP) includes the following information;

- Contact information for persons responsible for the site, Section 2.0,
- A summary of the institutional controls and site use restrictions at the site Section 3.0,
- A summary of the engineering controls at the site Section 4.0,
- General maintenance and monitoring procedures required Section 5.0,
- The procedures to be followed for temporary disruption of engineering controls Section 6.0,
- A summary of environmental monitoring requirements Section 7.0; and,
- The schedule for site monitoring and reporting, Section 8.0.

The Owner of the Site (or any portion thereof) will evaluate the criteria presented in this plan and recommend changes to NYSDEC, as appropriate, based on the actual post-closure conditions. At a minimum, this plan should be reviewed annually during the post-closure period and updated as necessary. No changes shall be made without written approval from NYSDEC. Proposal for changes to the approved SMP must be provided to NYSDEC for review and approval in writing. Copies of approved changes shall be provided to all site owners, operators, and regulators and should be kept on file as amendments to this document.

This Site Management Plan is incorporated by reference into the deed restriction (Section 3.0) for the site therefore, upon approval of the SMP by NYSDEC, this SMP and the procedures outlined herein become enforceable in accordance with applicable regulations.

Due to lot designation changes during the Village redevelopment process, a slight modification to the ongoing site restrictions was required and will be discussed further in Sections 4.1 and 5.0. All areas of the site subject to the restrictions, inspections, and maintenance are described throughout this SMP. The “site” referred to throughout this document is the site boundary of Block 1, Lot 71 as illustrated on Figure 2.

2.0 ORGANIZATION AND SITE CONTACT INFORMATION

The current owner of the property on which the former MGP site is located is the Village of Port Chester - Industrial Development Agency (Village). As the property owner, the Village voluntarily conducted the remedial activities and is responsible for the continued monitoring of the site. The current operator of the site is G&S Port Chester Retail 1, LLC (G&S). The NYSDEC and NYSDOH will be providing project oversight. Contact information for representatives of these agencies are listed below as well as other relevant numbers that will be referenced throughout this document.

Owner **Block 1 Lot 71 - 10 Waterfront Place**

Village of Port Chester - Industrial Development Agency
Mr. Christopher J. Russo, Village Manager
222 Grace Church Street
Port Chester, New York 10573
914-939-5200

Operator **Block 1 Lot 71 - 10 Waterfront Place**

G&S Port Chester Unit 2A, LLC
Mr. John Faltings
211 East 43rd Street - 25th Floor
New York, NY 10017
(212) 286-3300

Regulatory Agencies

New York State Department of Environmental Conservation
Division of Environmental Remediation
Mr. William Bennett - Project Engineer
625 Broadway
Albany, NY 12233-7014
518-402-9662 (during non-working hours - contact DEC 24 Hour Spill Hotline)

New York State Department of Environmental Conservation
DEC 24 Hour Spill Hotline 1-800-457-7362 (within NY State) or
(518) 457-7362 (outside NY State)

New York State Department of Health
Mr. Nathan Walz - Public Health Specialist
547 River Street
Troy, NY 12180-2216
518-402-7880

Westchester County Health Department
145 Huguenot Street
New Rochelle, NY 10801
914-813-5161

Project Consultant JM Sorge, Inc.
Environmental Consultants
Mr. Joseph M. Sorge
57 Fourth Street
Somerville, NJ 08876
908-218-0066

3.0 SITE RESTRICTIONS AND INSTITUTIONAL CONTROLS

The remedial action objectives for the Site were based on the short and long term human health and environmental risks potentially posed by the Site, and the future use of the property. Due to the low levels of residual contamination at the site, the operations at the site will be restricted to commercial uses. No schools, day care, medical facilities, residential, or similar uses will be allowed on the site. The restricted use of the Site will be controlled through Village zoning, land use and design guidelines, and deed restrictions in accordance with 6 NYCRR Part 375-1.8(g)(2)(iii).

Limited soil contaminants remain at the Site, which may have concentrations above NYSDEC Recommended Soil Cleanup Objectives (RSCO). The deed restrictions will prevent the use of groundwater and disturbance of the final cover system.

The Deed Restriction is applicable to the entire site as established in the VCA as amended in accordance with NYSDEC correspondence dated November 6, 2009. The site boundary is illustrated on Figure 2.

Block 1 Lot 71

A Deed Restriction has been filed to establish the performance requirements for the maintenance and management of engineering controls. Engineering controls for the Site are discussed in Section 4 of this report and consist of a physical cap and the sub slab depressurization system (SSDS). The Deed Restriction is applicable to the entire Lot, and includes a description of the controls, and the Property Owner Agreement enforceable by the State of New York to establish and maintain the institutional controls. A copy of the filed Deed Restriction is included in Appendix A.

4.0 ENGINEERING CONTROLS

The primary exposure pathway for the remaining contaminants at the site (low levels of PAHs and metals in the soil and backfill) is via direct soil contact. A site cover system was designed to minimize or eliminate the potential for exposure to future occupants of the site and the public. All areas of the site were covered with a physical barrier system, or cap, as discussed below. The cap extends over the entire site and no original site soil is exposed.

A potential secondary pathway for exposure is via volatile vapors which may enter the building from the impacted soil and groundwater below. A sub-slab depressurization system (SSDS) was installed to minimize the potential for exposure via this pathway to future occupants of the site and the public. The installed SSDS is designed to maintain a negative pressure beneath the building slab thereby preventing potential volatile soil vapors from accumulating beneath the slab and entering the building.

4.1 PHYSICAL BARRIER LAYER (CAP)

The site cap is constructed of a layer of clean stone, and a concrete cover as illustrated on Figure 3. The cover for the portion of the site covered by the site building includes an eight (8) inch thick reinforced concrete slab floor underlain by a 10 mil synthetic vapor retarding barrier, over a 4 oz/sq yd non woven geotextile, over a minimum 6 inch thick clean aggregate layer (washed gravel). A permeable synthetic material (orange snow fence) acting as a visual marker, to delineate the remediated zone, was placed below the gravel and above the existing site material. The Sub Slab Depressurization System (SSDS) is located within the 6 inch gravel layer, as discussed below in Section 4.2.

The cover for the sidewalks, loading areas, and walkways surrounding the site building, is comprised of a minimum of 4 inches of concrete resting on a minimum 4 inch gravel sub base for a total of 8 inches. A permeable synthetic material acting as a visual marker, to delineate the remediated zone, was placed below the gravel and above the existing site material.

Disturbance of the barrier or any material below requires prior notification and approval of NYSDEC, specific procedures, and reporting responsibilities, as outlined in Section 6.0 below.

4.2 SUB SLAB DEPRESSURIZATION SYSTEM

The Sub Slab Depressurization System (SSDS) is located under the site building, within the 6 inch gravel layer, as discussed in Section 4.1. The sub-slab depressurization system design is illustrated on Figure 4A. Details of the system, such as the suction pit, vent pipe, exhaust risers, are shown on Figure 4B.

The SSDS was designed to prevent any potential accumulation of volatile vapors emanating from the site soil from entering the site structure by creating a low pressure zone beneath the slab. The system was designed in accordance with the EPA guidance document *Radon*

Prevention in the Design and Construction of Schools and Other Large Buildings (Third Printing with Addendum, June 1994). The system was designed by Sadat Associates, Inc.

The major system components are the 8-inch reinforced concrete slab which acts as the primary barrier between the soil and the interior of the building and as a barrier to potential sub slab vapor intrusion into the building areas. In addition, a 10 mil plastic sheet was installed beneath the building slab to further reduce vapor migration potential.

The venting portion of the system consists of a 6 inch gravel bedding material. The gravel venting layer, with suitable permeability, is continuous throughout the building footprint with a central gravel suction pit. A solid six (6) inch diameter PVC pipe vents the sub slab air from the central location to the building exterior. The PVC pipe is connected through a vertical standpipe installed in the SW utility room, to a suction fan on the building roof. The fan draws air from below the slab to create a negative pressure below the structure.

Periodic monitoring of the system is required to confirm proper system operation. Monitoring components of the system consist of one (1) central and four (4) perimeter sub-slab pressure monitors and a one air discharge sampling port. The monitoring locations are illustrated on Figure 5. System function monitoring is discussed in Section 5.2 and air sampling is discussed in Section 7.1

5.0 MAINTENANCE AND MONITORING OF ENGINEERING CONTROLS

5.1 COVER SYSTEM INSPECTION PROCEDURES AND MAINTENANCE REQUIREMENTS

Inspection and maintenance (if required) of the site cover system or cap is required to insure the continued protectiveness of the remedy. As outlined in the Deed Restriction, activities that disturb the cap, or require partial or full removal, are governed by this SMP and are subject to the reporting and management procedures established herein.

Inspection of the cap shall be conducted by Project Consultant personnel qualified to certify the continuing protectiveness of the engineering control, such as engineers, scientist, or consultants. Qualified individuals shall be properly trained in health and safety procedures in accordance with 29 CFR 1910.120.

Inspection of the concrete cover will be conducted at a minimum of once per year. The inspection will include a visual reconnaissance of the entire site including all driveway, sidewalk, and building areas. A report will be prepared documenting the condition of the cover system. A copy of the Inspection Report Form is included in the Operations, Maintenance and Monitoring Manual in Appendix B.

Any locations where excessive cracking or deterioration is observed will be noted and documented. Photographic documentation of cover areas is acceptable. The report will include repair (if warranted) and document any repair operations completed during the reporting period.

A copy of the inspection report will be maintained in a site log book and provided to NYSDEC in a periodic site monitoring report (Section 8.0), at the address provided above.

Potential concerns regarding the integrity of the cap by the owner(s), operator(s) or any occupant will be reported to the consultant for verification. The suspect area will be inspected by a qualified professional and documented within 30 days of receipt of a notice of concern. If required, repairs to the cover system will be made within 90 days of confirmation by qualified personnel that a repair is required. A report documenting the initial concern notice and subsequent activities including repair activities (if required) will be prepared for each notice of concern as discussed in Sections 6.1 and 8.0.

5.2 SSDS INSPECTION PROCEDURES AND MAINTENANCE

Inspection and regular maintenance of the site SSDS is required to insure the continued protectiveness of the system. As outlined in the Deed Restriction, activities that disrupt the effectiveness of the SSDS, are governed by this SMP and are subject to the reporting and management procedures established herein.

Inspection of the SSDS shall be conducted by Project Consultant personnel qualified to certify the continuing protectiveness of the engineering control, such as engineers, scientist, or consultants. Qualified individuals shall be properly trained in health and safety procedures in accordance with 29 CFR 1910.120.

The inspection will include a visual reconnaissance of the exposed portions of the system including the building interior slab, PVC vertical standpipe, exhaust fan, exterior pressure monitoring ports, air sampling port, and the permanent differential pressure monitoring equipment. The monitoring components of the system consist of one (1) central and four (4) perimeter sub-slab pressure monitors and a one air discharge sampling port. The location of system components are illustrated on Figures 4A, and 4B and the pressure monitoring locations are illustrated on Figure 5.

Excessive cracking or deterioration of the slab will be noted and documented on an inspection report form. Photographs may be used to document the concrete slab condition. An inspection report will include recommendations for repair (if warranted) and document any repair operations completed during the reporting period. An Inspection Report Form is included in the Operations, Maintenance and Monitoring Manual in Appendix B. A copy of the inspection report will be maintained in a site log book and provided to NYSDEC in the periodic site monitoring report (Section 8.0), at the addresses provided above.

SSDS Inspection and Maintenance Schedule

Weekly Inspection by Site Personnel

- Site personnel will check the differential pressure gauge (located in the SW utility room) to ensure the fan is maintaining adequate negative pressure. A copy of the operating manual for the Dwyer pressure monitoring unit and required pressure levels are included

in the OMM Plan in Appendix B. The meter should be set to read in inches of water column (inWC).

- If the alarm is tripped or the fan is not operating, the site personnel will notify the Project Consultant and the supervisor for the site operator. If notified, the site operator will complete service of the unit to restore proper operation. The Project Consultant will complete a system inspection with 72 hours of receipt of a notice that the alarm has been triggered.
- Sign the inspection sheet.

Quarterly Inspection by the Project Consultant

- Check the physical condition of the four (4) corner and one (1) central pressure monitoring ports and the air sampling port. Document condition on inspection form. (Complete repair as needed)
- Check the pressure at the four (4) corners of the slab using a portable differential pressure monitor such as the DM-1. A copy of the operating manual for the DM-1 portable pressure monitoring unit is included in the OMM Plan in Appendix B. The minimum acceptable negative pressure is -0.002 inWC. Record the pressure readings in the inspection sheet.
- Check the pressure at the central differential pressure monitor location in the SW utility room. The minimum acceptable negative pressure is -0.002 inWC. Record the pressure readings in the inspection sheet.
- Document that the visual alarm system is functioning. This test will require a temporary shutdown of the exhaust fan. Instructions for the test are included in the OM&M Manual in Appendix B.

Annual Inspection by the Project Consultant and Site Operator

- Inspect the fan for signs of failure or abnormal operation.
- Inspect the discharge location to ensure that no intake has been installed nearby and that the exhaust vent is not blocked.
- Inspect the slab for settling or cracks and add additional caulking where necessary.

A report of any alarm signal will be provided to the consultant for verification and correction. The SSDS will be inspected by a qualified professional and documented within 72 hours of receipt of a notice of concern. If required, repairs to the SSDS system will be made within 30 days of confirmation by qualified personnel that a repair is required. A report documenting the initial concern notice and subsequent activities including repair activities (if required) will be prepared for each notice of concern as discussed in Sections 6.2 and 8.0.

6.0 DISRUPTION OF ENGINEERING CONTROLS

6.1 CAP DISRUPTION PROCEDURES

Notification

Future development, building modifications, sub-surface utility repairs or certain other repairs may disturb these controls. During cover disruption activities, reasonable care must be taken to avoid disruption of the demarcation barrier or any soils below that barrier, unless required to complete the work. Following any temporary disturbance of the engineering control at the site, the engineering control must be repaired as soon as possible in accordance with original cap specifications.

No disruption of the demarcation barrier or any soils below that barrier may be conducted without prior written approval from NYSDEC; except in emergency circumstances (Emergency plans will be discussed in Section 6.3. Approved modifications to the engineering controls may require revisions to the Deed Restriction.

The site owner(s) and/or operator(s) shall notify the following, a minimum of 30 days prior to the planned cover system disruption activities:

- The Project Consultant,
- The Village of Port Chester,
- G&S Port Chester, LLC,
- New York State Department of Environmental Conservation,
- New York State Department of Health.

Contact information is provided in Section 2.0. No disruption of the cover shall commence until written approval is received from NYSDEC.

Notification will be prepared by the Project Consultant and must include;

- Identification of the site including site name, address, and NYSDEC site ID numbers,
- A summary of the reason for the proposed disturbance,
- A detailed description of the proposed activities,
- A health and safety plan, including a summary of protective measures to be incorporated during site activities to prevent worker, site personnel, or public exposure to the material below the demarcation barrier,
- Soil management plan, including the intended disposal arrangements, and on-site handling and storage procedures,
- A site map illustrating the proposed disturbance location,
- The anticipated date and duration of the proposed activities,
- A summary and schedule of the proposed restoration plan; and,
- The name and contact information of the company doing the work.

Site Work Procedures - Disturbance of Cover System Only

If planned site work involves disturbance of only the cover concrete sidewalk area, or concrete building floor, these areas shall be restored to their previous condition upon completion of the activities as soon as practical or a maximum of 90 days from the completion of activities. All possible care will be taken to prevent disturbance of the demarcation barrier. Documentation and reporting (including photographs) of the activities shall be provided as discussed below.

Site Work Procedures - Disturbance of Cover System, Demarcation Barrier, and Site Soils

No disruption of the cover shall commence until written approval of the workplan is received from NYSDEC. All material and soil located below the demarcation barrier shall be considered potentially contaminated above NYSDEC Recommended Soil Cleanup Objectives (RSCO). All work in the potentially contaminated zone will require personnel to be certified in accordance with OSHA requirements at 29 CFR 1910.120.

Reporting

At the completion of the disruption activities, a report shall be prepared documenting the activities. The report shall include;

- The horizontal and vertical extent of the excavation,
- The volume of contaminated soil disturbed,
- summary of how the soil was handled during activities,
- If the soil was not returned to its former location, the final disposition of the soil including the appropriate disposal facility documentation; and,
- A detailed description of the cover system restoration activities completed.

The reports shall be provided to NYSDEC. A copy of the notification correspondence, the completion report, and any regulatory agency responses, shall be maintained.

6.2 SSDS DISRUPTION PROCEDURES

Proper functioning of the SSDS is required to insure the protectiveness of the remedy. The primary system component is the concrete building slab. Therefore a temporary shutdown of the active ventilation portion of the system (the exhaust fan and/or the central suction pit pressure monitoring station) does not compromise the primary protectiveness of the total system, however, the length of time the system is down, should be limited to the extent reasonable.

Shut down of the system is permissible for minor repairs or system testing. Brief shutdowns of less than 60 minutes, (i.e. for alarm testing) shall not be considered a reportable disruption.

In the event a system shutdown is necessary, the following documentation must be provided in the next subsequent periodic monitoring report:

- Provide a description of the maintenance activities and procedures implemented to limit the period of time the fan unit is out of service,
- Record the following in the Maintenance log: date, reason for shutdown, time the system was shut down, pressure readout from the suction pit while system off, time the system was back on, pressure readout from suction pit monitor following system re-start; and,
- The maintenance report shall be included in the annual monitoring report for the site.

An Operations, Maintenance and Monitoring Manual (Appendix B) is provided which includes a summary of the system components and maintenance requirements, and provides copies of the warranties and instruction manuals for system components.

An instructional sign is located on the wall directly adjacent to the monitoring equipment. The sign documents system re-start, test, and notification instructions. A copy of the sign and a photograph of the location of the system components and instructions are included in the OM&M Manual.

6.3 EMERGENCY DISRUPTION PROCEDURES

No disruption of the engineering controls shall commence until written approval is received from NYSDEC except as discussed in Section 6.2 or in the case of an emergency. The limited contamination remaining at the site is documented in the Final Engineering Report (May 2009) for the site. Low levels of metals and semi-volatile organic compounds may be present in some of the site soils and in the groundwater. No levels identified at the site constitute an acute health risk; however, contact with the soil and groundwater should be avoided where possible.

In the event of a cap disturbance for an emergency, such as utility repairs, that will require disturbance of the site soils below the demarcation barrier, the following should be notified immediately;

- NYSDEC Project Engineer (during working hours),
- The Project Consultant, and
- NYSDEC 24 Hour Spill Hotline.

The following should be notified as soon as practical;

- NYSDEC Project Engineer,
- NYSDOH, and
- Westchester County Department of Health.

Contact information is provided in Section 2.0.

The following general guidelines shall be followed:

- All material and soil located below the demarcation barrier shall be considered potentially contaminated above NYSDEC Recommended Soil Cleanup Objectives (RSCO).
- All work in the potentially contaminated zone will be completed by personnel to be certified in accordance with OSHA 1910.120 (HAZWOPER). All workers will be provided with appropriate protective equipment. A Health and Safety Plan (HASP) will be prepared by the party undertaking the work.
- Temporary storage of material from below the demarcation barrier will be staged in a manner that will minimize direct contact and will prevent migration of potentially impacted soil due to wind, water, or precipitation.
- Soil may be returned to the excavation and the cap repaired to pre-disturbance conditions. A temporary cap of asphalt, concrete, or certified clean stone or soil is acceptable, however, the final repair to replace the cap to NYSDEC approved condition must be completed within 90 days.

A report shall be provided to NYSDEC by the Project Consultant within 90 days following the completion of activities documenting the work procedures, soil handling, health and safety procedures, and restoration.

7.0 ENVIRONMENTAL MONITORING

7.1 SSDS - AIR MONITORING

The SSDS is installed beneath the slab of the site building. Monitoring the air quality beneath the building was conducted during the first three years post remediation. The 2007 and 2008 results were reported to NYSDEC in a site monitoring report submitted in January 2009. No additional sub slab air sampling is required at this time in accordance with NYSDEC correspondence dated November 20, 2009. Therefore the 2009 air monitoring data will be provided in the first Periodic Review Report according to the schedule set forth in Section 8.0.

Detailed sampling procedures, equipment, required laboratory certifications and required data deliverable formats are provided in the OM&M Manual in Appendix B in the event that future sampling may be required.

7.2 GROUNDWATER MONITORING

Three monitoring wells, MW-1, MW-2, and MW-3 were installed to monitor the groundwater quality at the site. The well locations are illustrated on Figure 5. Monitoring the groundwater quality beneath the site is required to confirm the effectiveness of the remediation.

The first year post remediation (2007) sampling was conducted on a quarterly basis. Based on NYSDEC review of the initial results, annual sampling was approved for the period from 2008

through 2011 on a rotating seasonal basis. The frequency of the monitoring may be modified, as appropriate, based on laboratory analytical results, upon receipt of written approval of NYSDEC.

Groundwater samples will be collected in accordance with EPA Low Flow procedures and samples will be submitted to a NYSDEC certified laboratory. Groundwater samples will be analyzed for the following parameters; TCL VOC plus a library search for the 10 highest peaks, TCL SVOC plus a library search for 15 peaks, and Priority Pollutant Metals. The monitoring parameters may be modified, as appropriate, based on laboratory analytical results, upon written approval of NYSDEC.

Detailed sampling procedures, equipment, required laboratory certifications and required data deliverable formats are provided in the OM&M Manual in Appendix B. A periodic review report will be provided to NYSDEC in accordance with the reporting schedule in Section 8.0.

Well Abandonment

Upon the completion of the groundwater monitoring program, and upon approval of NYSDEC, all site monitoring wells will be abandoned in accordance with the NYSDEC document CP 43: Groundwater Monitoring Well Decommissioning Policy dated November 3, 2009.

8.0 MONITORING AND REPORTING SCHEDULES

In accordance with the Deed Restriction, the site will be monitored, inspected, and environmental samples will be collected as discussed above unless modifications are approved in writing from NYSDEC. Periodic Review Reports (PRR) will be submitted as determined by NYSDEC.

The first PRR will be submitted within 18 months of the issuance of the certificate of completion. Subsequent PRRs will be submitted annually or as directed by the NYSDEC or NYSDOH in the approval letter for the previous PRR submittal.

Periodic Review Reports will provide the information necessary to document the certification that the Institutional Controls and Engineering Controls (IC/EC) are in place and remain protective. The PRR will include copies of all site inspection reports, tabularized data for all environmental sampling conducted, completed cap or SSDS disruption reports, if any, copies of all laboratory reports and a summary QA/QC review of the data submitted. In the event of a determination that a failure of the IC/EC occurred, the PRR will include a plan and schedule to implement the corrective measures. A conclusion regarding the continued effectiveness of the IC/EC will be provided in the report.

Periodic Review Reports will also include a signed certification in accordance with DER-10 Section 1.5, by a Qualified Environmental Professional who has reviewed the monitoring and inspection reports.

Periodic Review Reports will be submitted in hard copy and electronic form in accordance with NYSDEC regulations to the following:

New York State Department of Environmental Conservation
Division of Environmental Remediation
Mr. William Bennett - Project Engineer
625 Broadway
Albany, NY 12233-7014

A copy of all Periodic Review Reports will be submitted in electronic form to:

New York State Department of Health
Mr. Nathan Walz - Public Health Specialist
547 River Street
Troy, NY 12180-2216
518-402-7880

An inspection, monitoring and sampling and reporting schedule is attached as Table 1.

TABLES

Site Monitoring, Sampling, and Reporting Schedule
Former Manufactered Gas Plant Site
Port Chester, New York

2007 through 2011

Task	2007												
	Dec 06	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Engineering Control Inspections													
Cap Inspection													
SSDS Inspection													
Pressure Monitoring													
Environmental Sampling													
Sub Slab Air Sampling													
Groundwater Sampling													
Reporting													
Periodic Site Monitoring Report													

Task	2008											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Engineering Control Inspections												
Cap Inspection												
SSDS Inspection												
Pressure Monitoring												
Environmental Sampling												
Sub Slab Air Sampling												
Groundwater Sampling												
Reporting												
Periodic Review Report												

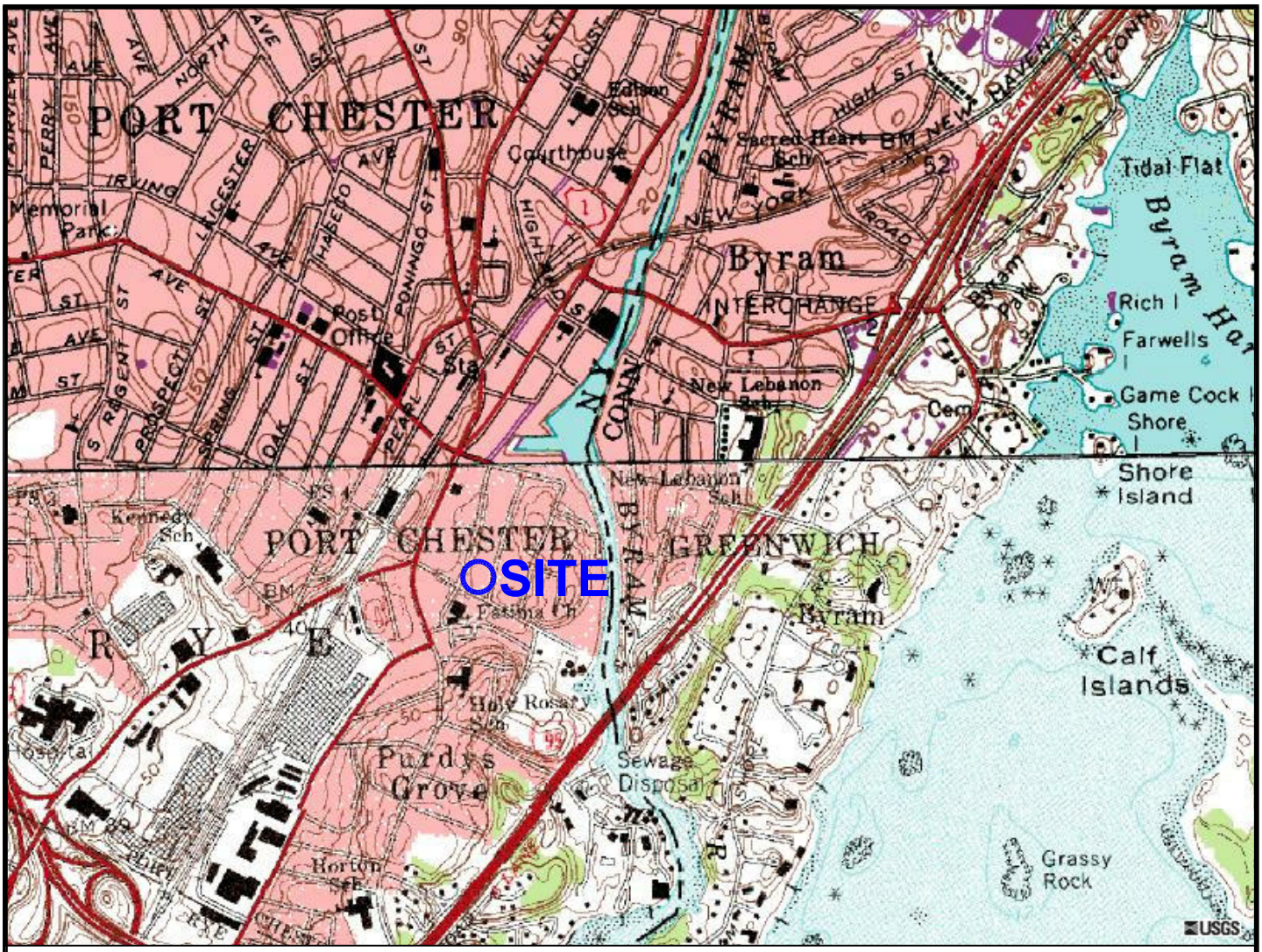
Task	2009											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Engineering Control Inspections												
Cap Inspection												
SSDS Inspection												
Pressure Monitoring												
Environmental Sampling												
Sub Slab Air Sampling												
Groundwater Sampling												
Reporting												
Periodic Review Report												

Task	2010											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Engineering Control Inspections												
Cap Inspection												
SSDS Inspection												
Pressure Monitoring												
Environmental Sampling												
Sub Slab Air Sampling												
Groundwater Sampling												
Reporting												
Periodic Review Report												

Task	2011											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Engineering Control Inspections												
Cap Inspection												
SSDS Inspection												
Pressure Monitoring												
Environmental Sampling												
Sub Slab Air Sampling												
Groundwater Sampling												
Reporting												
Periodic Review Report												

Activities completed as shown through December 2010
Activities after December 2010 are proposed and may be modified as approved by NYSDEC.

FIGURES



SCALE 1:24000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

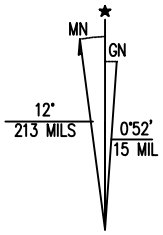
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

DATUM IS MEAN SEA LEVEL

SOURCE:

U.S.G.S. 7.5 MINUTE SERIES MAMARONECK AND GLENVILLE QUADRANGLE – NY–CT



UTM GRID AND 1967 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SITE LOCATION MAP
PORT CHESTER, NY

PREPARED FOR
VILLAGE OF PORT CHESTER

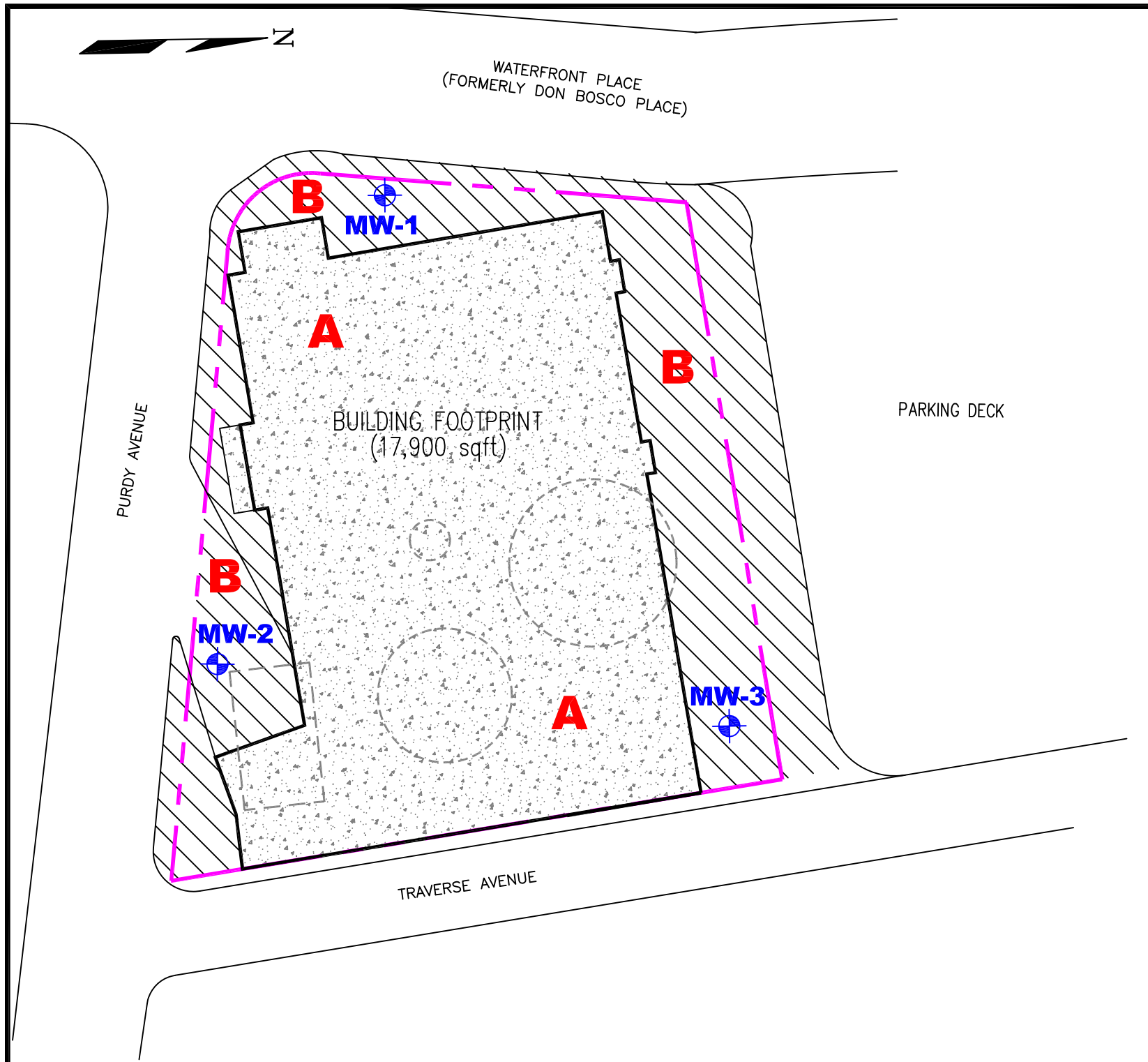
DATE: 04/11/02	DWG. No. Figure 1
JM SORGE, INC.	FIGURE 1

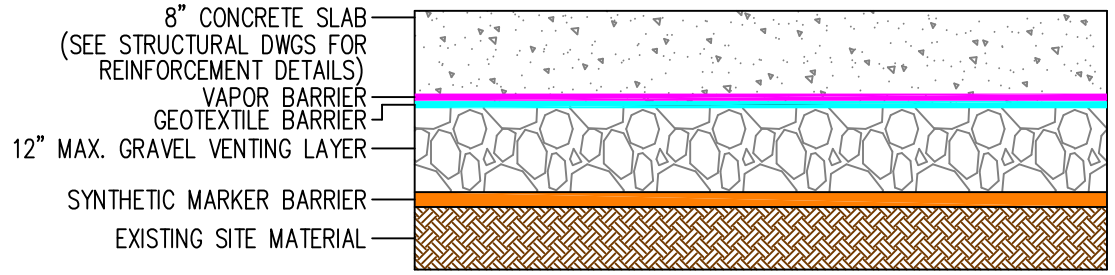
SITE BOUNDARY

FORMER MGP SITE
PORT CHESTER, NEW YORK

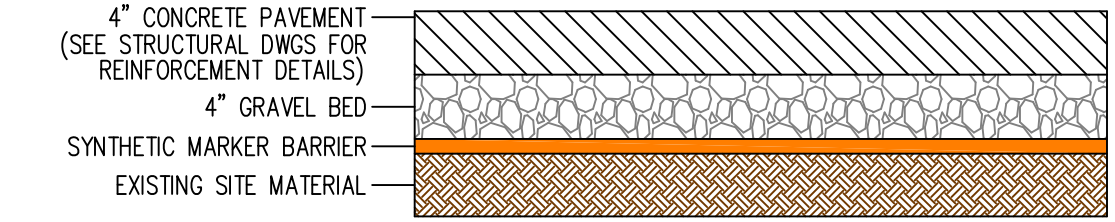
PREPARED FOR
VILLAGE OF PORT CHESTER

DATE: 06/26/09	DWG. No. 02.095 SMP2
JM SORGE,INC.	FIGURE 2





A: FINAL COVER FOR AREAS OCCUPIED BY BUILDING



B: FINAL COVER FOR CONCRETE PAVED AREAS

LEGEND:

- POST REMEDIATION MONITORING WELL LOCATIONS
- BUILDING FOOTPRINT (TYPE A)
- CONCRETE PAVED (TYPE B)
- CURRENT VCA SITE BOUNDARY; BLOCK 1, LOT 71
- FORMER MGP STRUCTURES
- CURRENT SITE BUILDING

0 40 80

scale feet

SCALE SUBJECT TO VERIFICATION

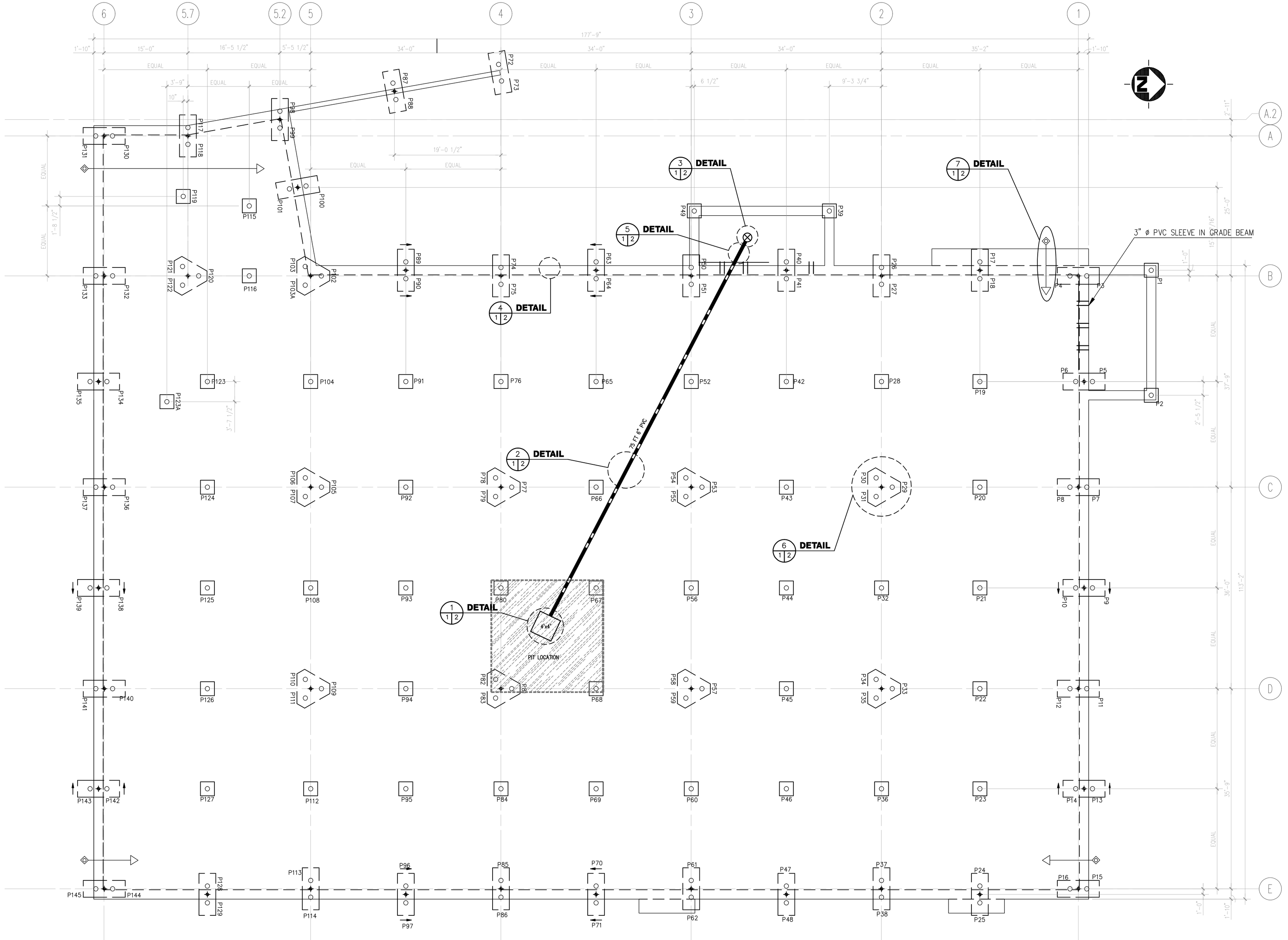
SOURCE:
Based on a As Built Map
dated February 2007
prepared by John Marano, Land Surveyor

SITE PLAN SHOWING LOCATIONS AND
CROSS SECTIONS OF ENGINEERING CONTROLS

FORMER MGP SITE
PORT CHESTER, NEW YORK

PREPARED FOR
VILLAGE OF PORT CHESTER

DATE: 08/07/09	DWG. No. 02.095 SMP3
JM SORGE,INC.	FIGURE 3



1. HANGERS SHOULD BE USED IN ACCORDANCE WITH LOCAL BUILDING CODES FOR THE GAS VENTING PIPES.

LEGEND

- LOCATION OF AIR EXHAUST RISER (TO BLOWER)
- 6" PVC, SCHED.40 VENT PIPE
- SUCTION PIT (4'x4'x1')
- UNDERSLAB SAMPLING/ PRESSURE PROBE
- UNDERSLAB SAMPLING STATION/ PRESSURE MONITOR
- GEOTEXTILE AREA BELOW AGGREGATE COURSE

BAR SCALE

REV. NO.	DATE	REMARKS

CLIENT:
JM SORGE, Inc
Environmental Consultants
57 Fourth Street
Somerville, NJ 08876

OWNER:
Village of Port Chester
222 Grace Church Street
Port Chester, NY 10573

ENGINEER:
Lahbib Chibani, Ph.D., P.E.
Professional Engineer License No. 37055 N.J.
6 Tally Road, Mercerville, NJ 08619
(609) 826-9600 FAX (609) 826-9601

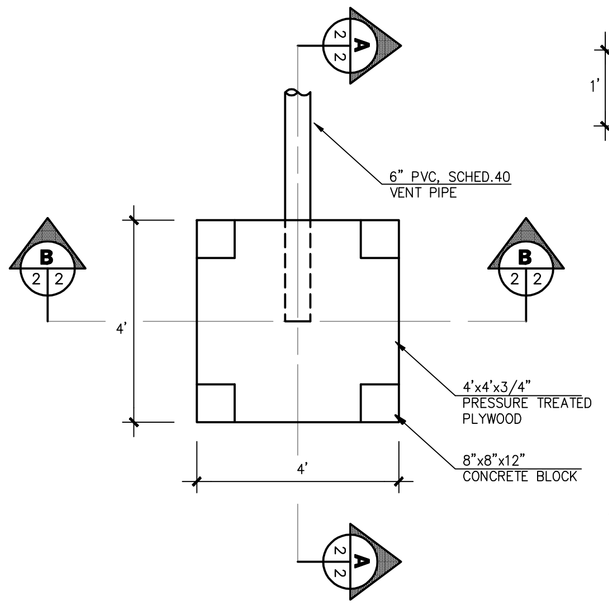
PROJECT:
REMEDIATION OF
THE FORMER MGP SITE
85 PURDY AVE.
PORT CHESTER, NY

DRAWING TITLE:
FIGURE 9A
AS-BUILT SUBSLAB
DEPRESSURIZATION SYSTEM (SSDS)
LAYOUT

Date:	Drawn by:	Design by:
01/05/06	JG	KB
Scale: 1"=1/8'	Checked by:	Project Mgr: KB

JOB NO:	SHEET	OF
05060-0102	4A	

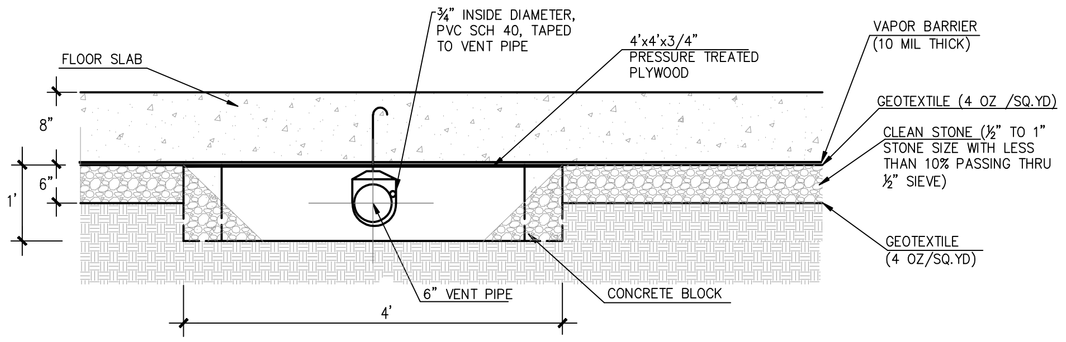
Autocad Path H:\SORGE\AS-BUILT



1 / 2 1 **DETAIL**

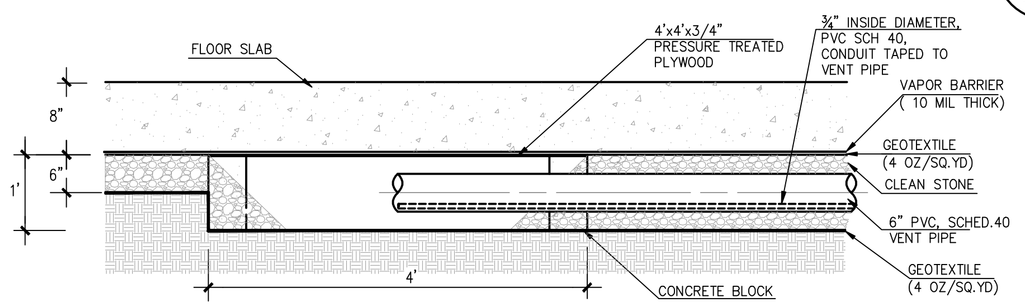
SUCTION PIT

N.T.S.



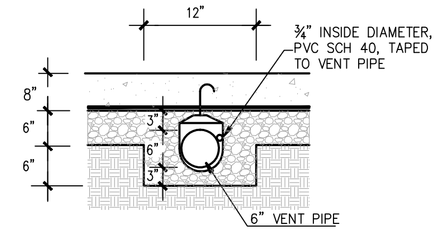
SECTION B-B

N.T.S.



SECTION A-A

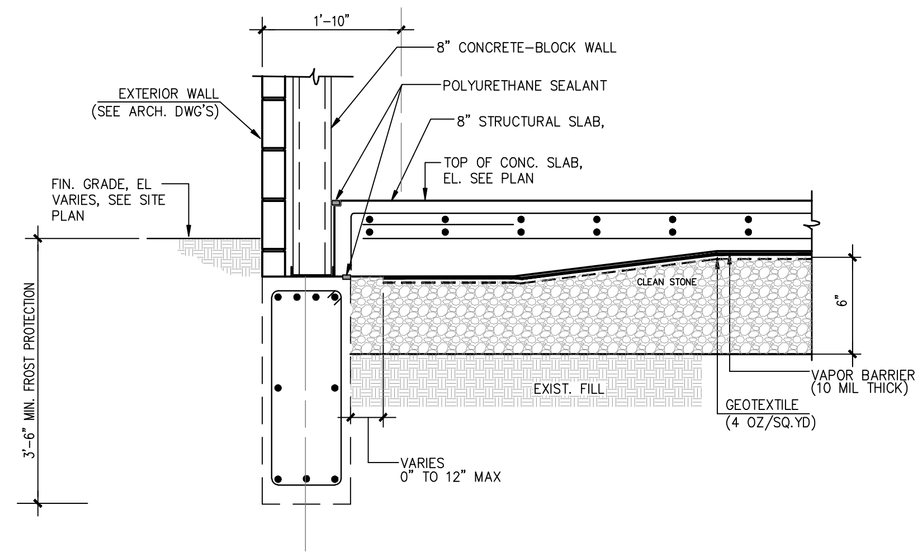
N.T.S.



2 / 2 1 **DETAIL**

TYPICAL TRENCH DETAIL

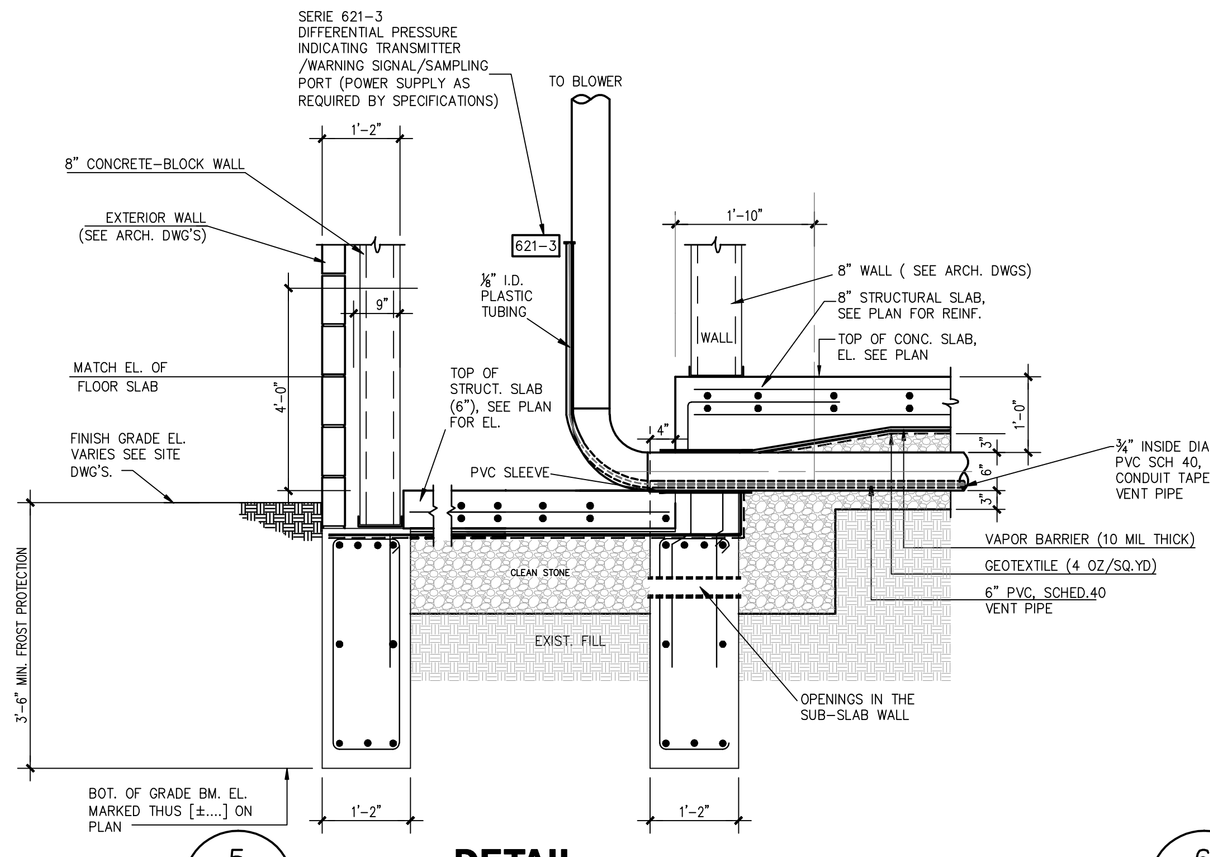
N.T.S.



4 / 2 1 **DETAIL**

VAPOR BARRIER SEAL ABOVE GRADE BEAM

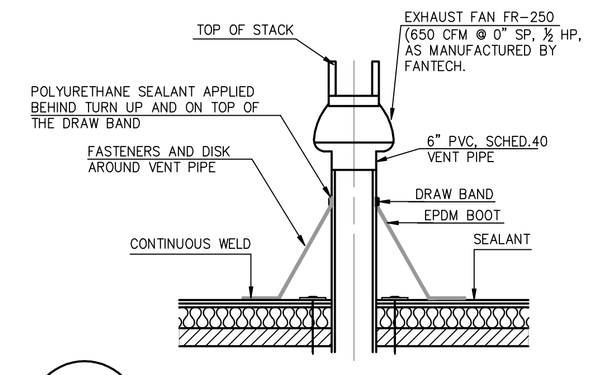
N.T.S.



5 / 2 1 **DETAIL**

AIR EXHAUST RISER

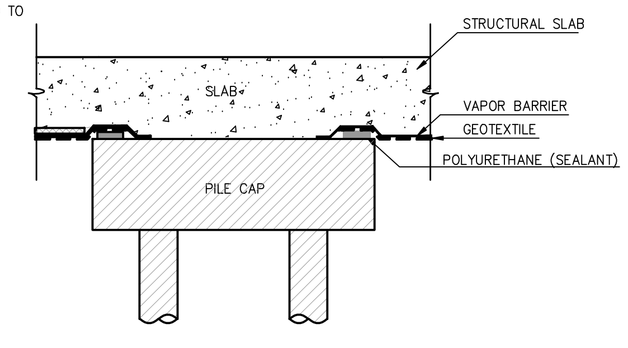
N.T.S.



3 / 2 1 **DETAIL**

SEALING PIPE PENETRATION
THROUGH ROOF

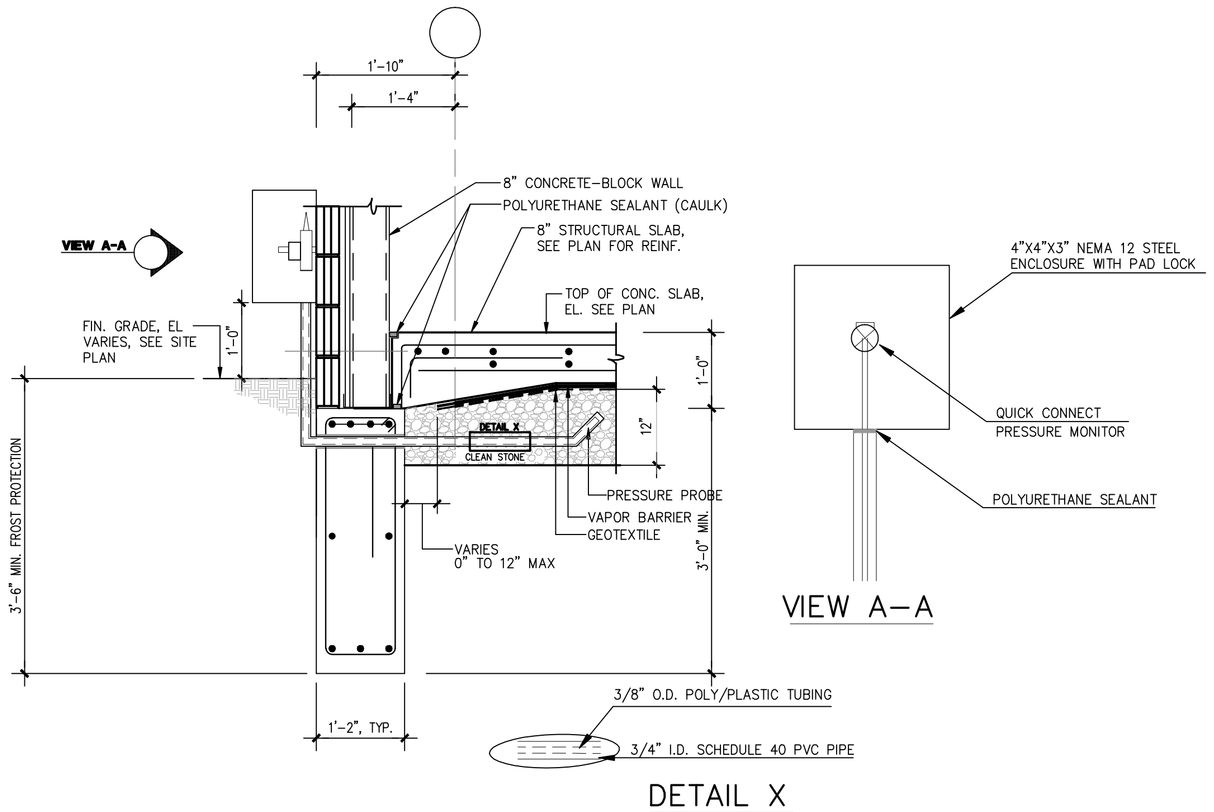
N.T.S.



6 / 2 1 **DETAIL**

VAPOR BARRIER SEAL
ABOVE PILE CAP

N.T.S.



DETAIL X

7 / 2 1 **DETAIL**

UNDER SLAB PRESSURE
MONITORING STATION

N.T.S.

LEGEND

BAR SCALE

REV. NO.	DATE	REMARKS

CLIENT:
JM SORGE, Inc
Environmental Consultants
57 Fourth Street
Somerville, NJ 08876

OWNER:
Village of Port Chester
222 Grace Church Street
Port Chester, NY 10573

ENGINEER:
Lakhi Chibani
Lakhi Chibani, Ph.D., P.E.
Professional Engineer License No. 37055 N.J.
6 Tally Road, Mercerville, NJ 08619
(609) 826-9600 FAX (609) 826-9601

PROJECT:
REMEDIATION OF
THE FORMER MGP SITE
85 PURDY AVE.
PORT CHESTER, NY

DRAWING TITLE:
FIGURE 9B
AS-BUILT SUBSLAB
DEPRESSURIZATION SYSTEM (SSDS)
DETAILS

Date:	Drawn by:	Design by:
01/05/06	JG	KB
Scale: N.T.S	Checked by:	Project Mgr: KB

JOB NO:	SHEET	OF
06060-0102	4B	

Autocad Path H:\SORGE\AS-BUILT

N

WATERFRONT PLACE

(FORMERLY DON BOSCO PLACE)

PURDY AVENUE

TRAVERSE AVENUE

CONCRETE

PARKING DECK

COMMERCIAL BUILDING

MW-1

MW-2

MW-3

NW CORNER

SW CORNER

NE CORNER

SE CORNER

AIR SAMPLING PORT

SUCTION PIT PRESSURE MONITORING PORT

LEGEND:

- GROUNDWATER MONITORING WELL LOCATIONS
- SUB-SLAB PRESSURE MONITORING PORT
- SUB-SLAB AIR SAMPLING PORT
- FORMER MPG STRUCTURES
- CURRENT VCA SITE BOUNDARY; BLOCK 1, LOT 71
- CURRENT SITE BUILDING

SOURCE:
Based on a As Built Map
dated February 2007
prepared by John Marano, Land Surveyor

0 30 60
scale feet
SCALE SUBJECT TO VERIFICATION

MONITORING WELL LOCATIONS AND
SUB-SLAB MONITORING PORT LOCATION MAP

FORMER MGP
PORT CHESTER, NEW YORK

PREPARED FOR
VILLAGE OF PORT CHESTER

DATE: 04/06/09	DWG. No. 02.095 SMP5
JM SORGE,INC.	FIGURE 5

APPENDIX A

Deed Restriction

The Office of the Westchester County Clerk: This page is part of the instrument; the County Clerk will rely on the information provided on this page for purposes of indexing this instrument. To the best of submitter's knowledge, the information contained on this Recording and Endorsement Cover Page is consistent with the information contained in the attached document.

503083072DLR004S

Westchester County Recording & Endorsement Page

Submitter Information

Name:	Harris Beach PLLC	Phone:	585-419-8744
Address 1:	99 Garnsey Road	Fax:	585-419-8817
Address 2:	99 Garnsey Road	Email:	aabbink@harrisbeach.com
City/State/Zip:	Pittsford NY 14534	Reference for Submitter:	10-14 Waterfront Place

Document Details

Control Number: **503083072** Document Type: **Declaration (DLR)**

Package ID: 20101104000440010004 Document Page Count: **6** Total Page Count: **7**

Parties

☐ Additional Parties on Continuation page

1st PARTY		2nd PARTY	
1:	PORT CHESTER VILLAGE OF INDUSTRIAL DEVELOPMEN - Individual	1:	PORT CHESTER VILLAGE OF INDUSTRIAL DEVELOPMEN - Individual
2:		2:	

Property

☐ Additional Properties on Continuation page

Street Address: 10-14 WATERFRONT PLACE Tax Designation: 142.39-1-71

City/Town: RYE TOWN Village: PORT CHESTER

Cross- References

☐ Additional Cross-Refs on Continuation page

1: 2: 3: 4:

Supporting Documents

1: TP-584

Recording Fees

Statutory Recording Fee:	$40.00
Page Fee:	$35.00
Cross-Reference Fee:	$0.00
Mortgage Affidavit Filing Fee:	$0.00
RP-5217 Filing Fee:	$0.00
TP-584 Filing Fee:	$5.00
Total Recording Fees Paid:	**$80.00**

Transfer Taxes

Consideration:	$0.00
Transfer Tax:	$0.00
Mansion Tax:	$0.00
Transfer Tax Number:	23669

Mortgage Taxes

Document Date:

Mortgage Amount:

Basic:	$0.00
Westchester:	$0.00
Additional:	$0.00
MTA:	$0.00
Special:	$0.00
Yonkers:	$0.00
Total Mortgage Tax:	**$0.00**

Dwelling Type: Exempt: ☐

Serial #:

RECORDED IN THE OFFICE OF THE WESTCHESTER COUNTY CLERK

Recorded: 12/29/2010 at 05:49 PM

Control Number: **503083072**

Witness my hand and official seal

Timothy C. Idoni
Westchester County Clerk

Record and Return To

☐ Pick-up at County Clerk's office

Harris Beach PLLC
66 Broadway, Suite 1101

Albany, NY 12207
Attn: Cheryl LaGrange

DECLARATION OF COVENANTS AND RESTRICTIONS

THIS DECLARATION OF COVENANTS AND RESTRICTIONS is made the 10 day of November, 2010, by the Village of Port Chester Industrial Development Agency, a public benefit corporation existing under the laws of the State of New York and having an office for the transaction of business at 222 Grace Church Street, Port Chester, New York 10573.

WHEREAS, Former MGP – Purdy and Traverse Avenues is the subject of Voluntary Cleanup Agreement, dated April 9, 2002, and executed by the Village of Port Chester as part of the New York State Department of Environmental Conservation's (the "Department's") Voluntary Cleanup Program (Site#: V00516-3; Index #: D3-0001-02-02), namely that parcel of real property located on Purdy Avenue in the Village of Port Chester, County of Westchester, State of New York, which is part of lands conveyed by the Village of Port Chester to the Village of Port Chester Industrial Development Agency by deed dated October 10, 2003 and recorded in the Westchester County Clerk's Office on August 24, 2006 as Control Number 462160216 and being more particularly described in **Appendix A**, attached to this declaration and made a part hereof, and hereinafter referred to as "the Property"; and

WHEREAS, the Department approved a remedy to eliminate or mitigate all significant threats to the environment presented by the contamination disposed at the Property and such remedy requires that the Property be subject to restrictive covenants.

NOW, THEREFORE, the Village of Port Chester Industrial Development Agency for itself and its successors and/or assigns, covenants that:

First, the Property subject to this Declaration of Covenants and Restrictions is shown on a map attached to this declaration as **Appendix B** and made a part thereof.

Second, unless prior written approval by the Department or, if the Department shall no longer exist, any New York State agency or agencies subsequently created to protect the environment of the State and the health of the State's citizens, hereinafter referred to as "the Relevant Agency," is first obtained, where contamination remains at the Property subject to the provisions of the Site Management Plan ("SMP"), dated January 2010, there shall be no construction, use or occupancy of the Property that results in the disturbance or excavation of the Property which threatens the integrity of the engineering controls or which results in unacceptable human exposure to contaminated soils.

Third, the owner of the Property shall not disturb, remove, or otherwise interfere with the installation, use, operation, and maintenance of engineering controls required for the Remedy, which are described in the SMP, unless in each instance they first obtain a written waiver of such prohibition by the Relevant Agency.

Record and Return To: Justin S. Miller, Esq. Harris Beach PLLC 677 Broadway, Suite 1101 Albany, New York 12207	Address: 10-14 Waterfront Place T. Rye V. Port Chester s/b/l: 142.39-1-71

Fourth, the owner of the Property shall prohibit the Property from ever being used for purposes other than for commercial use without the express written waiver of such prohibition by the Relevant Agency.

Fifth, the owner of the Property shall prohibit the use of the groundwater underlying the Property without treatment rendering it safe for drinking water or industrial purposes, as appropriate, unless the user first obtains permission to do so from the Department or Relevant Agency.

Sixth, the owner of the Property shall provide a periodic certification, prepared and submitted by a professional engineer to environmental professional acceptable to the Department or Relevant Agency, which will certify that the institutional and engineering controls put in place are unchanged from the previous certification, comply with the SMP, and have not been impaired.

Seventh, the owner of the Property shall continue in full force and effect any institutional and engineering controls required for the Remedy and maintain such controls, unless the owner first obtains permission to discontinue such controls from the Department or Relevant Agency, in compliance with the approved SMP which is incorporated and made enforceable hereto subject to modifications as approved by the Department or Relevant Agency.

Eighth, this Declaration is and shall be deemed a covenant that shall run with the land and shall be binding upon all future owners of the Property, and shall provide that the owner and its successors and assigns consent to enforcement by the Department or Relevant Agency if the prohibitions and restrictions that the Voluntary Cleanup Agreement require to be recorded, and hereby covenant not to contest the authority of the Relevant Agency to seek enforcement.

Ninth, any deed of conveyance of the Property, or any portion thereof, shall recite, unless the Department or Relevant Agency has consented to the termination of such covenants and restrictions, that said conveyance is subject to this Declaration of Covenants and Restrictions.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

IN WITNESS WHEREOF, the undersigned has executed this instrument the day written below.

VILLAGE OF PORT CHESTER INDUSTRIAL DEVELOPMENT AGENCY

By: Neil Pagano
Title: Chairman

STATE OF NEW YORK)
) S.S.:
COUNTY OF Westchester)

On the 10 day of November, in the year 2010, before me, the undersigned, personally appeared Neil Pagano, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s) acted, executed the instrument.

Notary Public State of New York

JUSTIN S. MILLER
Notary Public, State of New York
County of Monroe
Commission Expires June 8, 2011
02MI6020242

APPENDIX A
TO DECLARATION OF COVENANTS AND RESTRICTIONS

DESCRIPTION OF LANDS OF VILLAGE OF PORT CHESTER
INDUSTRIAL DEVELOPMENT AGENCY

The Property subject to the foregoing Declaration of Covenants and Restrictions consists of all that certain plot, piece or parcel of land, with improvements thereon, situate, lying and being in the Village of Port Chester, Town of Rye, County of Westchester and State of New York, known as Block 1 Lot 71 or Unit #2A as shown on a survey made by John Marano, Registered Land Surveyor, dated February 5, 2007, as follows:

BEGINNING at a point being the intersection of the Westerly sideline of relocated Traverse Avenue with the Northerly sideline of Purdy Avenue;

RUNNING THENCE along Purdy Avenue, North 82 degrees 11 minutes 58 seconds West, 189.33 feet to a point of a curvature;

THENCE Northwesterly, upon a curve to the right, having a radius of 25.00 feet, an arc distance of 39.27 feet (D-90 degrees 00 minutes 00 seconds) to a point of tangency on the Easterly sideline of Don Bosco Place, also known as Waterfront Place;

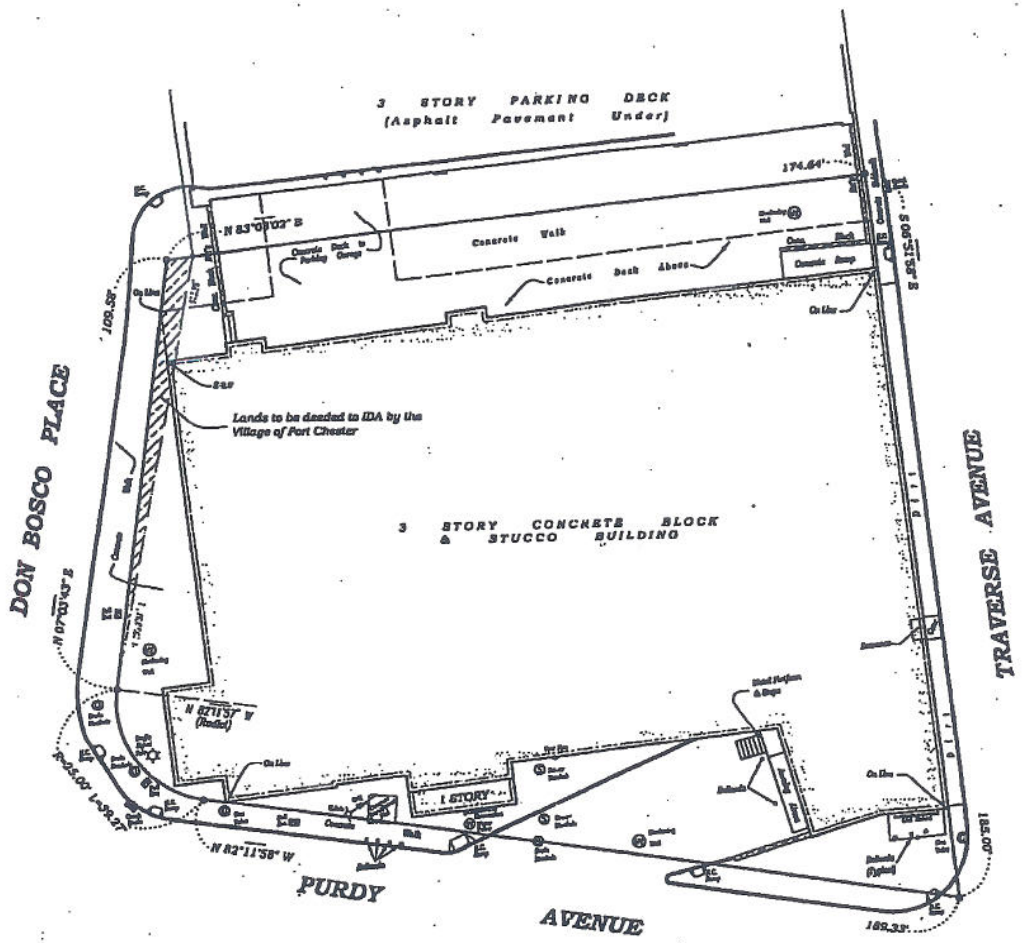
THENCE along Don Bosco Place, North 07 degrees, 03 minutes 43 seconds East, 109.58 feet to a point;

THENCE leaving Don Bosco Place, North 83 degrees 08 minutes 02 seconds East, 174.64 feet to a point on the Westerly side of Traverse Avenue;

THENCE along Traverse Avenue, South 06 degrees 51 minutes 58 seconds East, 185.00 feet to a point on Purdy Avenue, the place of BEGINNING.

APPENDIX B
TO DECLARATION OF COVENANTS AND RESTRICTIONS

MAP OF LANDS OF VILLAGE OF PORT CHESTER
INDUSTRIAL DEVELOPMENT AGENCY



AS BUILT SURVEY
- prepared for -

G & S PORT CHESTER UNIT 2A LLC

Modified Marina Development
- situated in the -
Village of PORT CHESTER
Westchester County, New York

Scale : 1"=20'
Surveyed : 5 February 2007

Certified to :

1. The Bank of Smithtown
2. Prestige Title Agency
3. First American Title Insurance Company (Title No. 07941-PA-W)
4. G & S Port Chester Unit 2A LLC

JOHN MARANO
Land Surveyor
378 Old Route 55, Apt. 2
Poughquag, New York 12570
Tel. (914)686-1744

It is a violation of the New York State Education Law for any person, unless acting under the direction of a Licensed Land Surveyor, to alter any item on this drawing and/or related specification. All alterations must be made in compliance with the New York State Education Law. The Licensed Land Surveyorwhose seal appears hereon assumes no responsibility for any such alteration or re-use without his consent.

by: _____
John Marano, Licensed Surveyor No. 38697

Only copies of this survey bearing the land surveyor's inked or embossed seal shall be considered a true & valid copy.

NOTES:

1. This survey was prepared without the benefit of an abstract or up to date title report and is therefore subject to any easements, restrictions, covenants, or any statement of facts that such documents may disclose.
2. Underground utilities not shown hereon are not certified.

Existing Lot Area = 30,053.79 Sq.Ft. (0.690 Acres)
Total Lot Area = 30,407.04 Sq.Ft. (0.698 Acres)

STATE OF NEW YORK, COUNTY OF WESTCHESTER SS.:

I, TIMOTHY C. IDONI, COUNTY CLERK AND CLERK OF THE SUPREME AND COUNTY COURTS, WESTCHESTER COUNTY DO HEREBY CERTIFY THAT I HAVE COMPARED THIS COPY WITH THE ORIGINAL THEREOF RECORDED IN MY OFFICE ON 12/29/10 AND THAT THE SAME IS A CORRECT TRANSCRIPT THEREFROM AND OF THE WHOLE OF SUCH ORIGINAL.

IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND AFFIXED MY OFFICIAL SEAL

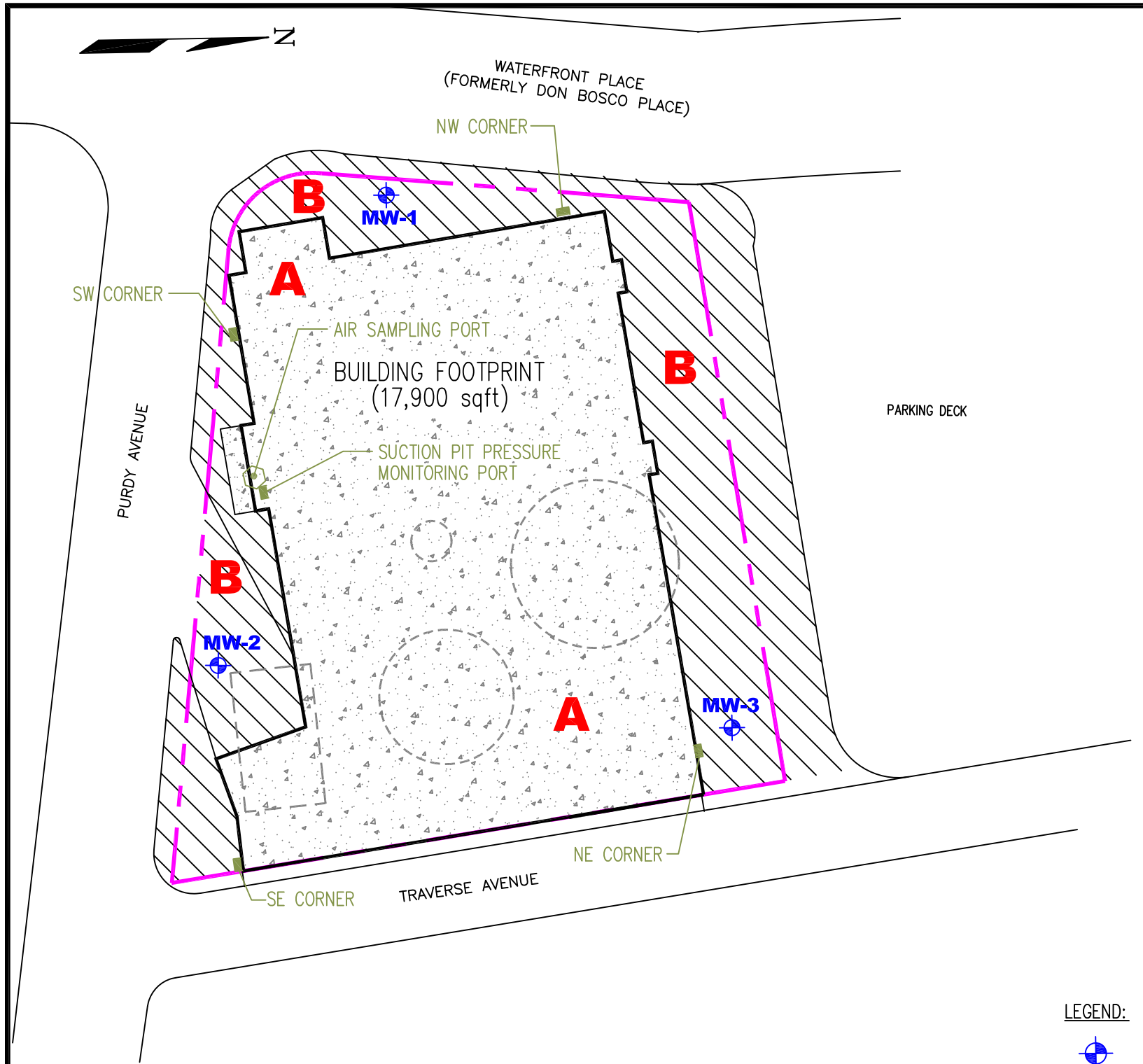
3/21/11

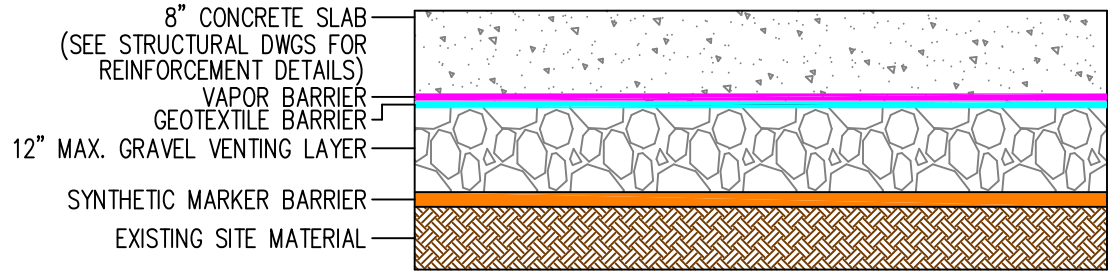
COUNTY CLERK AND CLERK OF THE SUPREME AND COUNTY COURTS, WESTCHESTER COUNTY.

FEE PAID

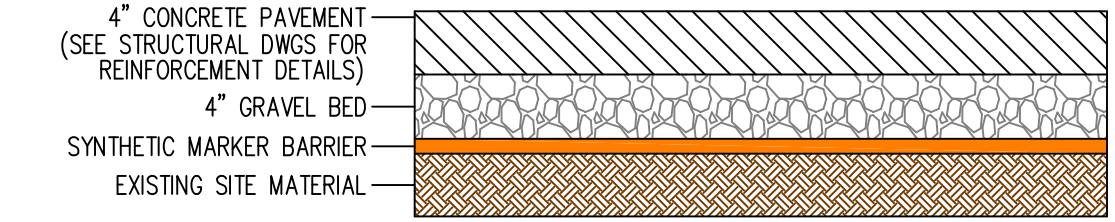
MAP OF THE PROPERTY

[ATTACH MAP FROM FINAL ENGINEERING REPORT SHOWING SITE BOUNDARIES, AND LOCATIONS OF CONCRETE AND ASPHALT CAPS, GROUNDWATER MONITORING WELLS, AND SUBSLAB SOIL GAS DEPRESSURIZATION SYSTEM INSTALLED ON THE SITE]





A: FINAL COVER FOR AREAS OCCUPIED BY BUILDING



B: FINAL COVER FOR CONCRETE PAVED AREAS

LEGEND:

- POST REMEDIATION MONITORING WELL LOCATIONS
- SUB-SLAB PRESSURE MONITORING PORT
- SUB-SLAB AIR SAMPLING PORT
- BUILDING FOOTPRINT (TYPE A)
- CONCRETE PAVED (TYPE B)
- CURRENT VCA SITE BOUNDARY; BLOCK 1, LOT 71
- FORMER MGP STRUCTURES
- CURRENT SITE BUILDING

0 40 80

scale feet

SCALE SUBJECT TO VERIFICATION

SOURCE:
Based on a As Built Map
dated February 2007
prepared by John Marano, Land Surveyor

SITE PLAN SHOWING LOCATIONS AND
CROSS SECTIONS OF ENGINEERING CONTROLS

FORMER MGP SITE
PORT CHESTER, NEW YORK

PREPARED FOR
VILLAGE OF PORT CHESTER

DATE: 08/07/09	DWG. No. 02.095-A-1
JM SORGE,INC.	A-1

APPENDIX B

Operations, Maintenance, and Monitoring Manual

OPERATIONS, MAINTENANCE AND MONITORING MANUAL

Former Manufactured Gas Plant

10 Waterfront Place

Port Chester, NY

Prepared By

JM Sorge, Inc.
environmental consultants
57 Fourth Street
Somerville, NJ 08876

January 2010

Table of Contents

Figure 1 Engineering Control Figure – Cap Coverage and Cross Sections

Figure 2A&B As Built SSDS Plan View and SSDS - details

Figure 3 Groundwater, Pressure, and Air Monitoring Locations

Appendix A - Inspection Forms
- Weekly Pressure Monitoring Sheet
- Quarterly Cap Inspection / Engineering Control Inspection Reporting Form
- Quarterly Sub Slab Pressure Monitoring and Inspection Form
- Annual SSDS Inspection Form

Appendix B - Equipment Manufacturer Specifications and Warranties
- Exhaust Fan and Motor
- Dwyer Differential Pressure Monitor
- Infiltec DMI Portable Differential Pressure

Appendix C- EPA Low Flow Groundwater Sampling Procedures
- Low Flow Groundwater monitoring Forms

Appendix D - Air Sampling Procedures
- Sample COC and Field Data Sheet

Operations, Monitoring, and Maintenance Manual

Former Manufactured Gas Plant
10 Waterfront Place
Port Chester, New York
NYSDEC Site # V00516-3

1.0 INTRODUCTION

This Operations, Monitoring, and Maintenance (OM&M) Manual has been prepared for the former Manufactured Gas Plant (MGP) site located at 10 Waterfront Place and Purdy Avenue in Port Chester, New York. The site has undergone remediation under the oversight and approval of the New York Department of Environmental Conservation (NYSDEC). Minor residual contaminated soils remain at depth beneath a protective barrier at the site, Therefore, certain controls, as described herein, are required in strict accordance with the Deed Restriction/Environmental Easement and Site Management Plan (SMP) approved for the site.

1.1 Purpose

This OMM Manual will provide direction for compliance with the requirements for managing the post remedial operation of the site. This document includes direction for:

- Operation and Maintenance of Engineering Controls
- Maintenance of the Institutional Controls
- Inspection and Site Evaluation
- Performing Environmental Sampling
- Report Submittals

1.2 Site Specific Warnings

Environmental investigations completed at the site identified volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), and metals in the soil, groundwater, and soil gas at the site. The contamination resulted from former industrial and commercial operations at the site. The majority of this contamination was removed during the remediation of the site; however, low levels of contamination remain below an engineered protective barrier.

All remaining impacted soil is located below a protective cap layer consisting of concrete or asphalt, as detailed below in Section 2.2. An orange plastic visual demarcation marker has been installed beneath the cap and above the potentially contaminated soil. The cap also prevents contact with the groundwater which is located approximately 10 feet beneath the site.

1.3 Site Description

The site is located between Waterfront Place (formerly Don Bosco Place) and Traverse Avenue at their intersections with Purdy Avenue, in the Village of Port Chester, New York. The Site is part of a larger area known as the Port Chester Marina Redevelopment Project and has been developed with a 2-story multi-tenant commercial building, and associated walkways.

Figure 1 illustrates the site boundary which consists of the entire Block 1 Lot 71 parcel.

1.4 Organization and Site Contacts

Owner **Block 1 Lot 71 - 10 Waterfront Place**

Village of Port Chester - Industrial Development Agency
Mr. Christopher J. Russo, Village Manager
222 Grace Church Street
Port Chester, New York 10573
914-939-5200

Operator **Block 1 Lot 71 - 10 Waterfront Place**

G&S Port Chester Unit 2A, LLC
Mr. John Faltings
211 East 43rd Street - 25th Floor
New York, NY 10017
(212) 286-3300

Regulatory Agencies

New York State Department of Environmental Conservation
Division of Environmental Remediation
Mr. William Bennett - Project Engineer
625 Broadway
Albany, NY 12233-7014
518-402-9662 (during non-working hours - contact DEC 24 Hour Spill Hotline)

New York State Department of Environmental Conservation
DEC 24 Hour Spill Hotline 1-800-457-7362 (within NY State) or
(518) 457-7362 (outside NY State)

New York State Department of Health
Mr. Nathan Walz - Public Health Specialist
547 River Street
Troy, NY 12180-2216
518-402-7880

Project Consultant

JM Sorge, Inc.
Environmental Consultants
Mr. Joseph M. Sorge
57 Fourth Street
Somerville, NJ 08876
908-218-0066

2.0 SUMMARY OF SITE REMEDIAL ACTION

The Remedial Action completed at the Site included the excavation and off-site disposal of significantly contaminated soil. The Final Engineering Report (dated July 2009) detailing the completion remediation was submitted to NYSDEC in September 2009.

Following restoration and development of the site, institutional controls in the form of Deed Restrictions established requirements for site use restrictions and site monitoring to insure the protection of human health and the environment. Engineering controls were installed to physically prevent direct contact with remaining site contaminants.

The goals of the remedial actions completed at the Site were to return the site to productive use and insure future protection of human health and the environment. The soil removal and engineering controls installed have eliminated the majority of the contaminant source material and will effectively eliminate potential future exposure pathways.

2.1 Summary of Institutional Controls

The Deed Restriction is applicable to the entire Site, and includes a map showing the area of control, a description of the controls, and Property Owner Agreements enforceable by the State of New York. The Deed Restriction applies to the entire, or portion thereof, and is recorded pursuant to Real Property Law Section 291.

In accordance with the Deed Restrictions the operations at the site will be restricted to commercial uses. No schools, day care or medical facilities, residential, or similar uses will be allowed on the site. The restrictions also prevent the use of groundwater and disturbance of the final cover system.

2.2 Summary of Engineering Controls

The primary exposure pathway for the remaining contaminants at the site is via direct soil or groundwater contact. A site cover system (Figure 1) was designed and installed to minimize or eliminate the potential for exposure to future occupants of the site and the public. All areas of the site were covered with a physical barrier system, or cap and no original site soil or backfill is exposed.

A potential secondary pathway for exposure is via volatile vapors which may enter the building from the impacted soil and groundwater below. The primary barrier to potential sub slab vapor intrusion into the building areas is the 8-inch reinforced concrete slab and the associated 10 mil plastic vapor barrier installed beneath the slab. A secondary, sub-slab depressurization system (SSDS) (Figures 2A and 2B) was installed to further minimize or eliminate the potential for exposure via this pathway to future occupants of the site and the public. The SSDS is designed

to maintain a negative pressure beneath the building slab and vapor barrier, thereby preventing potential volatile soil vapors from accumulating beneath the slab and entering the building.

3.0 SITE INSPECTIONS AND MAINTENANCE

3.1 Personnel

Site inspections shall be conducted by personnel qualified to certify the continuing protectiveness of the engineering control. Qualified individuals shall be properly trained in health and safety procedures in accordance with 29 CFR 1910.120.

3.2 Inspection Procedures

The following inspections shall be completed at the frequency discussed below. The condition of the cap/cover system and the SSDS will be reported and the reports maintained for review by regulatory agencies upon request.

Cap

The inspection will include a quarterly visual reconnaissance of the entire property including all driveway, sidewalk, and building areas (Figure 1). Conditions to be monitored include:

- Concrete areas will be examined for cracks, damage, or significant deterioration.
- Particular attention should be paid to cracking greater than 1/8 inch within the building area.

Excessive cracks or deterioration in the concrete covered areas of the site will be documented on the inspection reporting form. An inspection form is included in Appendix A, and should be completed during each inspection and kept on file in the site log book. Photographic documentation of the condition of the concrete site cover system is recommended. See Section 3.3 for a discussion of maintenance, repair, and reporting requirements.

SSDS

The inspection will include a visual reconnaissance of the readily accessible components of the slab and SSDS (Figures 2 and 3). Conditions to be monitored include:

Weekly – Conducted by Building Maintenance Personnel

- Check the differential pressure monitor for the suction pit and the system alarm to ensure the system is maintaining adequate negative pressure. The monitor is located in the SW utility room. Copies of the Dwyer differential pressure monitoring equipment specifications and manuals are included in Appendix B for reference. The minimum pressure reading allowable is negative 0.002 WC (-0.002) however the reading should typically remain at approximately -0.850 WC.

- Confirm that the visual alarm is not triggered. If flashing, follow the instruction to re-set the system. A copy of the re-set instructions is posted on the wall immediately above the monitor. A copy of the sign/instructions is included in Appendix A. Notify the Project Consultant as instructed. As discussed in Section 2.2, the primary vapor barrier is the concrete slab. Therefore, a temporary shutdown of the SSDS system does not represent an imminent health risk, however this condition should be repaired as soon as possible.
- Sign the inspection sheet and record the pressure reading and note any repair actions taken. A copy of the weekly inspection sheet is included in Appendix A.

Quarterly – Conducted by Project Consultant

- Check the physical condition of the 4 corner and one central pressure monitoring ports and the air sampling port as well as their exterior protective cover. Complete repair as needed. Document condition on inspection form. The locations of the ports are illustrated on Figures 2A and 3.
- Check the pressure at the four (4) corners of the slab using a portable differential pressure monitor such as the Infiltec Digital Micromanometer (DM1). Copies of the DM1 differential pressure monitoring equipment specifications and manuals are included in Appendix B for reference. The minimum acceptable negative pressure is -0.002 WC. Record the pressure readings in the inspection sheet. Typical pressure ranges from -0.02 to -0.15 inWC. Document the recorded pressure measurements on an inspection form. A copy of the form is included in Appendix A.
- Check the pressure at the central differential pressure monitor location in the SW utility room. The minimum acceptable negative pressure is -0.002 WC. Record the pressure readings in the inspection sheet. Document condition on inspection form. This is the same task that is performed weekly, as above.
- Document that the visual alarm system is functioning. This test will require a temporary shutdown of the exhaust fan. Shut down the exhaust fan using the power switch located to the right of the vertical standpipe. A red flashing light will rapidly appear on the pressure monitor. Turn the fan power back on and confirm that the red flashing light goes out. Document condition on inspection form.
- Inspect the slab for settling or cracks, document condition on inspection form, and add additional caulking where necessary. This inspection can be completed concurrently with the cap inspection.
- Objectionable odors emanating from the exhaust system will be reported.
- Insure copies of all inspection form are placed in the logbook.

Annually – Conducted by Project Consultant and Site Operator Personnel

- Inspect the fan and motor for signs of failure or abnormal operation. Copies of fan specifications and manuals are included in Appendix B for reference. The exhaust fan and motor, located on the building roof, should be inspected to insure that it is operating properly, and that the flow rate is maintained. The exhaust riser cap shall be inspected to assure that the rain deflection caps are in place.

- Perform preventive maintenance as required for proper system function.
- Inspect the discharge location to ensure that no intake has been located nearby and that the exhaust vent is not blocked.
- The vertical standpipe in the SW utility room shall be inspected for physical blockage, structural integrity.
- Document the findings of the inspection on an inspection form and place in the logbook.

Conditions requiring repair or maintenance identified during inspections or at times other than the required inspections and should be reported and repaired as below.

3.3 Maintenance Activities

Repairs to the site cover system or SSDS will be made within 30 days of a report of damage, disturbance, or deterioration, whether the report is made by the owner, operator, tenant, or as the result of a scheduled inspection.

Cap

The cap shall be repaired to return the protective cover system to the initial design specifications. Figure 1 illustrates the areas of the site and the corresponding cap system design.

- Seal cracks in the concrete building slab with polyurethane caulk,
- Replace concrete or asphalt with appropriate thickness as illustrated,
- Replace stone with clean gravel and provide documentation of the source.

Any repair of the cap system that requires activities that extend to the depth of the orange snow fence visual demarcation layer require prior notification of the NYSDEC as discussed in Section 6.0 of the SMP.

The date of the disturbance or deterioration, and the date and method of repair shall be documented.

SSDS

- Replace the fan unit in accordance with lifespan - Copy of warranty in Appendix B
- Replace rain shields as necessary
- Seal cracks in the concrete slab with polyurethane caulk
- Replace cracked or deteriorating PVC piping

3.4 Record Keeping

Copies of all weekly pressure monitoring sheets, quarterly and annual inspection forms shall be maintained in a log book on the premises. These documents are required to be included in the

yearly monitoring reports and must be available for inspection by regulators.

An evaluation of the combined inspection and maintenance reports shall be completed and included in a periodic Site Monitoring Report to NYSDEC as detailed in Section 5.0.

4.0 ENVIRONMENTAL SAMPLING

4.1 Groundwater Monitoring Plan and Procedures

Groundwater samples will be collected from all three (3) groundwater monitoring wells in accordance with EPA Low Flow procedures and samples will be submitted to a NYSDEC certified laboratory. Sampling frequency will be as outlined in the most recent approved version of the SMP. Groundwater samples will be analyzed for the following parameters; TCL VOC plus a library search for the 10 highest peaks, TCL SVOC plus a library search for 15 peaks, and Priority Pollutant Metals. Laboratory reports will be provided with Full Category A Deliverables.

A copy of the EPA Low Flow Sampling Procedures is included in Appendix C for reference. A copy of the monitoring well sampling reporting form is also included in Appendix C.

A separate form shall be completed for each well sampled. The analytical results of the groundwater sampling will be summarized in tabular form and compared to the current NYSDEC groundwater quality standards or criteria. A review of the QA/QC will be completed by a competent individual with experience in data review. A report will be provided to NYSDEC as detailed in Section 5.0.

4.2 Sub Slab Air Monitoring Plan and Procedures

The sub-slab air sampling port is installed in the exhaust riser of the sub slab depressurization system, located in the SW utility room. Air samples will be collected using a 6-liter laboratory cleaned and certified summa canister. Samples will be collected over a period of one (1) hour (0.1 liter/minute flow rate) utilizing a laboratory pre-set flow controller.

A copy of the Sampling Procedures is included in Appendix D for reference. A copy of the sampling form/laboratory Chain of Custody is also included in Appendix D.

Sampling frequency will be as outlined in the most recent approved version of the SMP. Samples will be submitted to a NYSDEC certified laboratory and will be analyzed for volatile organic compounds - Method TO-15. Laboratory reports will be provided with Full Category A Deliverables.

4.3 Evaluation of Monitoring Results

An evaluation of the monitoring results shall be completed by a qualified professional upon receipt of the results from the laboratory. The laboratory report shall be reviewed for completeness and the accuracy of the results confirmed. Immediately notify NYSDEC if the results indicate a condition eminently hazardous to human health. If quality control issues are identified, an evaluation of the need to re-sample shall be completed.

At the completion of each year of sampling, each round of data shall be reviewed together and in comparison to past data collected from the site. An evaluation of the data shall be included in a periodic Site Monitoring Report to NYSDEC as detailed in Section 5.0.

5.0 REPORTING

A periodic report will be prepared to document the inspection, maintenance, monitoring, and sampling activities completed in accordance with the frequency outlined in the most recent approved version of the SMP or subsequent correspondence from NYSDEC.

The report will include:

- The analytical results of the air and groundwater sampling summarized in tabular form,
- A review of the QA/QC completed by a competent individual with experience in data review,
- A general characterization of sub-slab air quality and site groundwater conditions,
- Observations of data trends, and comparisons with previous data,
- Where appropriate, a recommendation for the need for continued sampling or the reduction of sampling may be submitted to NYSDEC for review and consideration. In addition, based on analytical results, the need for the continued active operation of the SSDS system will be reviewed,
- Copies of all inspection forms,
- A summary of all relevant maintenance activities and repairs necessary for the reporting period.

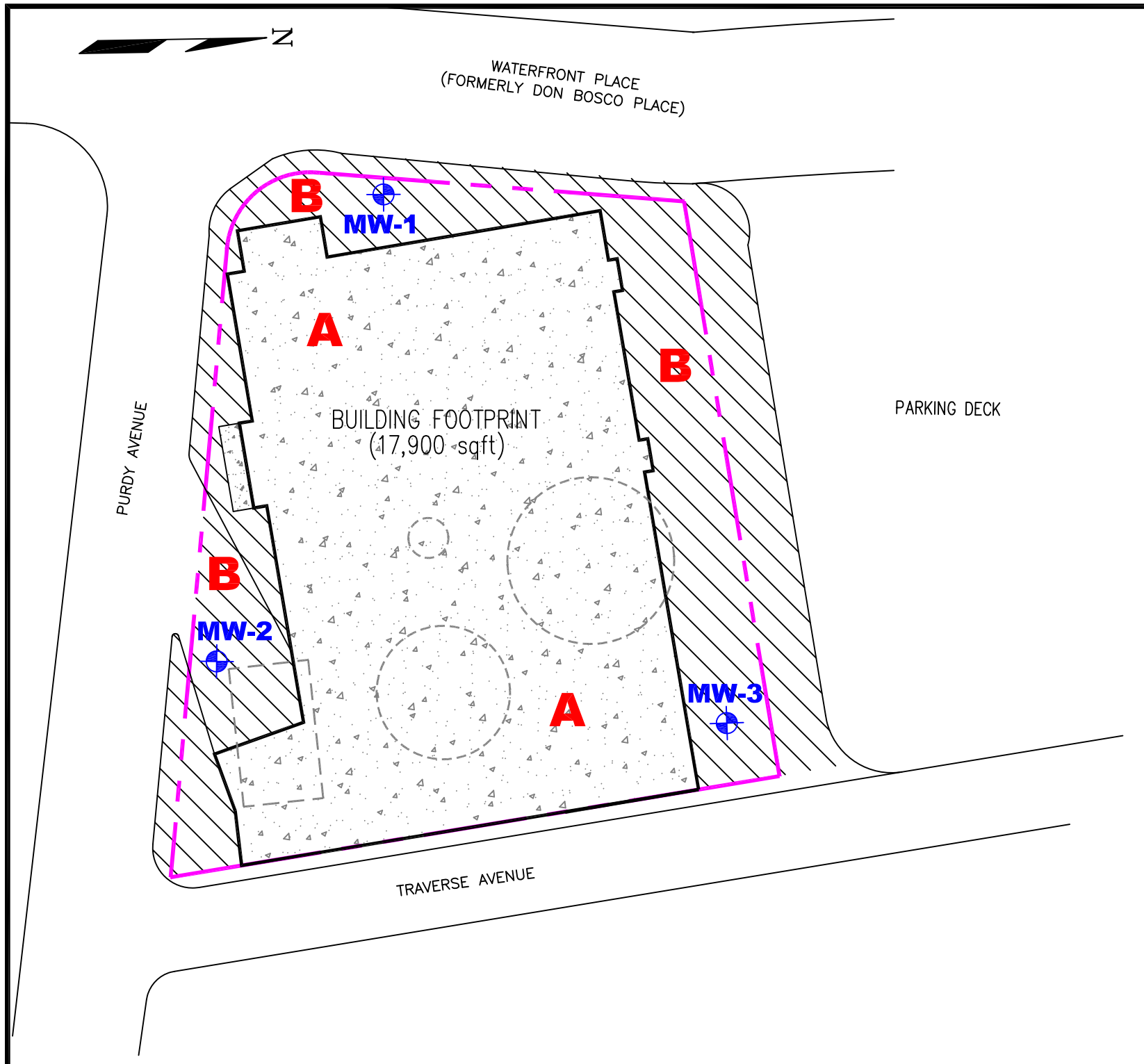
The report will be submitted in hard copy and electronic form to:

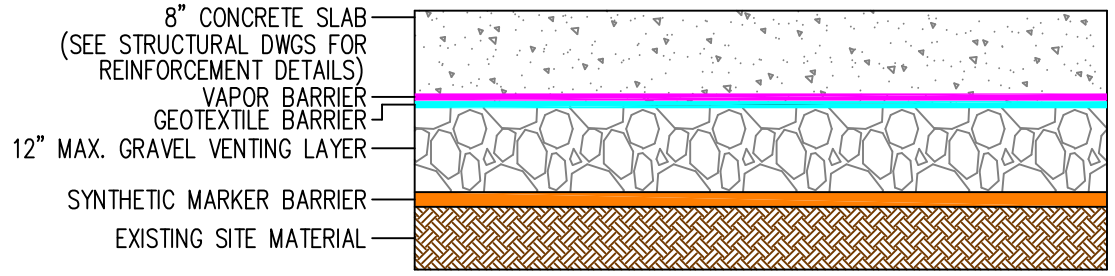
New York State Department of Environmental Conservation
Division of Environmental Remediation
Mr. William Bennett - Project Engineer
625 Broadway
Albany, NY 12233-7014
518-402-9662

The copy of the report will be submitted in electronic form to:

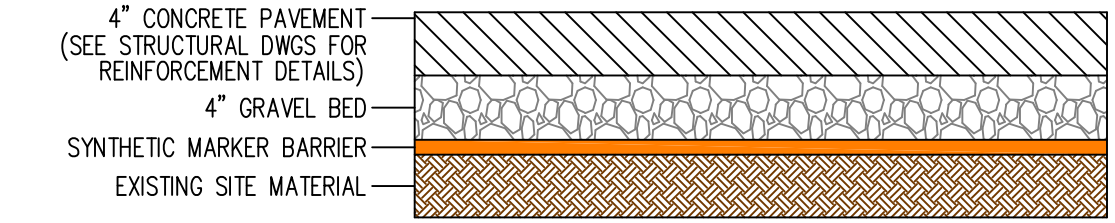
New York State Department of Health
Mr. Nathan Walz - Public Health Specialist
547 River Street
Troy, NY 12180-2216
518-402-7880

FIGURES





A: FINAL COVER FOR AREAS OCCUPIED BY BUILDING



B: FINAL COVER FOR CONCRETE PAVED AREAS

LEGEND:

- POST REMEDIATION MONITORING WELL LOCATIONS
- BUILDING FOOTPRINT (TYPE A)
- CONCRETE PAVED (TYPE B)
- CURRENT VCA SITE BOUNDARY; BLOCK 1, LOT 71
- FORMER MGP STRUCTURES
- CURRENT SITE BUILDING

0 40 80

scale feet

SCALE SUBJECT TO VERIFICATION

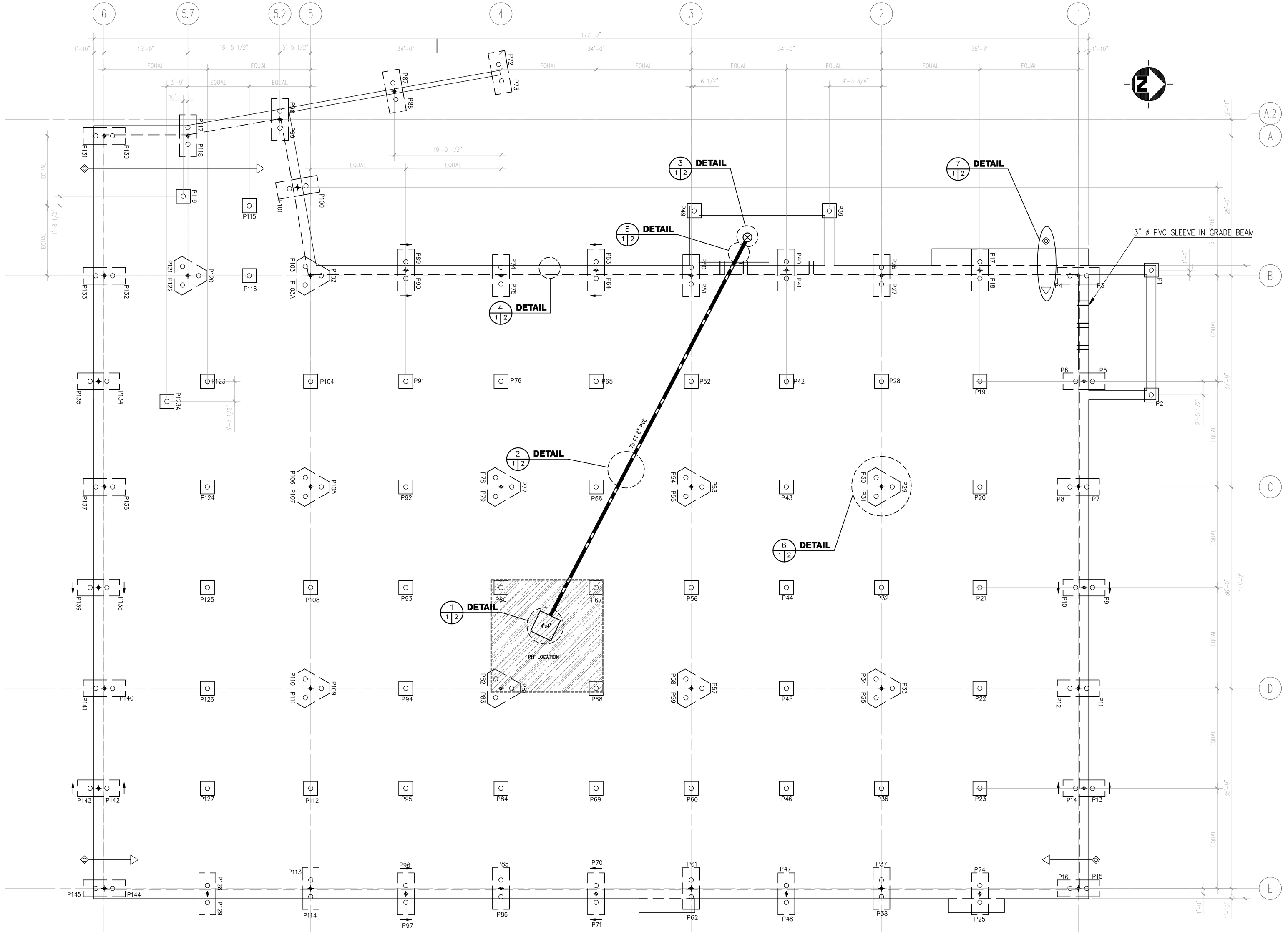
SOURCE:
Based on a As Built Map
dated February 2007
prepared by John Marano, Land Surveyor

SITE PLAN SHOWING LOCATIONS AND
CROSS SECTIONS OF ENGINEERING CONTROLS

FORMER MGP SITE
PORT CHESTER, NEW YORK

PREPARED FOR
VILLAGE OF PORT CHESTER

DATE: 08/07/09	DWG. No. 02.095 OMM1
JM SORGE,INC.	FIGURE 1



1. HANGERS SHOULD BE USED IN ACCORDANCE WITH LOCAL BUILDING CODES FOR THE GAS VENTING PIPES.

LEGEND

- LOCATION OF AIR EXHAUST RISER (TO BLOWER)
- 6" PVC, SCHED.40 VENT PIPE
- SUCTION PIT (4'x4'x1')
- UNDERSLAB SAMPLING/ PRESSURE PROBE
- UNDERSLAB SAMPLING STATION/ PRESSURE MONITOR
- GEOTEXTILE AREA BELOW AGGREGATE COURSE

BAR SCALE

REV. NO.	DATE	REMARKS

CLIENT:
JM SORGE, Inc
Environmental Consultants
57 Fourth Street
Somerville, NJ 08876

OWNER:
Village of Port Chester
222 Grace Church Street
Port Chester, NY 10573

ENGINEER:
Lahbib Chibani, Ph.D., P.E.
Professional Engineer License No. 37055 N.J.
6 Tally Road, Mercerville, NJ 08619
(609) 826-9600 FAX (609) 826-9601

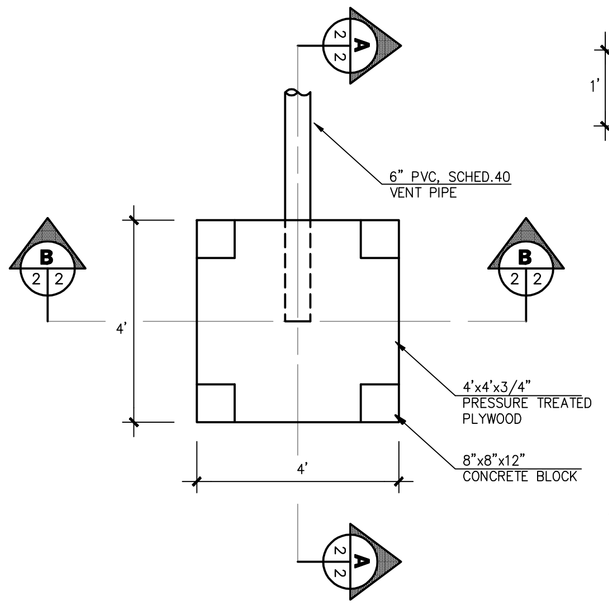
PROJECT:
REMEDIATION OF
THE FORMER MGP SITE
85 PURDY AVE.
PORT CHESTER, NY

DRAWING TITLE:
FIGURE 9A
AS-BUILT SUBSLAB
DEPRESSURIZATION SYSTEM (SSDS)
LAYOUT

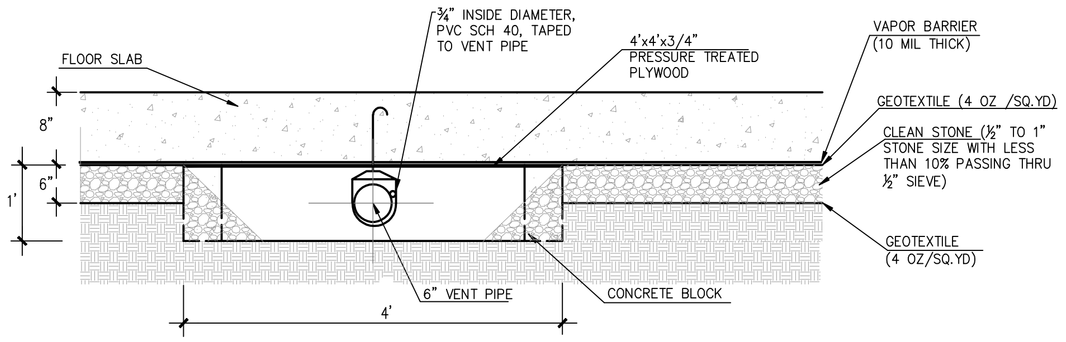
Date:	Drawn by:	Design by:
01/05/06	JG	KB
Scale: 1"=1/8'	Checked by:	Project Mgr: KB

JOB NO:	SHEET	OF
05060-0102	2A	

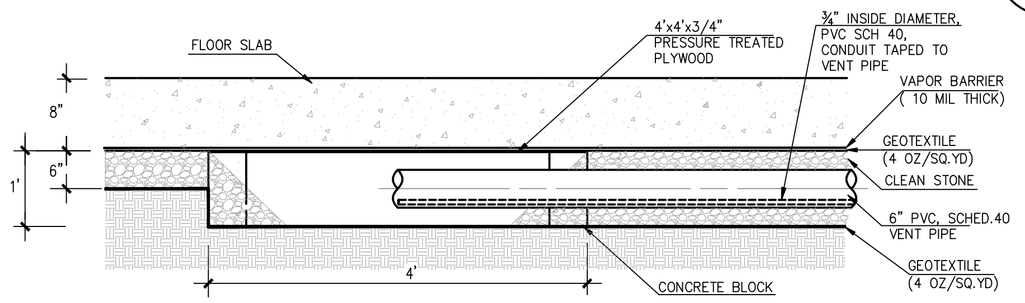
Autocad Path H:\SORGE\AS-BUILT



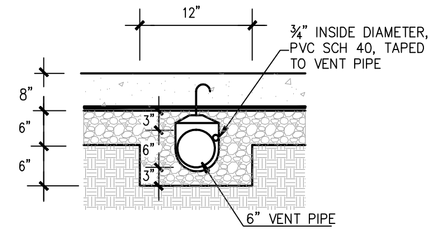
1 / 2 1 **DETAIL**
SUCTION PIT
N.T.S.



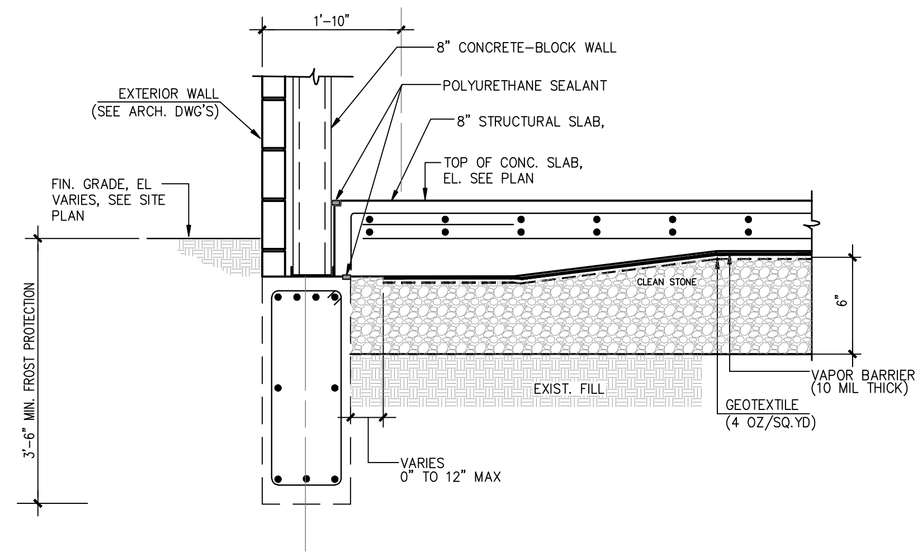
SECTION B-B
N.T.S.



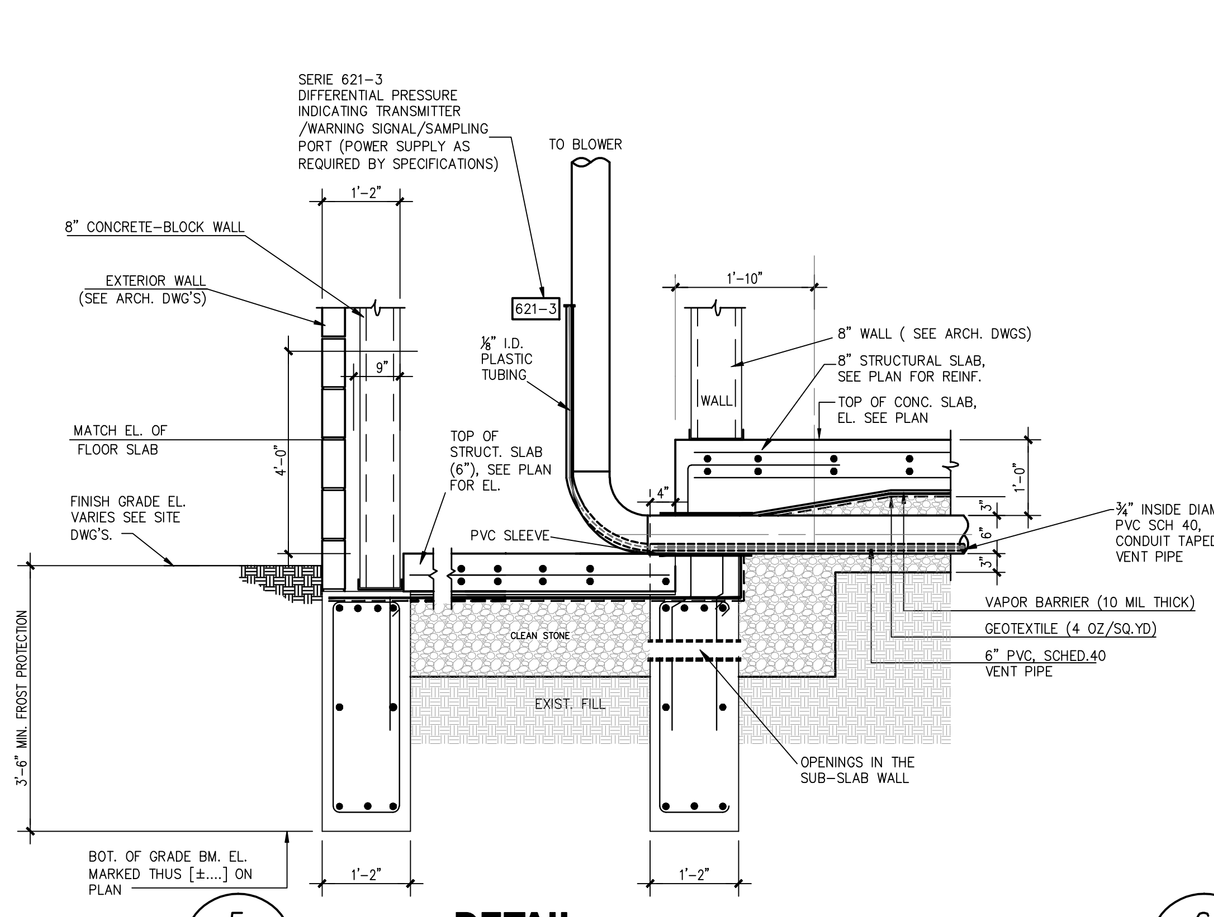
SECTION A-A
N.T.S.



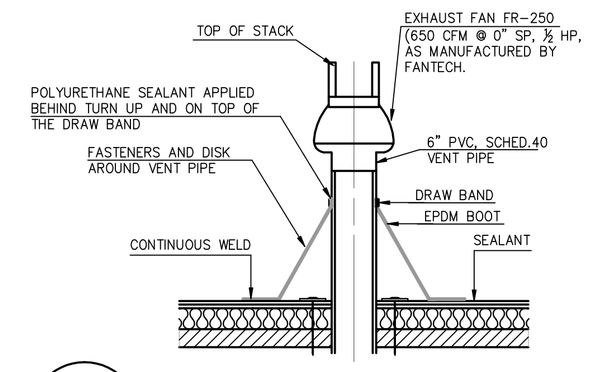
2 / 2 1 **DETAIL**
TYPICAL TRENCH DETAIL
N.T.S.



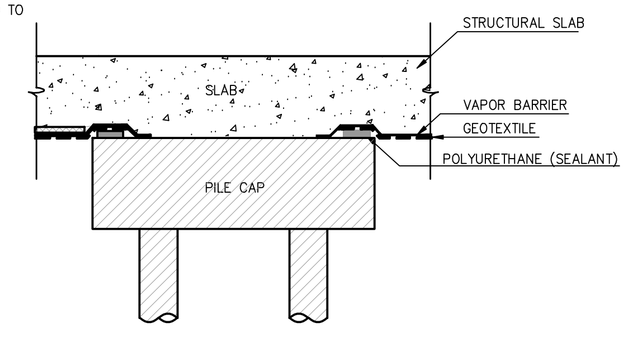
4 / 2 1 **DETAIL**
VAPOR BARRIER SEAL ABOVE GRADE BEAM
N.T.S.



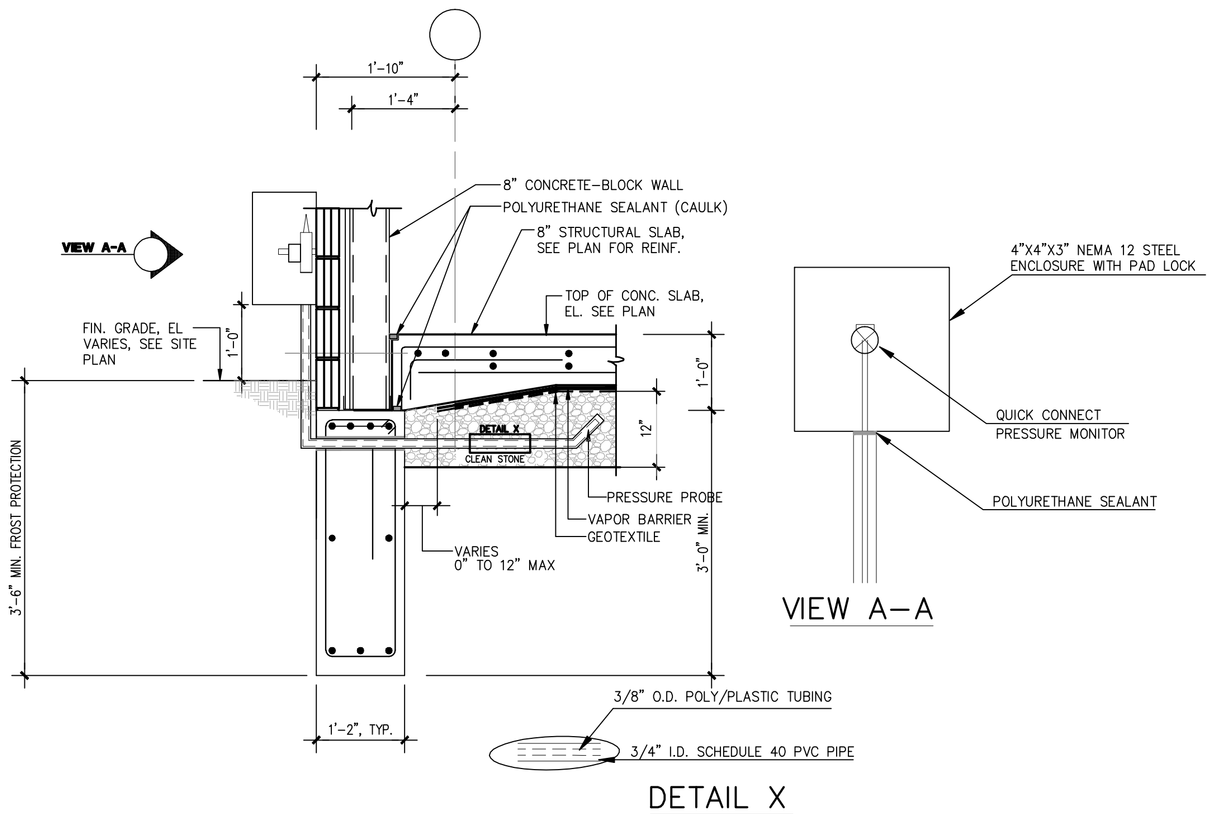
5 / 2 1 **DETAIL**
AIR EXHAUST RISER
N.T.S.



3 / 2 1 **DETAIL**
SEALING PIPE PENETRATION
THROUGH ROOF
N.T.S.



6 / 2 1 **DETAIL**
VAPOR BARRIER SEAL
ABOVE PILE CAP
N.T.S.



DETAIL X

7 / 2 1 **DETAIL**
UNDER SLAB PRESSURE
MONITORING STATION
N.T.S.

LEGEND

BAR SCALE

REV. NO.	DATE	REMARKS

CLIENT:
JM SORGE, Inc
Environmental Consultants
57 Fourth Street
Somerville, NJ 08876

OWNER:
Village of Port Chester
222 Grace Church Street
Port Chester, NY 10573

ENGINEER:
Lakhi Chibani
Lakhi Chibani, Ph.D., P.E.
Professional Engineer License No. 37055 N.J.
6 Tally Road, Mercerville, NJ 08619
(609) 826-9600 FAX (609) 826-9601

PROJECT:
REMEDIATION OF
THE FORMER MGP SITE
85 PURDY AVE.
PORT CHESTER, NY

DRAWING TITLE:
FIGURE 9B
AS-BUILT SUBSLAB
DEPRESSURIZATION SYSTEM (SSDS)
DETAILS

Date:	Drawn by:	Design by:
01/05/06	JG	KB
Scale: N.T.S	Checked by:	Project Mgr: KB

JOB NO:	SHEET	OF
05060-0102	2B	

Autocad Path H:\SORGE\AS-BUILT

N

WATERFRONT PLACE (FORMERLY DON BOSCO PLACE)

NW CORNER

MW-1

SW CORNER

AIR SAMPLING PORT

COMMERCIAL BUILDING

SUCTION PIT PRESSURE MONITORING PORT

PURDY AVENUE

CONCRETE PARKING DECK

MW-3

MW-2

NE CORNER

SE CORNER

TRAVERSE AVENUE

LEGEND:

- GROUNDWATER MONITORING WELL LOCATIONS
- SUB-SLAB PRESSURE MONITORING PORT
- SUB-SLAB AIR SAMPLING PORT
- FORMER MPG STRUCTURES
- CURRENT VCA SITE BOUNDARY; BLOCK 1, LOT 71 (9/5/2009)
- CURRENT SITE BUILDING

SOURCE:
Based on a As Built Map
dated February 2007
prepared by John Marano, Land Surveyor

0 40 80
scale feet
SCALE SUBJECT TO VERIFICATION

MONITORING WELL LOCATIONS AND
SUB-SLAB MONITORING PORT LOCATION MAP

FORMER MGP
PORT CHESTER, NEW YORK

PREPARED FOR
VILLAGE OF PORT CHESTER

DATE: 04/06/09	DWG. No. 02.095-OMM3
JM SORGE,INC.	FIGURE 3

APPENDIX A

Inspection Forms

Weekly - Pressure Monitoring Sheet
Copy of SSDS Instruction Sign
Quarterly - Cap Inspection Form/Engineering Control Inspection Reporting Form
Sub Slab Pressure Monitoring and Inspection Form
Annual - SSDS Inspection Form

Depressurization System Monitoring System Weekly Inspection Log

Former MGP Site- Port Chester, NY
NYSDEC Site ID# V00516-3

Date	Initials	Notes (if any)

If the system is not functioning correctly; please **call 908-218-0066**
When sheet is completely filled out please **fax** it to **980-218-9185**

Depressurization System Monitoring Location

This system monitors the operation of the venting system located beneath the building. In the event of a system malfunction, a flashing light will be seen on the monitor.

What to do if the light on the monitor is flashing

Building maintenance personnel should press the RE-SET button on the unit. The digital display should read a negative number [-0.836 for example] and the flashing light should go off. When the system returns to proper operating condition, please call the number below and report the condition.

If the system does not return to operating condition after pressing the RE-SET button, please:

- Check the exhaust fan operation, and
- notify your supervisor and the following to report the condition.

To report any problems with the monitoring system due to a malfunction or damage, or if you have any questions regarding the system, please call:

JM Sorge, Inc. - 57 Fourth St. – Somerville, NJ **908-218-0066** – If not during business hours, leave a voice message with **system reference # 2002095** and the conditions observed.

Quarterly Cap Inspection Form
ENGINEERING CONTROL INSPECTION REPORT

Former MGP, Port Chester, NY
NYSDEC Site ID# V00516-3

Person conducting the inspection: Date _____

_____ _____

Name and Title Company

Describe the current use within the Engineering Control Area (see attached site map).

_____

_____

_____

Describe the condition of the concrete (deterioration, significant cracking, potholes) cap within the Engineering Control Area (see attached site map).

_____

_____

_____

Describe any reports or evidence of alterations, improvements, disturbances and/or repairs during the previous three month period:

_____

_____

_____

Describe any alterations, improvements, disturbances and/or repairs likely to be necessary during the next three month period:

_____

_____

_____

Additional comments (use additional sheets as necessary):

_____

_____

_____

Date: _____ Signature: _____

Quarterly Sub Slab Depressurization Monitoring and Inspection Form
Port Chester Former MGP

Date : _____

Weather : _____

Tester : _____

Equipment : _____

Location	Measurement	Units*
Suction Pit		
NE Corner		
SE Corner		
NW Corner		
SW Corner		

***inWC - inches of Water Column**
Minimum acceptable pressure -0.002 inWC

Condition of pressure monitoring and air sampling port_____
Odors noted_____
Alarm operation test completed and acceptable_____
Interior slab inspection complete_____

Notes :

Annual SSDS Inspection

Former Port Chester MGP Site

Date of Inspection: _____

Inspector: _____

Check as Completed

____ - Fan and Motor Inspection

____ - Riser Piping Inspection

____ - Discharge Location Inspection

Describe regular maintenance procedures performed:

Describe additional repair activities needed:

_____

APPENDIX B

Equipment Manufacturer Specifications and Warranties

Exhaust Fan and Motor
Dwyer Differential Pressure Monitor
Infiltec DMI Portable Differential Pressure Monitor

THE NEW YORK BLOWER COMPANY
7660 Quincy Street
Willowbrook, IL 60527-5530
Visit us on the Web: http://www.nyb.com
Phone: (800) 208-7918 Email: nyb@nyb.com

INSTALLATION MAINTENANCE, OPERATING INSTRUCTIONS

IM-170

COMPACT GI FANS

WORD ABOUT SAFETY

The above **WARNING** decal appears on all **nyb** fans. Air moving equipment involves electrical wiring, moving parts, sound, and air velocity or pressure which can create safety hazards if the equipment is not properly installed, operated and maintained. To minimize this danger, follow these instructions as well as the additional instructions and warnings on the equipment itself.

All installers, operators and maintenance personnel should study AMCA Publication 410, "Recommended Safety Practices for Air Moving Devices", which is included as part of every shipment. Additional copies can be obtained by writing to New York Blower Company, 7660 Quincy St., Willowbrook, IL 60527.

ELECTRICAL DISCONNECTS

Every motor driven fan should have an independent disconnect switch to isolate the unit from the electrical supply. It should be near the fan and must be capable of being locked by maintenance personnel while servicing the unit, in accordance with OSHA procedures.

MOVING PARTS

All moving parts must have guards to protect personnel. Safety requirements vary, so the number and type of guards needed to meet company, local and OSHA standards must be determined and specified by the user. Never start a fan without having all safety guards installed. Check regularly for damaged or missing guards and do not operate any fan with guards removed. Fans can also become dangerous because of potential "windmilling", even though all electrical power is disconnected. Always block the rotating assembly before working on any moving parts.

SOUND

Some fans can generate sound that could be hazardous to exposed personnel. It is the responsibility of the system designer and user to determine sound levels of the system, the degree of personnel exposure, and to comply with applicable safety requirements to protect personnel from excessive noise. Consult **nyb** for fan sound power level ratings.

AIR PRESSURE AND SUCTION

In addition to the normal dangers of rotating machinery, fans present another hazard from the suction created at the fan inlet. This suction can draw materials into the fan where they become high velocity projectiles at the outlet. It can also be extremely dangerous to persons in close proximity to the inlet, as the forces involved can overcome the strength of most individuals. Inlets and outlets that are not ducted should be screened to prevent entry and discharge of solid objects.

RECEIVING AND INSPECTION

The fan and accessories should be inspected on receipt for any shipping damage. Turn the wheel by hand to see that it rotates freely and does not bind. If dampers or shutters are provided, check these accessories for free operation of all moving parts.

F.O.B. factory shipping terms require that the receiver be responsible for inspecting the equipment upon arrival. Note damage or shortages on the Bill of Lading and file any claims for damage or loss in transit. **nyb** will assist the customer as much as possible; however, claims must be originated at the point of delivery.

HANDLING AND STORAGE

Fans should be lifted by the base, mounting supports, or lifting eyes only. Never lift a fan by the wheel, shaft, motor, motor bracket, housing inlet, outlet, or any fan part not designed for lifting. A spreader should always be used to avoid damage.

Whenever possible, fans and accessories should be stored in a clean, dry location to prevent rust and corrosion of steel components. If outdoor storage is necessary, protection should be provided. Cover the inlet and outlet to prevent the accumulation of dirt and moisture in the housing. Cover motors with waterproof material. Refer to the bearing section for further storage instructions.

Check dampers for free operation and lubricate moving parts prior to storage. Inspect the stored unit periodically. **Rotate the wheel by hand every two weeks to redistribute grease on internal bearing parts.**

FAN INSTALLATION

nyb wheels are dynamically balanced when fabricated. Complete fans are test run at operating speeds to check the entire assembly for conformance to **nyb** vibration limits. Nevertheless, all units must be adequately supported for smooth operation. **Ductwork or stacks should be independently supported as excess weight may distort the fan housing and cause contact between moving parts.** Where vibration isolators are used, consult the **nyb** certified drawing for proper location and adjustment.

Slab-Mounted Units

A correctly designed and level concrete foundation provides the best means of installing floor-mounted fans. The mass of the base must maintain the fan/driver alignment, absorb normal vibration, and resist lateral loads. The overall dimensions of the concrete base should extend at least six inches beyond the base of the fan. The weight of the slab should be two to three times the weight of the rotating assembly, including the motor. The foundation requires firmly anchored fasteners such as the anchor bolts shown in Figure 1. Hammer-drilled expansion fasteners can be used in less demanding applications

Move the fan to the mounting location and lower it over the anchor bolts. Shim and grout as required to level the fan. Fasten the fan securely. When isolation is used, check the **nyb** certified drawing for installation instructions.

Elevated Units

When an elevated or suspended structural steel platform is used, it must have sufficient bracing to support the unit load and prevent side sway. The platform should be of welded construction to maintain permanent alignment of all members.

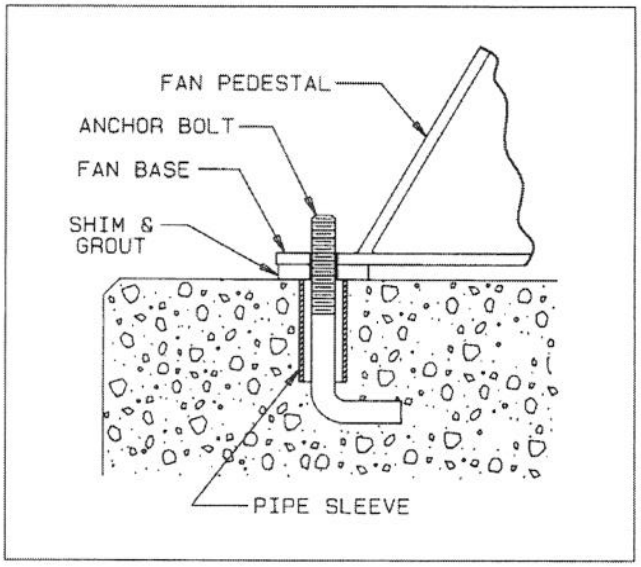


Figure 1

V-BELT DRIVE

Installation

1. Remove all foreign material from the fan and motor shafts. Coat shafts with machine oil for easier mounting. Mount the belt guard backplate at this time if partial installation is required prior to sheave mounting.
2. Mount sheaves on shafts after checking sheave bores and bushings for nicks or burrs. Avoid using force. If resistance is encountered, lightly polish the shaft with emery cloth until the sheave slides on freely.
3. Adjust the motor on its base to a position closest to the fan shaft. Install belts by working each one over the sheave grooves until all are in position. Never pry the belts into place. On **nyb** packaged fans, sufficient motor adjustment is provided for easy installation of the proper size belts.
4. Adjust sheaves and the motor shaft angle so that the sheave faces are in the same plane. Check this by placing a straightedge across the faces of the sheaves. Any gap between the edge and sheave faces indicates misalignment. Important: This method is only valid when the width of the surface between the belt edge and the sheave face is the same for both sheaves. When they are not equal, or when using adjustable-pitch sheaves, adjust so that all belts have approximately equal tension. Both shafts should be at right angles to the center belt.

Belt Tensioning

1. Check belt tension with a tensioning gage and adjust using the motor slide base. Excess tension shortens bearing life while insufficient tension shortens belt life, can reduce fan performance and vay cause vibration. The lowest allowable tension is that which prevents slippage under full load. Belts may slip during start-up, but slipping should stop as soon as the fan reaches full speed. For more precise tensioning methods, consult the drive manufacturer's literature.
2. Recheck setscrews, rotate the drive by hand and check for rubbing, then complete the installation of the belt guard.
3. Belts tend to stretch somewhat after installation. Recheck tension after several days of operation. Check sheave alignment as well as setscrew and/or bushing bolt tightness.

START-UP

Safe operation and maintenance includes the selection and use of appropriate safety accessories for the specific installation. This is the responsibility of the system designer and requires consideration of equipment location and accessibility as well as adjacent components. All safety accessories must be installed properly prior to start-up.

Safe operating speed is a function of system temperature and wheel design. Do not under any circumstances exceed the maximum safe fan speed published in the **nyb** bulletin, which is available from your **nyb** field sales representative.

Procedure

1. If the drive components are not supplied by **nyb,** verify with the manufacturer that the starting torque is adequate for the speed and inertia of the fan.
2. Inspect the installation prior to starting the fan. Check for any loose items or debris that could be drawn into the fan or dislodged by the fan discharge. Check the interior of the fan as well. Turn the wheel by hand to check for binding.

3. Check drive installation and belt tension.
4. Check the tightness of all setscrews, nuts and bolts. When finished, tighten hub setscrews with the wheel oriented such that the setscrew is positioned underneath the shaft.
5. Install all remaining safety devices and guards. Verify that the supply voltage is correct and wire the motor. "Bump" the starter to check for proper wheel rotation.
6. Use extreme caution when testing the fan with ducting disconnected. Apply power and check for unusual sounds or excessive vibration. If either exists, see the section on Common Fan Problems. To avoid motor overload, do not run the fan for more than a few seconds if ductwork is not fully installed. On larger fans, normal operating speed may not be attained without motor overload unless ductwork is attached. Check for correct fan speed and complete installation. Ductwork and guards must be fully installed for safety.
7. Setscrews should be rechecked after a few minutes, eight hours and two weeks of operation (see Tables 1 & 2 for correct tightening torques).

NOTE: Shut the fan down immediately if there is any sudden increase in fan vibration.

Table 1 - WHEEL SETSCREW TORQUES

Setscrew Size Diameter (in.)	Carbon Steel Setscrew Torque*	
	lb.-in.	lb.-ft.
1/4	75	6.2
5/16	144	12

*** Stainless Steel setscrews are not hardened and should not be tightened to more than 1/2 the values shown.**

Table 2 - BEARING SETSCREW TORQUE, lb.-in.

Setscrew Diameter	Manufacturer				
	Link-Belt	Sealmaster	SKF	McGill	Dodge
1/4	90	65	50	85	--
5/16	185	125	165	165	160

FAN MAINTENANCE

nyb fans are manufactured to high standards with quality materials and components. Proper maintenance will ensure a long and trouble-free service life.

Do not attempt any maintenance on a fan unless the electrical supply has been completely disconnected and locked. In many cases, a fan can windmill despite removal of all electrical power. The rotating assembly should be blocked securely before attempting maintenance of any kind.

The key to good fan maintenance is regular and systematic inspection of all fan parts. Inspection frequency is determined by the severity of the application and local conditions. Strict adherence to an inspection schedule is essential.

Regular fan maintenance should include the following:

1. Check the fan wheel for any wear or corrosion, as either can cause catastrophic failures. Check also for the build-up of material which can cause unbalance resulting in vibration, bearing wear and serious safety hazards. Clean or replace the wheel as required.
2. Check the V-belt drive for proper alignment and tension (see section on V-belt drives). If belts are worn, replace them as a set, matched to within manufacturer's tolerances.
3. Lubricate the bearings, but do not over lubricate (see the bearing section for detailed specifications).
4. Ceramic-felt shaft seals require no maintenance, although worn seals should be replaced. When lip-type shaft seals are provided, lubricate them with "NEVER-SEEZ" or other anti-seize compound.
5. During any routine maintenance, all setscrews and bolts should be checked for tightness. See the table for correct torques.
6. When installing a new wheel, the wheel should be centered in the housing between the inlet and drive sides.

WHEEL BALANCE

Airstreams containing particulate or chemicals can cause abrasion or corrosion of the fan parts. This wear is often uneven and can lead to significant wheel imbalance over time. When such wear is discovered, a decision must be made as to whether to rebalance or replace the wheel.

The soundness of all parts should be determined if the original thickness of components is reduced. Be sure there is no hidden structural damage. The airstream components should also be cleaned to remove any build-up of foreign material. Specialized equipment can be used to rebalance a cleaned wheel that is considered structurally sound.

Balance weights should be rigidly attached at a point that will not interfere with the housing nor disrupt airflow. Remember that centrifugal forces can be extremely high at the outer radius of a fan wheel. Welding is the preferred method of balance weight attachment. Weld material for standard Compact GI wheels should be a nickel, aluminum bronze alloy. Be sure to ground the welder directly to the fan wheel. Otherwise, the welding current could pass through the fan bearings and damage them.

BEARINGS

Storage

Any stored bearing can be damaged by condensation caused by temperature variations. Therefore, **nyb** fan bearings are filled with grease at the factory to exclude air and moisture. Such protection is adequate for shipment and subsequent immediate installation.

For long term or outdoor storage, mounted bearings should be regreased and wrapped with plastic for protection. **Rotate the fan wheel by hand at least every two weeks to redistribute grease on internal bearing parts.** Each month the bearings should be purged with new grease to remove condensation, since even a filled bearing can accumulate moisture. Use caution when purging, as excessive pressure can damage the seals. Rotate the shaft while slowly adding grease.

Operation

Check the setscrew torque before start-up (see table for correct values). Since bearings are completely filled with grease at the factory, they may run at an elevated temperature during initial operation. Surface temperatures may reach 180°F. and grease may bleed from the bearing seals. This is normal and no attempt should be made to replace lost grease. Bearing surface temperatures will decrease when the internal grease quantity reaches a normal operating level. Relubrication should follow the recommended schedule.

Lubrication

Use the following table for bearing lubrication interval, according to operating speed. Bearings should be lubricated with a premium quality lithium-based grease conforming to NLGI Grade 2. Examples are:

Mobil	-	Mobilgrease XHP
Texaco	-	Premium RB
Chevron	-	Amolith #2
Shell	-	Alvania #2

Do not use "high temperature" greases, as many are not formulated for the high speeds associated with fan bearings.

Add grease to the bearing while running the fan or rotating the shaft by hand. Be sure all guards are in place if lubrication is performed while the fan is operating. Add just enough grease to cause a slight purging at the seals. Do not over lubricate.

BEARING LUBRICATION INTERVAL [months]

	RPM				
Shaft	1-1000	1001-2000	2001-3000	3001-4000	4001-5000
1"	6	5-6	4-6	3-4	2

Sealmaster, McGill, Link-Belt, and SKF

NOTE:

1. **These are general recommendations only; specific manufacturer's recommendations may vary slightly.**
2. **Assumes clean environment, -20°F. to 120°F.**
   a. **Consult The New York Blower Company for operation below -20°F. ambient.**
   b. **Ambient temperatures greater than 120°F. will shorten bearing life.**
   c. **Under extremely dirty conditions, lubricate more frequently.**
3. **Assumes horizontal mounting configuration. For vertically mounted applications, lubricate twice as frequently.**

COMMON FAN PROBLEMS

Excessive Vibration

A common complaint regarding industrial fans is "excessive vibration". **nyb** is careful to ensure that each unit is precisely balanced prior to shipment; however, there are many other causes of vibration including:

1. Loose mounting bolts, setscrews, bearings or couplings.
2. Misalignment or excessive wear of couplings or bearings.
3. Misaligned or unbalanced motor.
4. Bent shaft due to mishandling or material impact.
5. Accumulation of foreign material on the wheel.
6. Excessive wear or erosion of the wheel.
7. Excessive system pressure or restriction of airflow due to closed dampers.
8. Inadequate structural support, mounting procedures or materials.
9. Externally transmitted vibration.

Inadequate Performance

1. Incorrect testing procedures or calculations.
2. Fan running too slowly.
3. Fan wheel rotating in wrong direction or installed backwards on shaft.
4. Wheel not properly centered relative to inlet cone.
5. Poor system design, closed dampers, air leaks, clogged filters, or coils.
6. Obstructions or sharp elbows near inlets.
7. Sharp deflection of airstream at fan outlet.

Excessive Noise

1. Fan operating near "stall" due to incorrect system design or installation.
2. Vibration originating elsewhere in the system.
3. System resonance or pulsation.
4. Improper location or orientation of fan intake and discharge.
5. Inadequate or faulty design of supporting structures.
6. Nearby sound reflecting surfaces.
7. Loose accessories or components.
8. Loose drive belts.
9. Worn bearings.

Premature Component Failure

1. Prolonged or major vibration.
2. Inadequate or improper maintenance.
3. Abrasive or corrosive elements in the airstream or surrounding environment.
4. Misalignment or physical damage to rotating components or bearings.
5. Bearing failure from incorrect or contaminated lubricant or grounding through the bearings while arc welding.
6. Excessive fan speed.
7. Extreme ambient or airstream temperatures.
8. Improper belt tension.
9. Improper tightening of wheel setscrews.

LIMITED PRODUCT WARRANTY

All products are warranted by **nyb** to be free from defects in materials and workmanship for a period of one (1) year after shipment from its plant, provided buyer demonstrates to satisfaction of **nyb** that the product was properly installed and maintained in accordance with **nyb**'s instructions and recommendations and that it was used under normal operating conditions.

This warranty is limited to the replacing and/or repairing by **nyb** of any part or parts which have been returned to **nyb** with **nyb**'s written authorization and which in **nyb**'s opinion are defective. Parts not manufactured by **nyb** but installed by **nyb** in equipment sold to the buyer shall carry the original manufacturer's warranty only. All transportation charges and any and all sales and use taxes, duties, imports or excises for such part or parts shall be paid for by the buyer. **nyb** shall have the sole right to determine whether defective parts shall be repaired or replaced.

This warranty does not cover any customer labor charges for replacement of parts, adjustments or repairs, or any other work unless such charges shall be assumed or authorized in advance, in writing, by **nyb.**

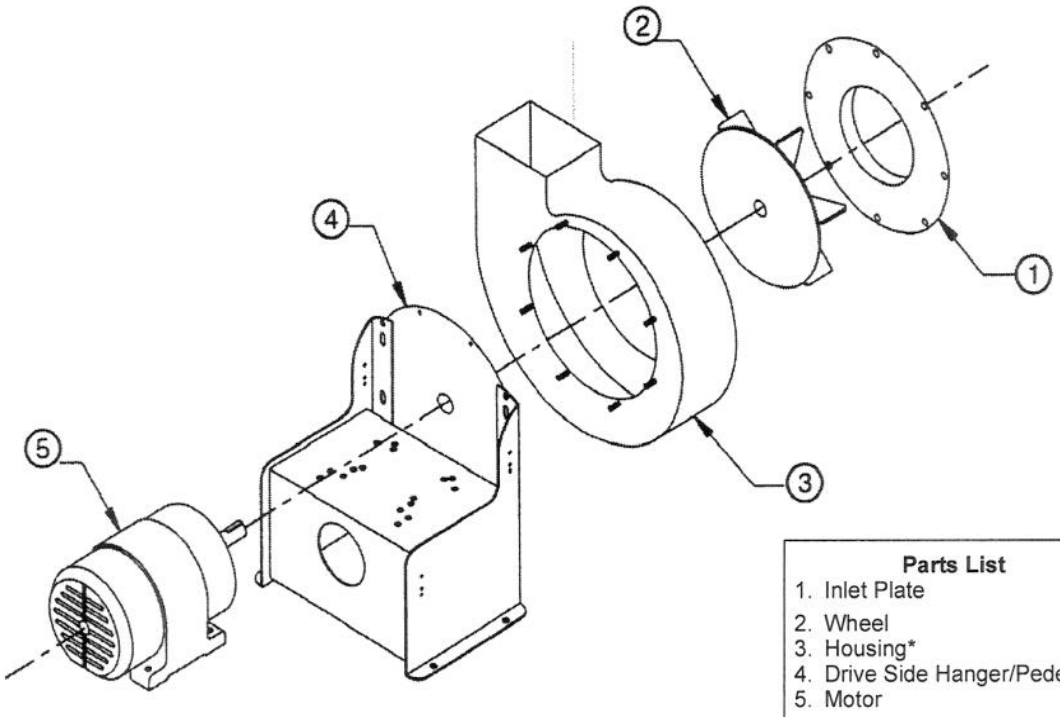
This warranty does not cover any product which, in the judgement of **nyb,** has been subject to misuse or neglect, or which has been repaired or altered outside **nyb's** plant in any way which may have impaired its safety, operation or efficiency, or any product which has been subject to accident.

This warranty shall be null and void if any part not manufactured or supplied by **nyb** for use in any of its products shall have been substituted and used in place of a part manufactured or sup-plied by **nyb** for such use.

There are no warranties, other than those appearing on the acknowledgement form **INCLUDING NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE,** given in connection with the sale of the goods sold hereunder. The buyer agrees that his sole and exclusive remedy, and the limit of **nyb**'s liability for loss from any cause whatsoever, shall be the purchase price of the goods sold hereunder for which a claim is made.

The New York Blower Company – 7660 Quincy Street – Willowbrook, Illinois 60527-5530

DIRECT DRIVE COMPACT GI FANS

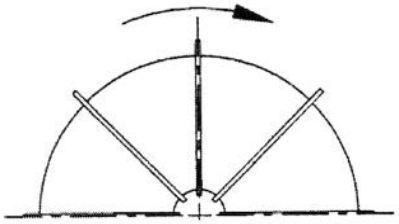


Parts List

1. Inlet Plate
2. Wheel
3. Housing*
4. Drive Side Hanger/Pedestal
5. Motor

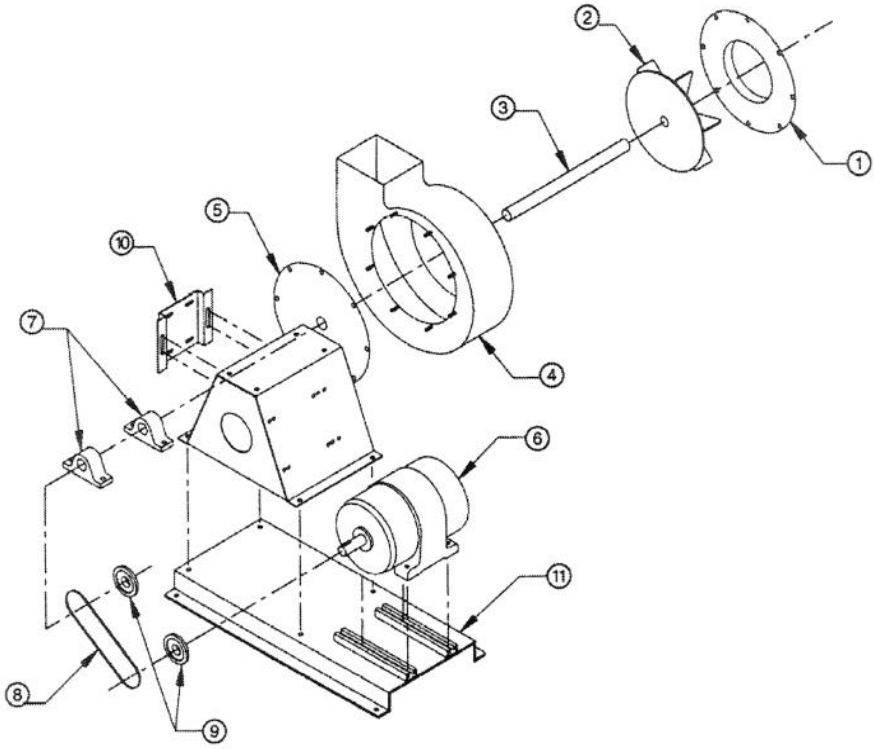
* Order for parts must specify rotation.

SPECIFY ROTATION AS VIEWED FROM DRIVE SIDE



ARROW INDICATES CLOCKWISE ROTATION

BELT DRIVE COMPACT GI FANS



REPLACEMENT PARTS

It is recommended that only factory-supplied replacement parts be used. **nyb** fan parts are built to be fully compatible with the original fan, using specific alloys and tolerances. These parts carry a standard **nyb** warranty.

When ordering replacement parts, specify the part name, **nyb** shop and control number, fan size, type, rotation (viewed from drive end), arrangement and bearing size or bore. Most of this information is on the metal nameplate attached to the fan base.

For assistance in selecting replacement parts, contact your local **nyb** representative or visit: http://www.nyb.com.

Example: Part required: Wheel
Shop/control number: B-10106-100
Fan description: Size 125 Compact GI Fan
Rotation: Clockwise
Arrangement: 9

Suggested replacement parts include:

Wheel	Component parts:	Damper
Shaft		Motor
Bearings		Sheaves
Shaft Seal		V-Belts

Parts List

1. Inlet Plate
2. Wheel
3. Shaft
4. Housing*
5. Drive Side Hanger/Pedestal
6. Motor
7. Bearings
8. Belt
9. Sheaves
10. Arr. 9 Motor Mounting Base
11. Arr. 9X Motor Mounting Base

* Orders for parts must specify rotation.

For assistance in selecting replacement parts, contact your local **nyb** representative or visit: http://www.nyb.com.

Please reply to ACFM Dynamics, LLC
PO Box 386 • Marion, CT 06444-0386
Phone:(203)395-3227 • FAX:(203)271-0141
E-MAIL: philritola@acfmdynamics.net

nyb | The New York Blower Company®

QUOTATION

FOB factory at LaPorte, Indiana, with full freight allowed.

Terms: 30 days net. Subject to nyb Conditions of Sale.

This quotation, for equipment manufactured by nyb, is valid for acceptance within 15 days. Purchased components such as motors, drives, and vibration bases are subject to adjustment to price in effect at time of shipment. nyb reserves the right to qualify and correct clerical errors before acceptance.

PRICE

8 August 2006

TO: Pat Shannon
G & S Investors

SUBJECT: Exhaust Fan
nyb/ACFM Proposal C.2322.0.200.0806

Dear Mr. Shannon,

We are pleased to offer the following **nyb** fan for your consideration on this project:

Tag	Model	Flow-CFM	SP-"WG	RPM	BHP	Temperature	Density	Mtr HP	Mtr RPM	Frame
EF	85 CGI	550	0	3500	0.855	70°F.	0.075	½	3600	56

- direct-drive, Arrangement 4 Compact General Industrial (CGI) Fan with cast aluminum wheel featuring radial blades for stable performance from wide-open to closed-off
- 3-60-230/460V., explosion-proof motor
- explosion-proof starter (for field-wiring by others)
- factory-mounting of the motor, and factory-testing of the fan assembly
- slip-fit inlet and outlet connections
- flexible inlet connector
- housing drain
- roof curb/equipment support
- RIS vibration isolators
- Weather cover

Weight: Approximately 100#s assembled
Shipment: 3-4 weeks ARO
Option: Add $60.00 for a 1 HP motor in lieu of ½ HP. At 0.855 BHP, this fan will overload the specified ½ HP motor at this capacity.

Please contact me immediately with any questions. If we are favored with your valuable order for this fan, please issue your order to:

ACFM Dynamics, LLC

Thank you for this opportunity to be of service.

Sincerely,

Phil Ritola

THE NEW YORK BLOWER COMPANY
CONDITIONS OF SALE AND LIMITED PRODUCT WARRANTY

1. **ENTIRE AGREEMENT/CHANGES**
The terms and conditions appearing on The New York Blower Company (nyb) acknowledgement of buyer's order constitute the entire agreement between nyb and buyer. No additional, different, or revised terms and conditions shall become a part of this agreement unless expressly agreed to by nyb, in writing, at the home office of The New York Blower Company in LaPorte, Indiana. Stenographic or clerical errors are subject to correction.

2. **PRICE PROTECTION**
Prices as officially acknowledged by nyb are subject to change as follows: Prices on equipment of nyb manufacture are firm for shipment up to six months from the date of original order entry. Such prices are subject to adjustment if shipment is made after six months and up to 12 months from the date of original order entry at an increase not to exceed 15%. If equipment is shipped after 12 months from the date of original order entry, prices will be adjusted to the price in effect at time of shipment. All complete component accessory material manufactured by others and furnished with nyb equipment such as motors, drives, vibration bases, controls or other completely assembled component structures are subject to adjustment to the price at time of shipment regardless of the date of original order entry.

3. **INSPECTION AND DAMAGE**
The buyer agrees to inspect the goods shipped in accordance with this agreement upon receipt thereof, and to immediately report any damage or shortage to nyb and to the carrier. Further, buyer agrees to file any claims for shortages or damage with the carrier.

4. **CREDIT SALES**
Payment is due within 30 days of the invoice date. nyb, at its option, reserves the right to withdraw credit, or change the terms thereof at any time.

5. **SHIPPING DATES**
All dates of shipments are contingent upon strikes, accidents, shortage of materials, delays of carriers, or causes which are unavoidable or beyond the control of nyb.

6. **CANCELLATIONS**
All orders are for firm delivery and not subject to change or cancellation, without approval from nyb. In the event a cancellation or change is approved, buyer agrees to pay reasonable cancellation charges or any price increases applicable to such change.

7. **DESIGN CHANGES**
nyb reserves the right to make changes in design, improvements and additions in and to its products any time without imposing any liability or obligation on itself to apply or install the same in any product manufactured by it.

8. **TAXES**
Federal, state or local taxes are not included in nyb's prices, and will be added to the purchase price, where applicable. In such event, buyer agrees to pay said taxes or furnish evidence of exemption.

9. **REPLACEMENT PARTS**
If this agreement is for replacement parts, buyer warrants that the original components in which these replacement parts will be placed are in satisfactory working condition, and when said replacement parts are installed, the resultant installation will operate in a safe manner, at speeds and temperatures for which the original equipment was purchased.

10. **SAFETY ACCESSORIES**
Buyer understands that nyb manufactures multi-functional goods that may or may not require safety devices, depending on the use and location of the goods. Buyer warrants to nyb that he has determined what safety devices, including warning devices and notices of danger, should be placed on the goods sold hereunder, and buyer further warrants that he has either purchased these with the goods sold hereunder or from another source.

LIMITED PRODUCT WARRANTY

All products are warranted by nyb to be free from defects in materials and workmanship for a period of one (1) year after shipment from its plant, provided buyer demonstrates to satisfaction of nyb that the product was properly installed and maintained in accordance with nyb's [illegible] under normal operating conditions.

This warranty is limited to the replacing and/or repairing by nyb of any part or parts which have been returned to nyb with nyb's written authorization and which in nyb's opinion are defective. Parts not manufactured by nyb but installed by nyb in equipment sold to the buyer shall carry the original manufacturer's warranty only. All transportation charges and any and all sales and use taxes, duties, imports or excises for such part or parts shall be paid for by the buyer. nyb shall have the sole right to determine whether defective parts shall be repaired or replaced.

This warranty does not cover any customer labor charges for replacement of parts, adjustments or repairs, or any other work unless such charges shall be assumed or authorized in advance, in writing, by nyb.

This warranty does not cover any product which, in the judgment of nyb, has been subject to misuse or neglect, or which has been repaired or altered outside nyb's plant in any way which may have impaired its safety, operation or efficiency, or any product which has been subject to accident.

This warranty shall be null and void if any part not manufactured or supplied by nyb for use in any of its products shall have been substituted and used in place of a part manufactured or supplied by nyb for such use.

There are no warranties, other than those appearing on the acknowledgement form INCLUDING NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, given in connection with the sale of the goods sold hereunder. The buyer agrees that his sole and exclusive remedy, and the limit of nyb's liability for loss from any cause whatsoever, shall be the purchase price of the goods sold hereunder for which a claim is made.

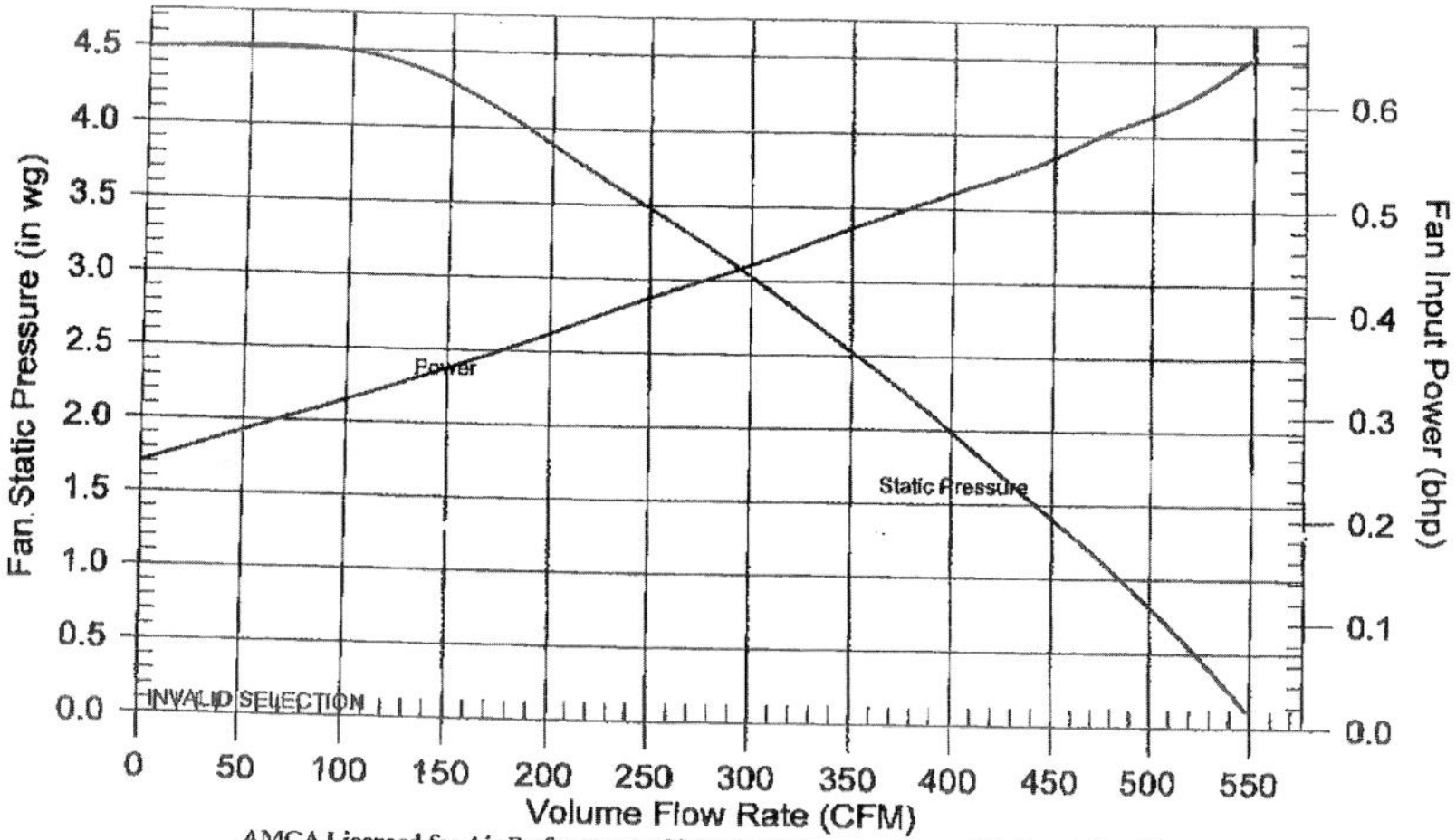
The New York Blower Company

Fan-to-Size
Volume Flow Rate: 550 CFM
Fan Static Press.: 0.00 in wg
Speed: 3500 rpm
Power: 0.855 bhp

Compact GI
85
Arr.: 4

Tag: Exhaust Fan

Temp.: 70 Deg F
Altitude: 0 ft
Density: 0.0750 lb/ft3
Outlet Velocity: 5340 ft/min

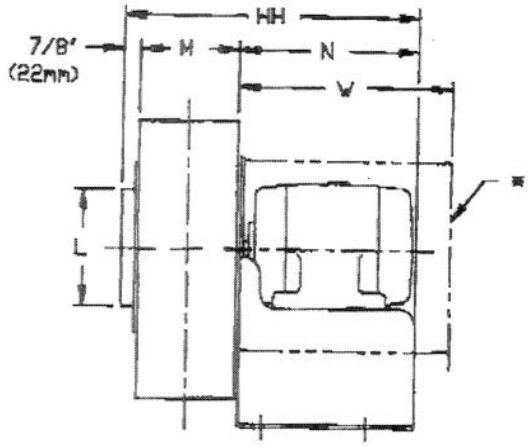


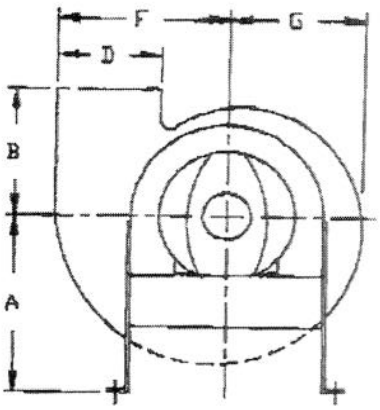
AMCA Licensed for Air Performance without Appurtenances. Power (bhp) excludes drives.
Performance shown is for installation type: D - Ducted inlet, Ducted outlet.

Customer:
G & S Investors
1.914.937.4210

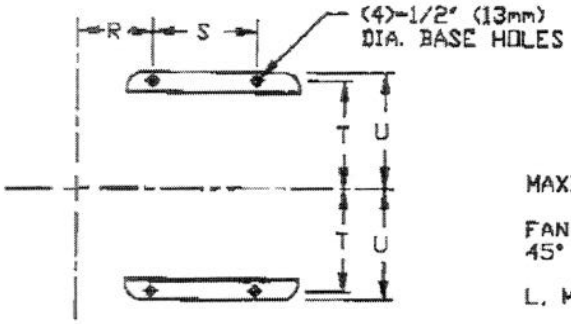
Your Sales Representative:
ACFM Dynamics
Phone: 1.203.395.3227

G & S Investors
Port Chester, NY
Exhaust Fan





* : OPTIONAL WEATHER COVER



MAXIMUM TEMPERATURE: 180°F (82°C).

FAN IS ROTATABLE IN FIELD BY 45° INCREMENTS.

L, M, & D ARE OUTSIDE DIMENSIONS.

ITEM	DIMENSIONS	
	in	mm
A	10 1/2	267
B	6	152
D	4 5/8	117
F	6 7/8	175
G	5 7/8	149
HH	14 5/8	371
L	5	127
M	3 5/8	92

ITEM	DIMENSIONS	
	in	mm
N	10 1/8	257
R	3 5/16	84
S	6	152
T	6 1/4	159
U	6 3/4	171
W	14 1/4	362

TOLERANCE: ±1/8" (±3mm)

nyb The New York Blower Company
7660 Quincy Street, Willowbrook, IL 60521

COMPACT GI FAN
SIZE 85 CW UB

Date 06-27-96

Drawing No _____ Rev ___

B60A

ACFM Dynamics, LLC

P.O. Box 386
Marion, CT 06444-0386
(203) 395-3227
(203) 271-0141
www.acfmdynamics.net

CPC-2 (Insulated) Conventional Roof Curb

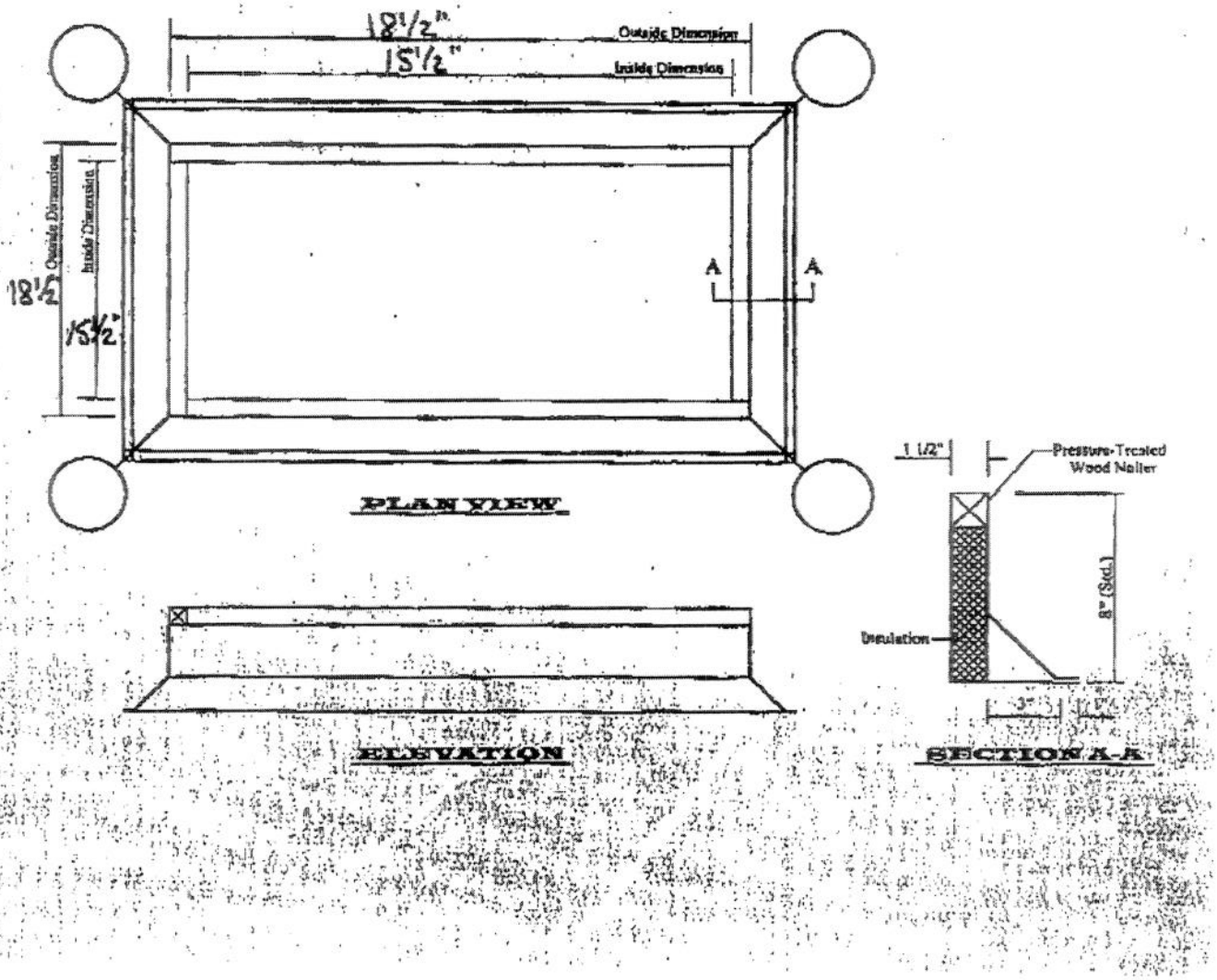
STANDARD FEATURES

1. 18 Ga. Galvanized Steel Construction.
2. Fully Welded One-Piece Construction.
3. Curbs Prime Painted after Fabrication.
4. Pressure-Treated 2 x 2 Wood Nailer.
5. 1 1/2" Thick, 3# Density Fiberglass Insulation.
6. Internal Angle Reinforcing.
7. Fully Mitered and Welded 3" Cant.

OPTIONS

1. 1/2" PLYWOOD TOP
2. 18GA. WELDED TOP
3.
4.

PROJECT NAME: G & S Investors
CITY, STATE: Port Chester, NY
CUSTOMER: G & S Investors
JOB NUMBER: C.2337.0.700.080L



Revised 01/2002

SECTION 15830

FANS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Centrifugal fans.

B. Related Sections:

1.2 REFERENCES

A. American Bearing Manufacturers Association:
1. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:
1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. National Electrical Manufacturers Association:
1. NEMA MG 1 - Motors and Generators.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.

C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

Revised 01/2002

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300.

C. Balance Quality: Conform to AMCA 204.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum one hundred years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.8 WARRANTY

A. Section 01700 - Execution Requirements: Product warranties and product bonds.

B. Furnish manufacturer's standard warranty for fans. Minimum requirements are one year from start-up or eighteen months from shipment, whichever is first occurring.

1.9 EXTRA MATERIALS

A. Section 01700 - Execution Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 CENTRIFUGAL FANS

A. Manufacturer:
1. The New York Blower Company (as represented by Phil Ritola of ACFM Dynamics, LLC + PO Box 386 + Marion, CT 06444-0386 + P:1.203.395.3227 + F:1.203.271.0141 + E:philritola@acfmdynamics.net
2. Substitutions: Not Permitted.

B. Performance:

Revised 01/2002

1. Performance Base: 70°F. air, sea level, 0.075#/ft.^{3} density
2. Temperature Limit: Maximum 180°F.
3. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

C. Wheel:
1. Radial Wheel: All-aluminum casting with radial blades and a backplate with hub keyed to the shaft with set screws. Wheel and inlet diameters and outlet areas shall be in accordance with the standard dimensions adopted by AMCA for industrial centrifugal fans. Designs not in accordance with AMCA Standard 99-2402 are not acceptable.

D. Housing:
1. Heavy-gauge steel, continuously welded construction. Housings of square design, lock seams, partially welded, or sheet metal panel construction are not acceptable.
2. Housings are to be reinforced as required to increase structural integrity and prevent vibration.
3. All fan surfaces are to be thoroughly cleaned prior to painting using a combination of washing and hand and power tool cleaning as required. After cleaning, all steel surfaces are to be coated with a polyester powder, baked till cured. Surfaces of bolted components not accessible after assembly shall be coated and allowed to dry prior to assembly. Primer only will not be accepted.

E. Accessories:
1. Arrangement 4
2. AMCA Type C Spark-Resistant Construction
3. Weather cover
4. Slip-fit inlet and outlet connections
5. threaded drain
6. Vibration Eliminator Company T22-3 RIS vibration isolators
7. flexible inlet connector: 29 oz/yd.^{2} neoprene-coated fiberglass sleeve, nominal 5-inch ID with beaded hems for clamping with hose clamps, 6-inches long
8. CPC-2 Insulated Roof Curb (Equipment Support) with ½-inch plywood top and 18 gauge welded cover

F. Capacity:
1. Air Flow: 550 CFM.
2. Static Pressure: 0" WG.
3. RPM: 3500
4. BHP: 0.855
5. Outlet Velocity: 5340 FPM

G. Electrical Characteristics and Components:

1. Motors: Explosion-proof, ¼ HP, 2-pole, 3-60-230/460 volt.
   a. Option: 1 HP motor recommended.
2. Akron Electric Type CXJ8106-H1-N1-N6-RP2 explosion-proof control station with ABBA9-31-11-84 starter, 480 volt, with 120 volt coil.

Revised 01/2002

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Secure centrifugal fans to support structure using the fan base bars and isolators.

C. Pipe scroll drains to nearest drain.

3.2 MANUFACTURER'S FIELD SERVICES

A. Section 01400 - Quality Requirements: Requirements for manufacturer's field services.

3.3 CLEANING

A. Section 01700 - Execution Requirements: Requirements for cleaning.

B. Vacuum clean inside of fan housing.

3.4 DEMONSTRATION

A. Section 01700 - Execution Requirements: Requirements for demonstration and training.

B. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.

B. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

AKRON ELECTRIC, INC.

EXPLOSION-PROOF CONTROL STATIONS "CXJ" SERIES

CATALOG NUMBER	INSIDE DIMENSIONS (INCHES)				OUTSIDE DIMENSIONS (INCHES)			MOUNTING (INCHES)		LUG BOLT SIZE (INCHES)	MAX. CONDUIT (INCHES)	EST. WEIGHT (LBS.)
CXJ	W	L	D	Dc	A	B	C	E	F	—	—	—
4164	4	16	4	1	8	20	6 1/2	12 1/8	6 3/4	3/8	2	33
664	6	6	4	1	9 3/4	9 3/4	6 1/4	5 1/8	9 1/8	3/8	2	17
684	6	8	4	1	9 3/4	11 3/4	6 7/16	4 1/2	9 1/8	3/8	2	23
685	6	8	5	1	9 3/4	11 3/4	7 7/16	4 1/2	9 1/8	3/8	2	25
686	6	8	6	1	9 3/4	11 3/4	8 7/16	4 1/2	9 1/8	3/8	2	26
6104	6	10	4	1	10	14	6 3/8	6 1/2	9 1/8	3/8	2	26
6115	6	11	5	1	10	15	7 7/16	8 1/2	9 1/8	3/8	2	29
6124	6	12	4	1	10	16	6 7/16	8 1/2	9 1/8	3/8	2	30
* 6126	6	12	6	1	10	16	8 7/16	8 1/2	9 1/8	3/8	2	36
6135	6	13	5	1	10	17	7 7/16	9 1/2	9 1/8	3/8	2	34
6154	6	15	4	1	10 1/2	20 1/2	6 9/16	12 1/8	9 1/8	3/8	2	42
6186	6	18	6	1 1/2	10 1/2	22 1/2	9 1/16	13 1/8	9 1/8	3/8	3	46
# 6485	6	48	5	1	10	52	7 3/4	40	8	3/8	2	109
7104	7	10	4	1	11 1/2	14 1/2	6 9/16	6 1/2	9 3/4	3/8	2	20
7106	7	10	6	1	11 1/2	14 1/2	8 9/16	6 1/2	9 3/4	3/8	3	25
7185	7	18	5	1	11 1/2	22 1/2	7 9/16	14 1/2	9 3/4	3/8	2	60
884	8	8	4	1	12 1/2	12 1/2	6 9/16	4 1/2	10 3/4	3/8	2	33
886	8	8	6	1	12 1/2	12 1/2	8 9/16	4 1/2	10 3/4	3/8	3	36
888	8	8	8	1	12 1/2	12 1/2	10 9/16	4 1/2	10 3/4	3/8	4	39
8104	8	10	4	1	12 1/2	14 1/2	6 9/16	6 1/2	10 3/4	3/8	2	36
8106	8	10	6	1	12 1/2	14 1/2	8 9/16	6 1/2	10 3/4	3/8	3	41
8108	8	10	8	1	12 1/2	14 1/2	10 9/16	6 1/2	10 3/4	3/8	4	46
8124	8	12	4	1	12 1/2	16 1/2	6 9/16	8 5/8	10 3/4	3/8	2	41
8126	8	12	6	1	12 1/2	16 1/2	8 9/16	8 5/8	10 3/4	3/8	3	46
8128	8	12	8	1	12 1/2	16 1/2	10 9/16	8 5/8	10 3/4	3/8	4	50
9115	9	11	5	1	13 1/2	15 1/2	7 9/16	7 1/4	13 1/8	3/8	2	46
10104	10	10	4	1	14 1/2	14 1/2	6 3/4	6 1/2	13	3/8	2	40
10106	10	10	6	1	14 1/2	14 1/2	8 3/4	6 1/2	13	3/8	3	50
10108	10	10	8	1	14 1/2	14 1/2	10 3/4	6 1/2	13	3/8	4	57
10144	10	14	4	1 1/2	14 1/2	18 1/2	7 3/16	10 5/8	13	3/8	2	60
10146	10	14	6	1 1/2	14 1/2	18 1/2	9 3/16	10 5/8	13	3/8	3	68
10148	10	14	8	1 1/2	14 1/2	18 1/2	11 3/16	10 5/8	13	3/8	4	75

P.O. BOX 26505 • AKRON, OHIO 44319-0005 • PHONE (330) 745-8891 • FAX (330) 745-2504

AKRON ELECTRIC, INC.

EXPLOSION-PROOF CONTROL STATIONS "CXJ" SERIES

CATALOG NUMBER	INSIDE DIMENSIONS (INCHES)				OUTSIDE DIMENSIONS (INCHES)			MOUNTING (INCHES)		LUG BOLT SIZE (INCHES)	MAX. CONDUIT (INCHES)	EST. WEIGHT (LBS.)
CXJ	W	L	D	Dc	A	B	C	E	F	—	—	—
12124	12	12	4	1 1/2	17	17	7 1/2	8 5/8	15 3/4	1/2	2	70
12126	12	12	6	1 1/2	17	17	9 1/2	8 5/8	15 3/4	1/2	3	77
12126-LW	12	12	6	1 9/16	16	16	6 7/8	8 5/8	15 3/4	1/2	4	58
12128	12	12	8	1 1/2	17	17	11 1/2	8 5/8	15 3/4	1/2	4	87
12184	12	18	4	1 1/2	17	23	7 1/2	14 1/8	15 3/4	1/2	2	102
12186	12	18	6	1 1/2	17	23	9 1/2	14 1/8	15 3/4	1/2	3	116
12188	12	18	8	1 1/2	17	23	11 1/2	14 1/8	15 3/4	1/2	4	120
12205	12	20	5	1 1/2	17	25	8 1/2	14 3/8	15 3/4	1/2	2	111
12244	12	24	4	1 1/2	17 1/8	29 1/8	7 5/8	18 3/4	15 3/4	1/2	2	126
12246	12	24	6	1 1/2	17 1/8	29 1/8	9 5/8	18 3/4	15 3/4	1/2	3	142
12248	12	24	8	1 1/2	17 1/8	29 1/8	11 5/8	18 3/4	15 3/4	1/2	4	154
122410	12	24	10	1 1/2	17 1/8	29 1/8	13 5/8	18 3/4	15 3/4	1/2	4	165
12306	12	30	6	1 1/2	17	35	9 5/8	23	15 3/4	1/2	3	177
12364	12	36	4	1 1/2	17	41	7 5/8	29	15 3/4	1/2	2	197
12366	12	36	6	1 1/2	17	41	9 5/8	29	15 3/4	1/2	3	210
12368	12	36	8	1 1/2	17	41	11 5/8	29	15 3/4	1/2	4	222
*12468	12	46	8	1 1/2	17 1/8	51 1/8	11 5/8	15 3/4	39	1/2	4	260
14144	14	14	4	1 1/2	19 1/8	19 1/8	7 1/2	9 3/4	17 1/2	1/2	2	83
14146	14	14	6	1 1/2	19 1/8	19 1/8	9 1/2	9 3/4	17 3/4	1/2	3	94
14148	14	14	8	1 1/2	19 1/8	19 1/8	11 1/2	9 3/4	17 3/4	1/2	4	104
14286	14	28	6	1 1/2	19 1/8	33 1/8	9 1/2	22 1/2	17 3/4	1/2	3	153
16164	16	16	4	1 1/2	21 1/8	21 1/8	7 5/8	11	19 3/4	5/8	2	103
16166	16	16	6	1 1/2	21 1/8	21 1/8	9 5/8	11	19 3/4	5/8	3	120
16168	16	16	8	1 1/2	21 1/8	21 1/8	11 5/8	11	19 3/4	5/8	4	143
16246	16	24	6	1 1/2	21 1/8	29 1/8	9 7/8	18 3/8	19 3/4	5/8	3	174
16248	16	24	8	1 1/2	21 1/8	29 1/8	11 7/8	18 3/8	19 3/4	5/8	4	194
162410	16	24	10	1 1/2	21 1/8	29 1/8	13 7/8	18 3/8	19 3/4	5/8	4	212
*164610	16	46	10	1 1/2	21 1/8	51 1/8	13 3/4	19 3/8	39	5/8	4	370
18184	18	18	4	1 1/2	23 1/8	23 1/8	8	13	21 3/4	5/8	2	131
18186	18	18	6	1 1/2	23 1/8	23 1/8	10	13	21 3/4	5/8	3	149
18188	18	18	8	1 1/2	23 1/8	23 1/8	12 3/8	13	21 3/4	5/8	4	176
18246	18	24	6	1 1/2	23 1/8	29 1/8	9 7/8	18 3/8	21 3/4	5/8	3	193
18248	18	24	8	1 1/2	23 1/8	29 1/8	11 7/8	18 3/8	21 3/4	5/8	4	210

P.O. BOX 26505 • AKRON, OHIO 44319-0005 • PHONE (330) 745-8891 • FAX (330) 745-2504

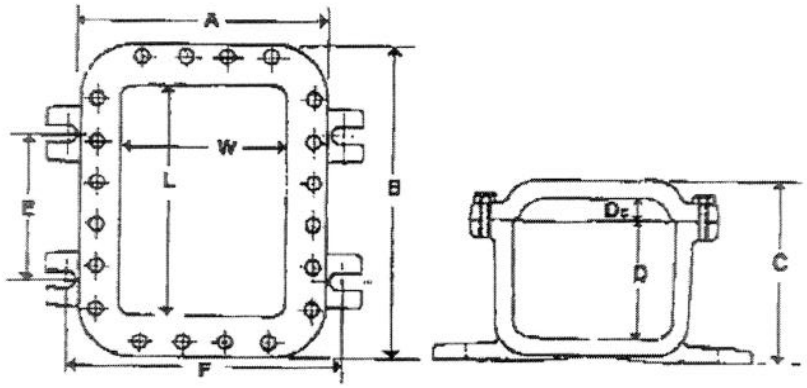
AKRON ELECTRIC, INC.

EXPLOSION - PROOF CONTROL STATIONS "CXJ" SERIES

CATALOG NUMBER	INSIDE DIMENSIONS (INCHES)				OUTSIDE DIMENSIONS (INCHES)			MOUNTING (INCHES)		LUG BOLT SIZE (INCHES)	MAX. CONDUIT (INCHES)	EST. WEIGHT (LBS.)
CXJ	W	L	D	Dc	A	B	C	E	F	—	—	—
182410	18	24	10	1 1/2	23 1/8	29 1/8	13 7/8	18 5/8	21 3/4	5/8	4	234
18308	18	30	8	1 1/2	23 1/8	35 1/8	11 7/8	23	21 3/4	5/8	4	268
18368	18	36	8	1 1/2	24	42	12 1/16	29	21 3/4	5/8	4	410
183610	18	36	10	1 1/2	23 1/2	41 1/2	14 1/4	29	21 3/4	5/8	4	436
24248	24	24	8	1 1/2	29 1/2	29 1/2	12 1/8	18 5/8	28	5/8	4	306
242410	24	24	10	1 1/2	29 1/2	29 1/2	14 1/8	18 5/8	28	5/8	4	320
24308	24	30	8	1 1/2	29 1/8	35 1/8	11 7/8	23	28	5/8	4	306
24368	24	36	8	1 1/2	30	42	12 9/16	29	28	5/8	4	471
243610	24	36	10	1 1/2	30	42	14 9/16	29	28	5/8	4	501
#323612	32	36	8	6	38 1/4	42 1/4	15 7/8	29	36	5/8	4	600
#346810	34	68	5	5	40	74	17 1/8	54	42 1/2	5/8	2	1160
#38388	38	38	8	2	44	44	16 1/8	24	46	5/8	4	800

NEMA 4X,7,9 ENCLOSURES DESIGNED TO THIRD PARTY SPECIFICATIONS. THESE BOXES CARRY NO FORMAL LISTINGS.

* U.L. CLASSIFIED ENCLOSURES ONLY - (NO C.S.A. CERTIFICATION)



- Mounting feet will be aligned right & left (as shown above) unless otherwise specified.
- For an enclosure size not listed above or a special application, contact Akron Electric.
- All conduit runs must be sealed within 6 inches of the enclosure.
- Note: enclosures have internal Taper (Draft) of 1/16" per inch of depth (Dimensions "W" and "L" are across top of base).
- Hinges and mounting pans are not included as standard.
- See pages C11 thru C15 for ordering information, modifications and conduit working area.

P.O. BOX 26505 • AKRON, OHIO 44319-0005 • PHONE (330) 745-8891 • FAX (330) 745-2504

AKRON ELECTRIC, INC.

ORDERING INFORMATION

ORDERING INSTRUCTIONS:

1) CHOOSE ENCLOSURE SIZE.
2) CHOOSE MODIFICATIONS FROM TABLES III & IV (page C12).
3) SELECT THE LETTER TO SPECIFY THE LOCATION OF CONDUIT OPENING FROM TABLE II (below).
4) CHOOSE THE OUTLET CODE NUMBER TO INDICATE THE SIZE OF DESIRED CONDUIT FROM TABLE V (page C12).
5) ADD ALL MODIFICATIONS FROM TABLES III & IV TO THE END OF THE JUNCTION BOX CATALOG NUMBER.
6) LIST CONDUIT SIZE & LOCATION ON SEPARATE LINE FROM CATALOG NUMBER & MODIFICATIONS.

EXAMPLE:

CXJ 12186 - H2 - N1 - N4 - G3 - 2B8 - 3P11 - 5N6
(C1 - H3 - M2 - R2)

EXAMPLE INCLUDES:

CXJ 12186 ENCLOSURE
Medium duty cast hinge (H2)
Mounting pan (N1)
NEMA 4 O-ring gasket (N4)
(1) 3" diameter round window (G3)
(2) Black push button with N.O. contact
(3) Red pilot lights (120 V)
(5) Metallic nameplates (specify legend)
(1) 1/2" NPT hole at location "C"
(1) 1" NPT hole at location "H"
(2) 3/4" NPT holes at locations "M" & "R"
(5) 3/4" NPSM Operator holes (supply layout)

- All operator holes are tapped 3/4"-14 NPSM (TABLE I).
- A minimum of 2 1/2" between centers of operator holes is required to maintain U.L. & C.S.A. certification (TABLE I).
- When operators are cover mounted, hinges should be used to avoid damage to wiring when opening cover.
- Long barrel operators are required if cover thickness is 7/8" or larger (see C13).
- Consult factory or attach layout sheet for combination of windows and operators.
- Consult factory for any custom layouts or custom windows.

TABLE I - COVER LAYOUT

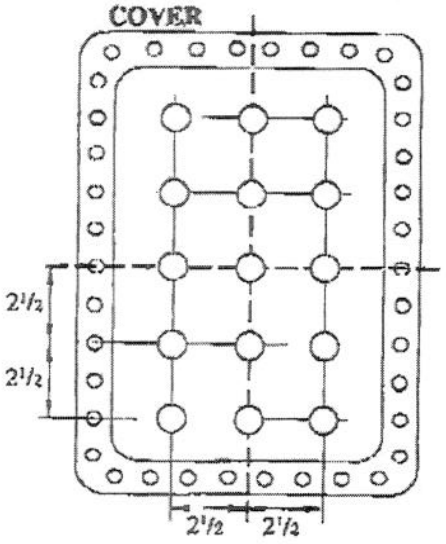
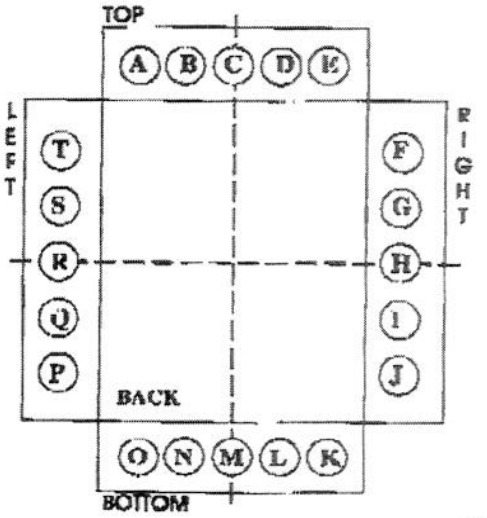


TABLE II - CONDUIT LOCATIONS



P.O. BOX 26505 • AKRON, OHIO 44319-0005 • PHONE (330) 745-8891 • FAX (330) 745-2504

AKRON ELECTRIC, INC.

ORDERING INFORMATION

TABLE III - MODIFICATIONS

- BD - Breather/Drain Unit
- E1 - Corrosion Resistant Coating - Outside Only
- E2 - Corrosion Resistant Coating - Inside & Out
- E3 - S.S. (316) Captive Quick Thread Cover Bolts
- H1 - Stainless Steel Modular Hinge Set
- H2 - Medium Duty Cast Aluminum Hinge Set
- H3 - Heavy Duty Cast Aluminum Hinge Set
- K - Terminal Block, 600 Volt, 20 Amp. Standard
- N1 - Aluminum Mounting Pan 3/16" Thick Standard
- N2 - Galvanized Mounting Pan
- N3 - Phenolic Mounting Pan
- N4 - "O - Ring" Gasket for NEMA 4X Application
- N5 - Corrosion Resistant Stainless Steel Cover Bolts

TABLE IV OPERATORS & WINDOWS

- B1 - START, Green Push Button (flush head)
- B2 - START, Green Push Button (raised head)
- B3 - STOP, Red Push Button (flush head)
- B4 - STOP, Red Push Button (raised head)
- B5 - START-STOP Green-Red Dual Push Button
- B6 - RED Mushroom Head Moment. Push Button
- B7 - RED Mushroom Head Maintain Push Button
- B8 - BLACK Push Button with N.O. Contact
- B9 - BLACK Push Button with N.C. Contact
- C1 - Circuit Breaker Handle, 100 AMP.
- C2 - Circuit Breaker Handle, 225 AMP.
- C3 - Circuit Breaker Handle, 400 AMP.
- E8 - Custom Mounting Bracket For Meters
- G1 - 1" Diameter Round Window Glass
- G2 - 2" Diameter Round Window Glass
- G3 - 3" Diameter Round Window Glass
- G4 - 4" Diameter Round Window Glass
- G5 - 5 1/4" Diameter Round Window Glass
- G6 - 6 3/4" Diameter Round Window Glass
- G7 - 7 5/8" Diameter Round Window Glass
- G8 - Custom Square or Rectangular Window Glass
- N6 - Metallic Nameplate
- N7 - Phenolic Nameplate
- N8 - Custom Nameplate (anodized, stainless steel
- P+* - PilotLights
- PL+* - Illuminated PushBhutton

  + = lense color code; 1-red, 2-green, 3-amber, 4-blue, 5-white

  * = voltage code: 0-6 v, 1-120 v, 2-240 v, 4-480 v, 6-600 v
- R1 - Reset Push Button
- R2 - Potentiometer
- R3 - Close Up Plug (3/4" NPSM)
- S1 - 2-Pos. Selector Switch, Maintained
- S2 - 2-Pos. Selector Switch, Spr. Retd. from Left
- S3 - 2-Pos. Selector Switch, Spr. Retd. from Right
- S4 - 3-Pos. Selector Switch, Maintained
- S5 - 3-Pos. Selector Switch, Spr. Retd. from Left
- S6 - 3-Pos. Selector Switch, Spr. Retd. from Right
- S7 - 3-Pos. Selector Switch, Spr. Retd. from L. & R.
- S8 - 3-Pos. Selector Switch, Key Operated
- S9 - 3-Pos. Selector Switch, Key Operated

TABLE V - CONDUIT SPACING

OUTLET CODE	TRADE SIZE OF CONDUIT (NPT)	MINIMUM CENTER TO CENTER CONDUIT SEPARATIONS (INCHES)									
		4	3 1/2	3	2 1/2	2	1 1/2	1 1/4	1	3/4	1/2
1	1/2	3 5/8	3 3/8	3	2 5/8	2 3/8	2	2	1 3/4	1 5/8	1 1/2
2	3/4	3 3/4	3 1/2	3 1/8	2 3/4	2 1/2	2 1/8	2 1/8	1 7/8	1 3/4	
3	1	4	3 5/8	3 1/4	3	2 5/8	2 3/8	2 3/8	2		
4	1 1/4	4 1/4	4	3 5/8	3 1/4	3	2 5/8	2 5/8			
5	1 1/2	4 1/4	4	3 5/8	3 1/4	3	2 5/8				
6	2	4 5/8	4 1/4	3 7/8	3 5/8	3 1/4					
7	2 1/2	4 7/8	4 5/8	4 1/4	3 7/8						
8	3	5 5/8	5	4 5/8							
9	3 1/2	5 5/8	5 1/4								
10	4	5 7/8									

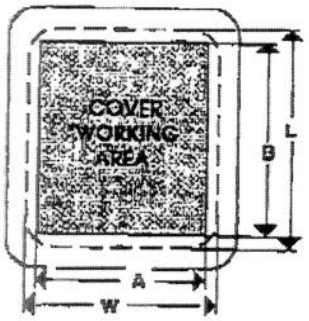
* If seals are used, additional clearance may be required. Check dimensions of seals and fittings to determine required spacing. Consult factory for assistance.

TRADE SIZE OF CONDUIT (NPT)	THREADS PER IN.	MINIMUM WALL THICKNESS (IN.)
1/2 - 3/4	14	.357
1 - 2	11 1/2	.435
2 1/2 - 4	8	.625

P.O. BOX 26505 • AKRON, OHIO 44319-0005 • PHONE (330) 745-8891 • FAX (330) 745-2504

AKRON ELECTRIC, INC.

CXJ SERIES COVER DATA SHEET



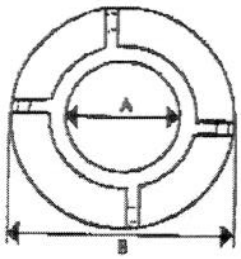
NOTES: 1. All openings in cover must be within the working area.
2. Maximum number of operators is based on 2½ inch centers.
3. Long barrel pilot devices required on enclosure sizes with cover thickness of 7/8" or larger.
4. All dimensions are in inches.

COVER WORKING AREAS

COVER SIZE	NOMINAL DIMENSIONS		COVER WORKING AREA		MAX. QTY. OPERATORS		COVER THICKNESS
	W	L	A	B	ROW	COL.	
416	4	16	2½	14½	1	6	5/8
66	6	6	4½	4½	2	2	1/2
68	6	8	4	6	2	2	5/8
610	6	10	4	8	2	3	9/16
611	6	11	4	9	2	3	5/8
612	6	12	4	10	2	4	5/8
613	6	13	4	11	2	4	5/8
616	6	16	4	14	2	5	21/32
618	6	18	4	16	2	6	21/32
648	6	48	3	39	1	16	5/8
710	7	10	5	8	2	3	21/32
718	7	18	5	16	2	6	21/32
88	8	8	6	6	2	2	21/32
810	8	10	6	8	2	3	21/32
812	8	12	6	10	2	4	21/32
911	9	11	7	9	3	3	21/32
1010	10	10	8	8	3	3	3/4
1014	10	14	7½	11½	3	4	7/8
1212	12	12	9½	9½	4	4	13/16
1218	12	18	9½	15½	4	6	7/8

COVER SIZE	NOMINAL DIMENSIONS		COVER WORKING AREA		MAX. QTY. OPERATORS		COVER THICKNESS
	W	L	A	B	ROW	COL.	
1220	12	20	9½	17½	4	6	7/8
1224	12	24	9	21	4	8	1
1230	12	30	9	27	4	11	15/16
1236	12	36	9	33	4	13	15/16
1246	12	46	9	43	4	17	15/16
1414	14	14	11	11	4	4	7/8
1428	14	28	11	25	4	10	7/8
1616	16	16	13	13	5	5	15/16
1624	16	24	12½	20½	5	7	1 1/16
1646	16	46	13	43	5	17	1 1/8
1818	18	18	14½	14½	5	5	1
1824	18	24	14½	20½	5	7	1 1/16
1830	18	30	14½	26½	6	10	1 1/16
1836	18	36	15	33	5	13	1 7/16
2424	24	24	21	21	8	8	1 1/8
2430	24	30	20½	26½	8	10	1 1/16
2436	24	36	20½	32½	8	13	1 9/16
3236	32	36	28½	32½	11	13	1 3/8
3468	34	68	30	64	12	25	1 1/16
3838	38	38	34	34	13	13	1

EXPLOSION PROOF WINDOWS / GC - SERIES DATA



CATALOG #	VIEWING DIAM. "A"	OVERALL DIM. "B"	THREAD
GC1	1"	2 7/8"	2½ - 16
GC2	2"	4"	3⅝ - 12
GC3	3"	5 1/16"	4¾ - 12
GC4	4"	6⅝"	5¾ - 12
GC5	5 1/4"	7 7/8"	7⅛ - 12
GC6	6¾"	10⅝"	9⅛ - 12
GC7	7⅝"	11⅜"	10 ⅛ - 12

P.O. BOX 26505 • AKRON, OHIO 44319-0005 • PHONE (330) 745-8891 • FAX (330) 745-2504

AKRON ELECTRIC, INC.

MOUNTING PANS & HINGES (CX] Series)

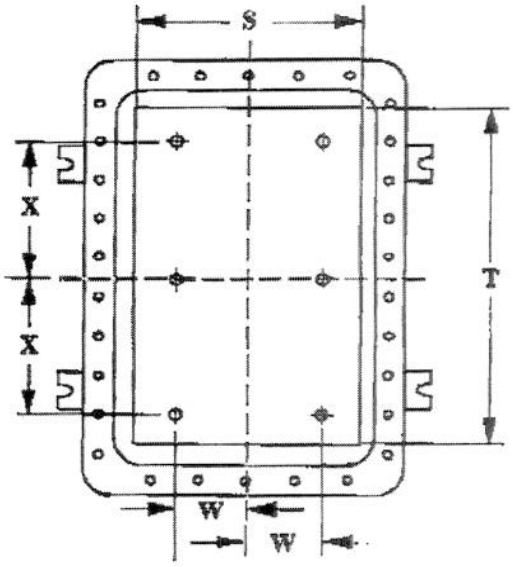
BOX INSIDE DIMENSION		MOUNTING PAN DIMENSION		MOUNTING BOSS DIMENSION		NUMBER OF BOSSES	HINGE TYPE
W	L	S	T	W	X	—	—
4	16	3	15	—	—	0	H1
6	6	5	5	1 3/4	1 3/4	4	H1
6	8	5	7	1 3/4	2 3/4	4	H1
6	10	5	9	1 1/2	3 1/2	4	H1
6	11	5	10	1 1/2	4 1/2	4	H1
6	12	5	11	1 1/2	4 1/2	4	H1
6	13	5	12	1 1/2	5	4	H1
6	16	5	15	1 1/2	6 1/2	4	H1
6	18	5	17	1 1/2	6 1/2	4	H1
6	48	5	46	—	20	3	*H1
7	10	6	9	2	3 1/2	4	H1
7	18	6	17	2 1/2	6 1/2	4	H1
8	8	6 1/2	6 1/2	2 1/2	2 1/2	4	H1
8	10	6 1/4	8 1/4	2 1/2	3 1/2	4	H1
8	12	6 1/2	10 1/2	2 1/2	4 1/2	4	H1
9	11	7 1/2	9 1/2	3	4	4	H1
10	10	8 1/2	8 1/2	3 1/2	3 1/2	4	H1
10	14	8	12	3 3/8	5 5/16	4	H1
12	12	10	10	4 1/2	4 1/2	4	H1
12	18	10	16	4 1/2	7 1/2	4	H2

BOX INSIDE DIMENSION		MOUNTING PAN DIMENSION		MOUNTING BOSS DIMENSION		NUMBER OF BOSSES	HINGE TYPE
W	L	S	T	W	X	—	—
12	20	10	18	4 1/2	8 1/2	4	H2
12	24	10	22	4 1/2	10 1/2	4	H2
12	30	10	28	4 1/2	13 1/2	6	H2
12	36	10	34	4	16	6	*H2
12	46	10	44	4	21	6	*H2
14	14	12	12	5 1/2	5 1/2	4	H2
14	28	12	26	5	12	6	H2
16	16	14	14	6 1/2	6 1/2	4	H2
16	24	14	22	6 1/2	10	4	H2
16	46	14	44	6	21	6	*H2
18	18	16	16	7	7	4	H2
18	24	16	22	7 1/2	10	6	H2
18	30	16	28	7	13	6	H2
18	36	14	32	6	14 1/2	6	*H3
24	24	20	20	9	9	8	H3
24	30	22	28	10	13	6	H3
24	36	20	32	8 1/2	14 1/2	6	*H3
32	36	30	34	14	16	6	*H3
34	68	30	64	—	—	-0-	*H3
38	38	34	34	—	—	-0-	*H3

* - Additional hinges are required for enclosures with lengths (L) of 36 inches or longer.
NOTE: Hinges are mounted on left side as standard (unless specified).

MOUNTING PANS (XJCTS/C/D Series)

XJCTS/G/D NUMBER	MOUNTING PAN DIMENSION		MOUNTING BOSS DIMENSION	
	S	T	W	X
XJCTS1	3 3/4	3 3/4	1.563	1.563
XJCTS2	4 3/4	4 3/4	2.063	2.063
XJCTS3	4 3/4	4 3/4	2.063	2.063
XJCTS4	5 1/2	5 1/2	2.438	2.438
XJCTS5	6 1/2	6 1/2	2.938	2.938
XJCTS6	6 1/2	6 1/2	2.938	2.938
XJCTS7	6 1/2	8	2.938	3.688
XJCTS8	8	8	3.688	3.688
XJCTS9	8 1/2	8 1/2	3.938	3.938
XJCTS10	8 1/2	8 1/2	3.938	3.938
XJCTS11	8 1/2	8 1/2	3.938	3.938
XJCTS12	4 3/4	4 3/4	2.063	2.063



OPEN BOX VIEW

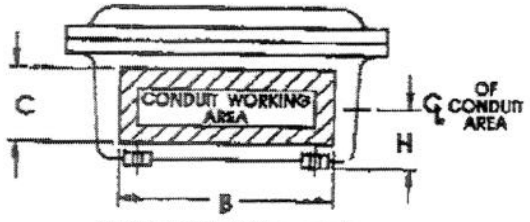
P.O. BOX 26505 • AKRON, OHIO 44319 -0005 • PHONE (330) 745-8891 • FAX (330) 745-2504

AKRON ELECTRIC, INC.

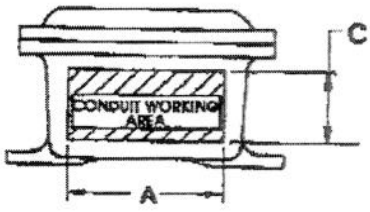
CONDUIT WORKING AREA

ENCLOSURE CATALOG NUMBER	SHORT SIDE		LONG SIDE		℄ OF WORKING AREA
	WIDTH	DEPTH	LENGTH	DEPTH	
CXJ	A	C	B	C	H
4164	2 1/2	2 1/8	14 1/2	2 1/8	2 1/2
664	4 3/4	2 3/8	4 3/8	2 3/8	2 1/4
684	4 3/4	2 1/4	6 3/4	2 1/4	2 3/8
685	4 1/2	3 1/4	6 1/2	3 1/4	2 7/8
686	4 1/2	4 1/4	6 1/2	4 1/4	3 5/8
6104	4 3/4	2 3/8	8 3/4	2 3/8	2 3/8
6115	4 5/16	3 1/8	9 5/16	3 1/8	3 1/8
6124	4 1/2	2 1/8	10 1/2	2 1/8	2 3/8
6126	4 5/16	4 1/8	10 5/16	4 1/8	3 3/8
6135	4 5/16	3 1/8	11 5/16	3 1/8	2 7/8
6164	4 3/4	2 1/8	14 3/4	2 1/8	2 1/2
6186	4 5/16	4 1/8	16 5/16	4 1/8	3 1/2
6485	4 1/2	3 1/8	46 1/2	3 1/8	3 5/8
7104	5 1/2	2 1/8	8 1/2	2 1/8	2 1/2
7106	5 5/16	4 1/8	8 5/16	4 1/8	3 1/2
7185	5 7/16	3 1/8	16 7/16	3 1/8	3
884	6 1/2	2 1/8	6 1/2	2 1/8	2 1/2
886	6 5/16	4 1/8	6 5/16	4 1/8	3 1/2
888	6 3/16	6 1/8	6 3/16	6 1/8	4 1/2
8104	6 1/2	2 1/8	8 1/2	2 1/8	2 1/2
8106	6 5/16	4 1/8	8 5/16	4 1/8	3 1/2
8108	6 3/16	6 1/8	8 3/16	6 1/8	4 1/2
8124	6 1/2	2 1/8	10 1/2	2 1/8	2 1/2
8126	6 5/16	4 1/8	10 5/16	4 1/8	3 1/2
8128	6 3/16	6 1/8	10 3/16	6 1/8	4 3/8
9115	7 5/16	3 1/8	9 5/16	3 1/8	3
10104	8 1/2	2	8 1/2	2	2 1/2
10106	8 5/16	4	8 5/16	4	3 1/2
10108	8 3/16	6	8 3/16	6	4 1/2
10144	8	1 3/4	12	1 3/4	2 3/8
10146	7 13/16	3 3/4	11 13/16	3 3/4	3 3/8
10148	7 11/16	5 3/4	11 11/16	5 3/4	4 5/8
12124	10	1 5/8	10	1 5/8	2 5/8
12126	9 13/16	3 5/8	9 13/16	3 5/8	3 5/8
12126 LW	10 1/4	4 1/4	10 1/4	4 1/4	3 3/8
12128	9 11/16	5 5/8	9 11/16	5 5/8	4 15/16
12184	10	1 5/8	16	1 5/8	2 5/8
12186	9 13/16	3 5/8	15 13/16	3 5/8	3 5/8
12188	9 11/16	5 5/8	15 11/16	5 5/8	4 5/8

ENCLOSURE CATALOG NUMBER	SHORT SIDE		LONG SIDE		℄ OF WORKING AREA
	WIDTH	DEPTH	LENGTH	DEPTH	
CXJ	A	C	B	C	H
12205	9 13/16	2 5/8	17 13/16	2 5/8	3 1/8
12244	10	1 5/8	22	1 5/8	2 3/4
12245	9 13/16	3 5/8	21 13/16	3 5/8	3 3/4
12248	9 11/16	5 5/8	21 11/16	5 5/8	4 3/8
122410	9 9/16	7 3/8	21 9/16	7 5/8	5 3/4
12306	9 13/16	3 5/8	27 13/16	3 5/8	3 3/4
12364	8 1/2	1 1/4	32 1/2	1 1/4	2 1/8
12366	8 5/16	3 1/4	32 5/16	3 1/4	3 7/8
12368	8 3/16	5 1/4	32 3/16	5 1/4	4 7/8
12468	8 3/16	5 1/4	42 3/16	5 1/4	4 7/8
14144	12	1 5/8	12	1 5/8	2 3/4
14146	11 13/16	3 5/8	11 13/16	3 5/8	3 3/4
14148	11 11/16	5 5/8	11 11/16	5 5/8	4 3/4
14286	10 5/16	3 1/4	24 5/16	3 1/4	3 1/8
16164	14	1 1/2	14	1 1/2	2 3/4
16166	13 15/16	3 1/2	13 15/16	3 1/2	3 3/4
16168	13 11/16	5 1/2	13 11/16	5 1/2	4 3/4
16246	13 15/16	3 1/2	21 15/16	3 1/2	3 5/8
16248	13 11/16	5 1/2	21 11/16	5 1/2	4 5/8
162410	13 9/16	7 3/8	21 9/16	7 3/8	5 3/4
164610	12 1/16	7	42 1/16	7	6
18184	15 3/4	1 5/8	15 3/4	1 5/8	2 3/8
18186	15 9/16	3 3/8	15 9/16	3 3/8	3 3/4
18188	15 7/16	5 3/8	15 7/16	5 3/8	5 1/8
18246	15 9/16	3 1/4	21 9/16	3 1/4	3 3/8
18248	15 7/16	5 1/4	21 7/16	5 1/4	4 3/4
182410	15 5/16	7 1/4	21 5/16	7 1/4	5 3/4
18308	15 7/16	5 1/4	27 7/16	5 1/4	4 3/4
18368	14 5/16	3 5/8	32 5/16	3 5/8	5 3/4
183610	14 1/16	6 1/2	32 1/16	6 1/2	6 1/4
24248	21 15/16	5	21 15/16	5	5 1/2
242410	21 15/16	6 5/8	21 13/16	6 5/8	6 1/4
24308	21 7/16	5 1/4	27 7/16	5 1/4	4 3/4
24368	21 15/16	3	33 15/16	3	5 3/4
243610	21 13/16	5 5/8	33 13/16	5 5/8	6 3/8
323612	29	2 3/4	33	2 3/4	4 5/8
346810	21 9/16	2 1/8	55 9/16	2 1/8	4 7/8
38388	22	6 1/8	22	5 1/8	7 3/8



SIDE VIEW



END VIEW

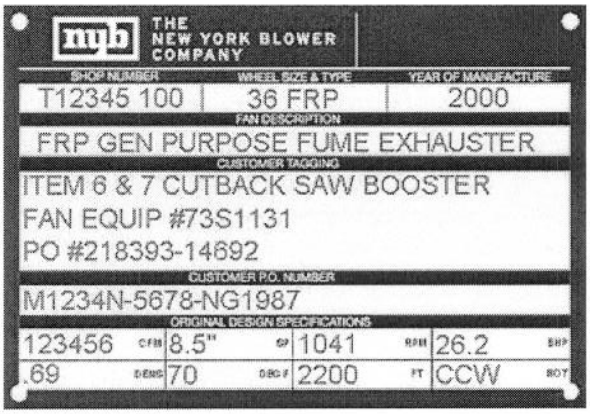
P.O. BOX 26505 • AKRON, OHIO 44319-0005 • PHONE (330) 745-8891 • FAX (330) 745-2504

NYB understands the importance of reliable repair services and replacement parts availability necessary for profitable and efficient operation within an industry. To help customers maintain high productivity within a system or application, NYB provides fan replacement parts for any product that carries our brand name.

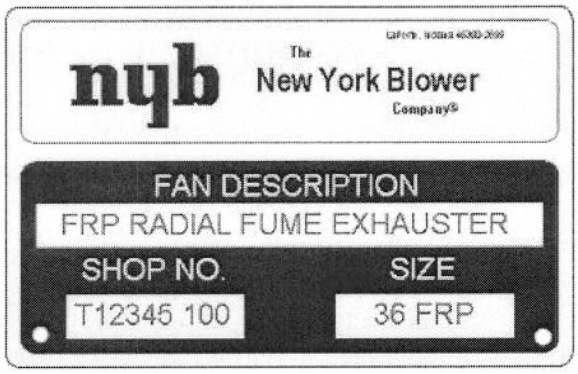
Please note that all NYB products include a nameplate that displays details of the fan at the time of its manufacture. Nameplates are typically located on the fan's bearing pedestal (or on the housing side if no pedestal is part of the design).

A nameplate includes a "Shop Number" which is in essence the serial number of the fan. Simply identify the "Shop Number" of your fan and contact a local New York Blower Sales Representative for further assistance.

Current nameplate design

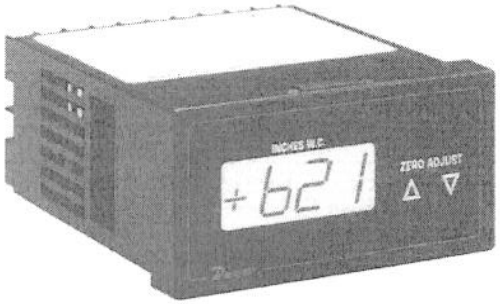


Old nameplate design (orders shipped prior to March 2001)



SERIES 621 PRESSURE INDICATOR

Specifications – Installation and Operating Instructions



The Dwyer Series 621 Pressure Indicator is a compact, 1/8 DIN instrument for measuring and controlling compatible air or gas pressure and converting it into a standard 3½ digit display with a 4-20 mA output signal. Positive, negative or differential pressures can be measured with a full span accuracy of ±0.5%. Ranges are available from 0-3 in. w.c. (0-0.75 kPa) to 0-100 PSI (0-690 kPa). Versatile circuit design enables use in 2, 3 or 4-wire current loops.

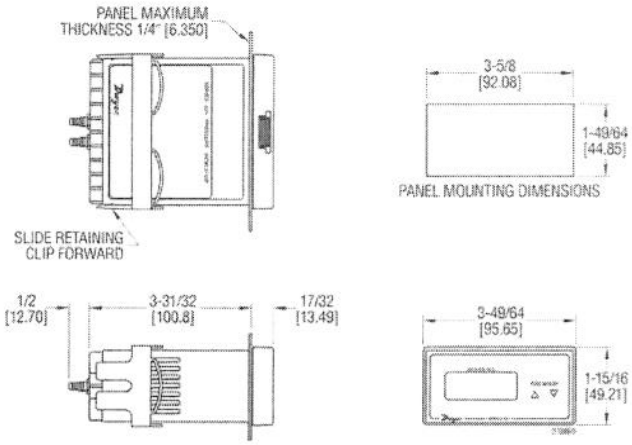


FIG. A

SERIES 621 ENGLISH MODELS & RANGES

MODEL NUMBER	RANGE	MAXIMUM PRESSURE
621-3	0-3 in. w.c.	5 PSI
621-6	0-6 in. w.c.	5 PSI
621-10	0-10 in. w.c.	5 PSI
621-20	0-20 in. w.c.	11 PSI
621-40	0-40 in. w.c.	11 PSI
621-100	0-100 in. w.c.	29 PSI
621-200	0-200 in. w.c.	29 PSI
621-1000	0-1000 in. w.c.	150 PSI
621P-10	0-10 PSI	58 PSI
621P-20	0-20 PSI	58 PSI
621P-30	0-30 PSI	58 PSI
621P-50	0-50 PSI	150 PSI
621P-100	0-100 PSI	150 PSI

SERIES 621 METRIC MODELS & RANGES

MODEL NUMBER	RANGE	MAXIMUM PRESSURE
621-0.75 kPa	0-0.75 kPa	34 kPa
621-1.5 kPa	0-1.50 kPa	34 kPa
621-2.5 kPa	0-2.50 kPa	34 kPa
621-5 kPa	0-5.00 kPa	76 kPa
621-10 kPa	0-10.00 kPa	76 kPa
621-25 kPa	0-25.0 kPa	200 kPa
621-50 kPa	0-69.0 kPa	400 kPa
621-138 kPa	0-138.0 kPa	400 kPa
621-207 kPa	0-207 kPa	400 kPa
621-249 kPa	0-249 kPa	1034 kPa
621-345 kPa	0-345 kPa	1034 kPa
621-690 kPa	0-690 kPa	1034 kPa

SPECIFICATIONS

GENERAL

Pressure Connections:	Barbed for 1/8" (3 mm) I.D. tubing
Media Compatibility:	Air and non-corrosive gases
Electrical Connections:	Terminal block
Housing:	Gray PVC, type I
Weight:	8.5 ounces (241 grams)
Adjustments:	Accessible potentiometers

ELECTRICAL

Power Supply:	10-35 VDC (2, 3 or 4 wire) 16-26 VAC (4 wire)
Output Signal:	4-20 mA DC (limited at 38 mA DC)
Loop Resistance:	0-1300 ohms DC max. 0-1200 ohms AC max.
Current Consumption:	DC, 38 mA max. AC, 76 mA max.

PERFORMANCE AT 70°F (21.1°C)

Zero Output:	4 mA DC
Full Span Output:	16 mA DC
Accuracy:	±.5% of full span output. Includes linearity, hysteresis and repeatability
Span and Zero:	Adjustable to 0.5% of full span
Warm-up Time:	10 minutes

ENVIRONMENTAL

Operating Temperature:	20 to 120°F (–6.7 to 49°C)
Thermal Errors:	±0.02%/°F typical

DWYER INSTRUMENTS, INC.
P. O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057

INSTALLATION

1. LOCATION: Select a location where the temperature of the unit will be between 20°F and 120°F. Distance from the receiver is limited only by total loop resistance. See Electrical Connections. The tubing feeding pressure to the instrument can be run practically any length required but long lengths will increase response time slightly. Mount the instrument in a location that will not be subject to excessive temperature, shock or vibration. All models are designed for mounting in an enclosed panel.

Select the mounting position for the instrument on the panel. Prepare the panel by cutting and deburring the required opening. Refer to Figure A.

From the front panel, slide the instrument through the cutout. The housing gasket should be against the housing flange before installing.

From the rear of the panel slide the mounting collar over the housing. Hold the housing with one hand and using the other hand, push the collar evenly against the panel until the springs are compressed. The ratchets will hold the mounting collar and housing in place.

2. POSITION: A horizontal position is recommended (pressure connections pointing horizontally) since that is how all standard models were originally spanned and zeroed at the factory. They can be used at other angles but final spanning and zeroing must be done while transmitter is in that alternative position.

3. PRESSURE CONNECTIONS: Two integral barbed tubing connections are provided for use with 1/8" (3 mm) I.D. vinyl or rubber tubing. Attach tubing from positive pressure source to port marked HI or from negative (vacuum) source to port marked LO. In either case, opposite port must be vented to atmosphere. For differential pressures, the higher source is connected to the HI port and the lower to the LO port.

ELECTRICAL CONNECTIONS

CAUTION: DO NOT EXCEED SPECIFIED SUPPLY VOLTAGE RATINGS. PERMANENT DAMAGE NOT COVERED BY WARRANTY WILL RESULT. THIS UNIT IS NOT DESIGNED FOR 120 OR 240 VOLT AC LINE OPERATION.

Electrical connections to the Series 621 Pressure Indicator are made to the terminal block located on the back of the unit. The terminal block is marked 17, 18, 19 and 20. Refer to Figure B for location of the terminal block, span and zero adjust potentiometers.

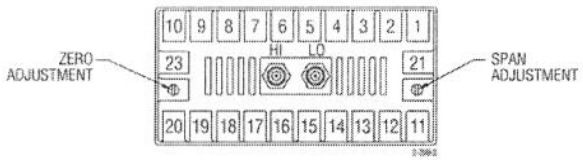


FIG. B

Wire Length – The maximum length of wire connecting the pressure indicator and receiver is a function of wire size and receiver resistance. Wiring should not contribute more than 10% of the receiver resistance to total loop resistance. For extremely long runs (over 1000 feet), choose receivers with higher resistance to minimize size and cost of connecting leads. Where wiring length is under 100 feet, hook-up wire as small as 22 AWG can be used.

2-Wire Operation – An external power supply delivering 10-35 VDC with minimum current capability of 40 mA DC (per indicator) must be used to power the control loop. See Fig. C for connection of the power supply, indicator and receiver. Note the jumper between 17 and 18. The range of the appropriate receiver load resistance (R_L) for the DC power supply voltage available is expressed by the formula and graph in Fig. F. Shielded two-wire cable is recommended for control loop wiring. If grounding is required, use negative side of the control loop after the receiver. Otherwise, in 2-wire operation it is not necessary to observe polarity of control loop connections.

2-WIRE CONNECTION

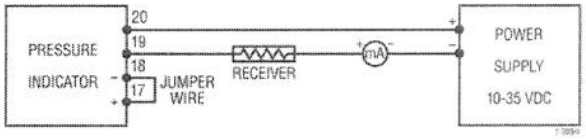


FIG. C

3-Wire Operation – An external power supply delivering 10-35 VDC with minimum current capability of 40 mA DC (per indicator) is required. See Fig. D for connection of power supply, indicator and receiver. The range of the appropriate receiver load resistance (R_L) for the DC power supply available is expressed by the formula and graph in Fig. F. Shielded cable is recommended for control loop wiring. Do not employ a separate ground in 3-wire operation. Unit will not function properly and/or damage could result. Control loop polarity must be observed in the following respect. Although power supply terminals 19 and 20 are not polarized, the receiver must be connected between terminal 18 of indicator and negative side of power supply.

3-WIRE CONNECTION

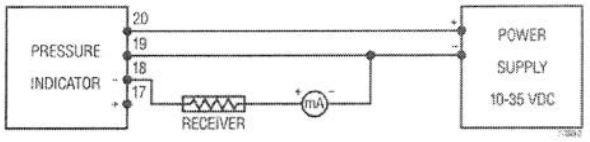


FIG. D

4-Wire Operation – An external power supply delivering 10-35 VDC with a minimum current capability of 40 mA DC (per transmitter) or 16-26 VAC with a minimum current capability of 80 mA AC (per transmitter) is required. See Fig. E for connection of power supply, indicator and receiver. The range of the appropriate load resistance (R_L) for the DC or AC power supply available is expressed by the formulas and graphs in Figs. F and G. Shielded cable is recommended for control loop wiring. Do not employ a separate ground in 4-wire operation. Unit will not function properly and/or damage could result. Control loop polarity must be observed; terminal 18 is negative and 17 is positive. Power supply terminals 19 and 20 are not polarized.

4-WIRE CONNECTION

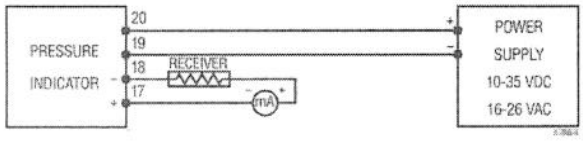


FIG. E

POWER SUPPLY VOLTAGE – VDC (2, 3 or 4-wire)

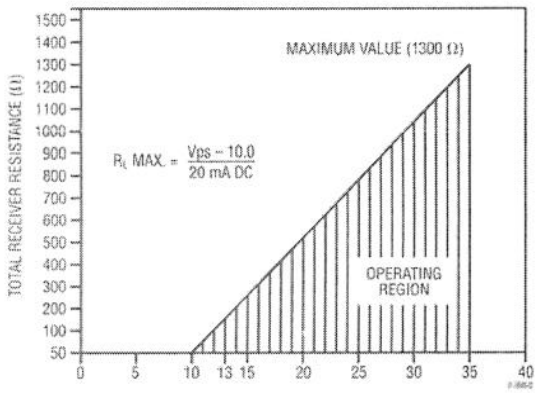


FIG. F

POWER SUPPLY VOLTAGE – VAC (4-wire)

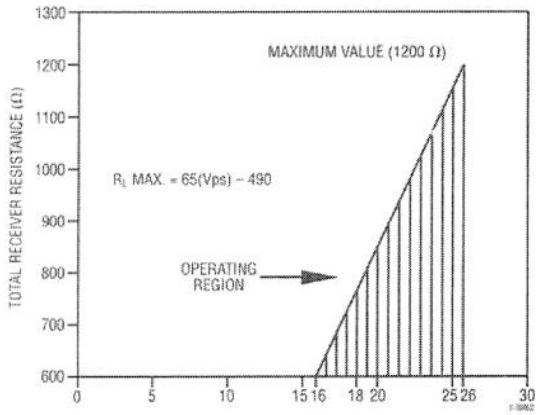


FIG. G

RECALIBRATION PROCEDURE

Transmitter – If the transmitter needs to be recalibrated, use the following procedure.

1. With the transmitter connected to the companion receiver, insert an accurate milliammeter in series with the current loop. Full scale range should be approximately 30 mA.

2. Connect a controllable pressure source to one leg of a tee with the second leg connected to the high pressure port of the pressure indicator and the third leg to an accurate test gage or manometer. The low pressure port must be vented to atmosphere. Calibration must be performed in the same position in which the unit will be mounted.

3. Apply electrical power to the unit and allow it to stabilize for 10 minutes.

4. With no pressure applied, use the Zero Adjust controls on the front of unit to set display to the center of the adjustment range. First, press and hold the ▲ key until it reaches its limit and record the value. Next, do the same with the ▼ key. Add readings and divide by two to establish the average. Example: If maximum ▲ reading is +0.22 and minimum ▼ reading is –0.14, total span is 0.36. Dividing 0.36 by 2 equals 0.18. Subtracting 0.18 from 0.22 equals 0.04. Adjust controls as necessary until display reads exactly 0.04.

5. Next, with no pressure applied to the pressure indicator, adjust the Transmitter Zero Control on the back of the unit so loop current is 4.00 mA. See Fig. B.

6. Apply full range pressure and adjust loop current to 20 mA using the Transmitter Span Control. See Fig. B.

7. Relieve pressure and allow pressure indicator to stabilize for 2 minutes.

8. Zero and Span controls are slightly interactive, so repeat steps 4 through 7 until zero and full range pressure consistently produce loop currents of 4 and 20 mA respectively.

9. Remove the milliammeter from the current loop and proceed with final installation of the pressure indicator and receiver.

Voltage Input – Series 621 Pressure Indicator can be easily adapted for receivers requiring 1-5 or 2-10 VDC input. Insert a 249 ohm, 1/2 watt (1-5 VDC) or 499 ohm (2-10 VDC) resistor in series with the current loop but in parallel with the receiver input. Locate this resistor as close as possible to the input. Because resistor accuracy directly influences output signal accuracy, we recommend use of a precision ±0.1% tolerance resistor to minimize this effect. See Figs. H and J.

3-WIRE CONNECTION (1-5/2-10 VDC OUTPUT)

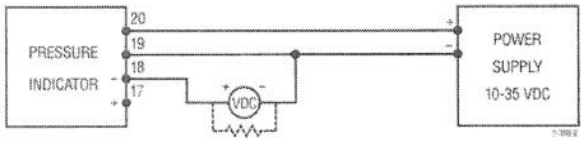


FIG. H

4-WIRE CONNECTION (1-5/2-10 VDC OUTPUT)

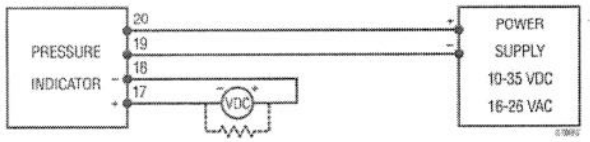


FIG. J

MULTIPLE RECEIVER INSTALLATION

An advantage of the standard 4-20 mA DC output signal provided by the Series 621 Pressure Indicator is that any number of receivers can be connected in series in the current loop. Thus, an A-701 Digital Readout Accessory, an analog panel meter, a chart recorder, process controlling equipment or any combination of these devices, can be operated simultaneously. It is only necessary that each be equipped with a standard 4-20 mA input and that proper polarity of the input connections be observed when inserting the device in the current loop. If any of the receiving devices displays a negative or downscale reading this indicates that the signal input leads are reversed.

MAINTENANCE

Upon final installation of the Series 621 Pressure Indicator and the companion receiver, including the A-701 Digital Readout, no routine maintenance is required. A periodic check of the system calibration is recommended. The Series 621 Pressure Indicator is not field serviceable and should be returned, freight prepaid, to the factory if repair is required. The A-701 Digital Readout should be returned to the manufacturer if service is needed. Refer to the A-701 instruction sheet.

Printed in U.S.A. 11/96

Fr. No. 01-440933-00

DWYER INSTRUMENTS, INC.
P.O. Box 373, Michigan City, Indiana 46361, U.S.A.
Phone: 219/879-8000 Fax: 219/872-9057

Series 621
Differential Pressure Indicating Transmitter
1/8 DIN Housing, 0.5% Full Scale Accuracy

CE

Product Details

Product Specifications

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Accuracy: ±0.5% F.S. (includes linearity, hysteresis & repeatability.)
Stability: ±1% F.S./yr.
Temperature Limits: 0 to 140°F (-17.8 to 60°C).
Compensated Temperature Limits: 20 to 120°F (-6.67 to 48.9°C).
Pressure Limits: See Ordering page.
Thermal Effect: 0.025% F.S./°F (0.045% F.S./°C).
Power Requirements: 10 to 35 VDC (2-wire).
Output Signal: 4 to 20 mA.
Zero and Span Adjustments: Accessible potentiometers.
Loop Resistance: DC; 0 to 1250 ohms max.
Current Consumption: DC; 38 mA max.
Electrical Connections: Terminal block.
Process Connections: Barbed for 1/8" (3.18 mm) I.D. tubing.
Enclosure Rating: Face designed to meet NEMA 4 (IP66).
Mounting Orientation: Not position sensitive.
Weight: 7.8 oz (221 g).
Agency Approvals: CE.

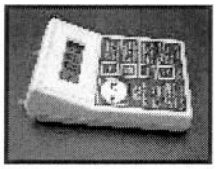
DM1 Micro-Manometer

measures pressures from -3.0 "wc (750 Pa) to +2.2 "wc (548 Pa)
with a resolution of 0.001 "wc or 0.1 Pa
and an accuracy of 1% of the measurement.

| New | Search | Links | Infiltec | Staff | Fun |
RADON CONTROL | About Radon | Radon FAQ | Pictures | Drawings | Fans | Large Buildings | Radon Catalog |
AIR LEAKAGE | About Blower Doors | FAQ | Ducts | Fire | Large Buildings | Contractors | Blower Door Catalog |

The DM1 is a portable digital micro-manometer with the easy-to-use 0.001 "wc or 0.1 Pa resolution to solve your toughest differential pressure measurement problems.
(click on thumbnails below for larger images)

- HVAC test and balance,
- Radon mitigation,
- Furnace draft analysis,
- Duct leakage testing,
- Pressure balancing,
- Combustion safety analysis,
- Advanced building diagnostics,
- Laboratory safety monitoring,
- Process monitoring,
- Filter condition checks,
- Environmental assessments, and
- Pitot or orifice pressure measurements.
- Data logging low differential pressures.



DM1 Digital Micro-Manometer Specifications

Feature	Specifications
Pressure Resolution:	Displays to 0.1 Pa below 200 Pa, and to 1 Pa above. Displays to 0.001 "wc below 2"wc, and to 0.01"wc above. Internal resolution is 0.025 Pa (0.0001 "wc) and this is the resolution of the serial output.
Pressure Range:	Bi-directional: Range -3.0 "wc (750 Pa) to +2.2 "wc (548 Pa).
Membrane Keypad:	4 keys covered by weatherproof labeled overlay.
- Units Key:	Select Metric (Pa) or U.S. ("wc) units.
- Zero Key:	Reset display to zero pressure.
- Time Avg Key:	Select block average of 1 (default), 2, 4, 8, 16 & 32 seconds.
- On/Off Key:	Turn power on and off.
Accuracy:	±1% of measurement or ±1 display digit, whichever is greater.

Display Type:	LCD with 1/2" high numbers.
Operating Temperature:	32°F to 122°F. (0°C to 50°C)
Storage Temperature:	-4°F to 160°F. (-20°C to 70°C)
Low Battery Display:	Current battery voltage is displayed at startup, "lowbat" displayed when voltage is under 6 volts.
Maximum Pressure:	±25 "wc, ±6 kPa or ±0.9 PSI
Over Range Indicator:	"OP" is displayed when pressure out of -3.0 "wc (750 Pa) to +2.2 "wc (548 Pa) range.
Update Indicator:	Decimal point blinks when display updates.
Weight With Battery:	8.9 oz. (253 grams)
Dimensions:	3.6" x 5.75" x 1.3/1.9" (91 x 146 x 33/49 mm).
Battery Life:	Over 200 hours from one 9 volt alkaline.
Operating Medium:	Air or non-corrosive, non-explosive gas.
Pressure Connections:	Barbed for 1/8" ID tubing.
Analog Output Option:	0-5v out: ~0v is -3"wc/-750 Pa, ~2.5v is 0 "wc/0 Pa, ~5v is +3"wc/+750 Pa. Voltage is independent of pressure display rezeroing. 2 wire plug and jack.
Analog Data Logger Option:	The DM1 can be connected to an Onset data logger to simultaneously record temperature, humidity, light levels, and DM1 differential pressure. This logger has a pressure resolution of 0.4 Pascal or 0.0018 "wc over the range -3.0 "wc (750 Pa) to +2.2 "wc (548 Pa). Time resolution can be set from 1 second to hours, and logging duration ranges from hours to days depending on time resolution and number of sensors recorded. The DM1-U12-012 logger incorporates an Onset U12-012 four channel data logger, as described in the downloadable user manual (PDF) and the data can be plotted with the Onset HOBOware Pro software. Click here for a sample data plot from this system.
Serial Output Option:	Female DB9 plug on 6 ft (2 m) cable. 9600b-8N0 pseudo RS232 protocol, ASCII records, ~1/sec, LF+CR termination, ±32000 range, 0.025 Pa (0.0001"wc) resolution.
Microprocessor:	Programmable 4 Mhz Microchip PIC14000 with 16 bit a/d. DM1 functions can be updated by replacing this chip.
Custom Firmware:	Custom microprocessor programming is available to optimize the DM1 for your pressure measurement application.

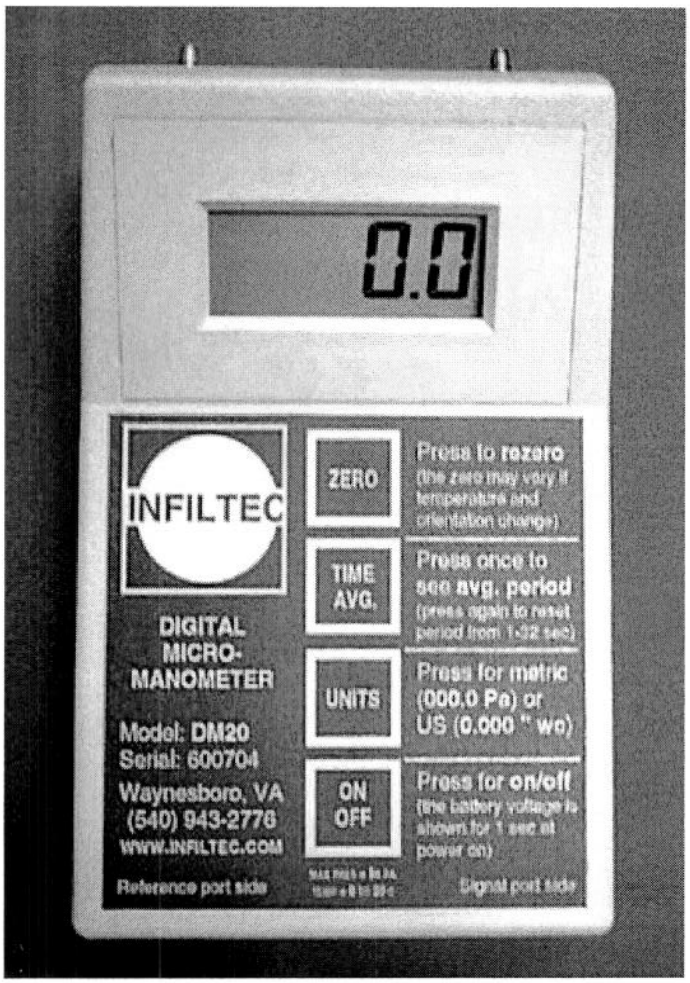
Optional Accessories:	Pitot tubes, static pressure probes & tubing.
Accessories Included:	Battery, soft carrying case, tubing, calibration certificate, user manual.
Warranty:	2 years coverage on parts and labor to repair any defects.

These specifications were updated on April 03, 2008, and are subject to change without notice.

For DM1 prices, see the Infiltec Radon or Blower Door catalogs, or call toll free (888) 349-7236.

| Home | Search | About Radon | Radon Catalog | About Blower Doors | Blower Door Catalog | Links | Fun |

Return to the Infiltec Home Page.


0.0
INFILTEC
DIGITAL
MICRO-
MANOMETER
Model: DM20
Serial: 600704
Waynesboro, VA
(540) 943-2776
WWW.INFILTEC.COM
Reference port side
ZERO
Press to rezero
(the zero may vary if temperature and orientation change)
TIME AVG.
Press once to see avg. period
(press again to reset period from 1-32 sec)
UNITS
Press for metric (000.0 Pa) or US (0.000 " wc)
ON OFF
Press for on/off
(the battery voltage is shown for 1 sec at power on)
Signal port side

measurements in metric units (Pa) are about twice as sensitive as the U.S. measurements ("wc).

4. Press the Time Avg. Key – The DM1 microprocessor makes many measurements of differential pressure each second, but these measurements are averaged together in a "block" to increase accuracy, and the size of the block can be adjusted by pressing the Time Avg. key. The first time you press this key, the block size in seconds is shown. No change is made in the block size if you just press the key once. The default value is 1 (one) second when the DM1 is turned on. If you press the Time Avg. key again within 1 second, the block size will double to 2, to 4, to 8, to 16 and finally to 32 seconds. Then it will go back to 1 second. Note that when you change the time averaging, it takes some time before the new average is ready, so the display shows "-" (dashes) in place of numbers while it is waiting for the first block. To indicate each time that a new block is calculated and displayed, the decimal point flashes. This allows you to see when an update occurs even if the number does not change. Note that for Pascal pressures over 200 Pa, there is no decimal displayed, so all the decimal points are flashed.

Position and Temperature Sensitivity - The zero reading of the DM1 may drift as the unit changes temperature, or if it changes position. The temperature drift can be minimized by keeping the DM1 at a constant temperature. For instance, do not leave the DM1 in a vehicle that will get very hot or cold and then expect to use the unit without allowing it to reach room temperature. If you want to make accurate measurements without zero drift over long periods of time, then put the DM1 somewhere that will stay at a constant temperature, like on a concrete basement floor. The DM1 pressure sensor is mounted so that it is least sensitive to position zero drift when tipping forward and backward, and most sensitive when tipping right and left. If you are careful, you may be able to keep the zero steady while picking the unit up from a flat surface and raising it to an overhead position. The secret is not to let it tip to the left or right as you raise or lower it.

Taking Care of the DM1 - The pressure sensor of the DM1 is delicate, so it should not be exposed to high pressures or moisture. Blowing hard into the ports will probably destroy the silicon chip pressure sensor. Do not leave the battery in the DM1 for long periods of time because battery leakage may damage the unit. A calibration check is recommended every 2 years.

For questions or service, please contact the Infiltec factory:

Shipping: Infiltec, 103 South Dolphine Ave, Waynesboro, VA 22980

Phone: (540) 943-2776

Email: Infiltec@rica.net, Web: http://www.Infiltec.com

DM1 Digital Micro-Manometer User Manual

The DM1 is a portable digital micro-manometer with the easy-to-use accuracy to solve your differential pressure measurement problems.

- HVAC test and balance,
- Radon mitigation,
- Furnace draft analysis,
- Duct leakage testing,
- Pressure balancing,
- Combustion safety analysis &
- Advance building diagnostics.

DM1 Specifications

Feature	Specifications
Pressure Resolution:	0.1 Pa below 200 Pa, 1 Pa above. 0.001"wc below 2"wc, 0.01"wc above.
Pressure Range:	Bi-directional: ±3 "wc and ±750 Pa.
Membrane Keypad:	4 Keys covered by weatherproof labeled overlay.
- Units Key:	Select Metric (Pa) or U.S. ("wc) units.
- Zero Key:	Reset display to zero pressure.
- Time Avg. Key:	Select block average of 1 (default), 2, 4, 8, 16 & 32 seconds.
- On/Off Key:	Turn power on and off.
Accuracy:	±1% of pressure or ±1 digit, whichever is greater.
Display Type:	LCD with 1/2" high numbers.

Operating Temperature:	32°F to 122°F. (0°C to 50°C)
Storage Temperature:	-4°F to 150°F. (-20°C to 70°C)
Low Battery Display:	Current battery voltage is displayed at startup, "lobat" displayed when voltage is under 6 volts.
Over Range Indicator:	"OF" is displayed when pressure is out of range.
Update Indicator:	Decimal point blinks when display updates.
Weight With Battery:	6.9 oz. (258 grams)
Dimensions:	3.6"x5.75"x1.3/1.9" (91x146x33/49 mm).
Battery Life:	Over 200 hours from one 9 volt alkaline.
Operating Medium:	Air or non-corrosive, non-explosive gas.
Pressure Connections:	Barbed for 1/8" ID tubing.
Optional Outputs:	Analog (0-5 Volts), or digital (serial RS232) signal.
Optional Accessories:	Pitot tubes, static pressure probes & tubing.
Accessories Included:	Battery, soft carrying case, tubing, calibration & users manual
Warranty:	2 years coverage on parts and labor to repair any defects.

DM1 INSTRUCTIONS

1. Press the ON/OFF Key - The DM1 starts up with a self test by briefly displaying all its characters (the display should show +1.9:.9.9), then displaying the battery voltage (about 9.3 volts for a new battery), then testing the display again (showing +1.9:.8.9), and finally showing zero pressure (0.0 indicates metric units of Pascals [Pa] and 0.000 indicates U.S. units of equivalent inches of water column ["wc]).

Battery Voltage - If the battery voltage is below 7.0 volts, the display will show the message lobat in small letters on the upper left of the display. The battery should be replaced soon because the DM1 will not work properly at voltages less than 5.5 volts. The DM1 will run over 200 hours on a 9 volt alkaline battery, and about half as long on a carbon battery.

Understanding Differential Pressure - The DM1 measures the difference in pressure between the two brass pressure ports at the front of the unit. If both of the ports are disconnected and open to the air, the differential pressure is zero. Similarly, if a tube is connected between the two ports, then the differential pressure is also zero. Note that when there is a lot of air motion near the ports, then connecting a tube between the two ports will give a more stable zero reading.

Reference and Signal Ports – Notice that the lower part of the label on the DM1 names the left port as "Reference Port" and the right port as "Signal Port". This is done to keep track of what the display sign (+ or -) means in terms of the relative pressure at the two ports. Typically the reference port is left open to the air, and the signal port is connected to a tube whose free end is moved to an area where a pressure is to be measured. If the display was at zero before the Signal port tube was moved, a change to a negative display indicates a lower pressure in the test area, and a positive number (no sign on the display indicates positive) indicates that the test pressure is higher than in the location where the DM1 is located. You can put a small positive pressure on the ports by putting your finger on the tip of the port and pressing. Try pressing on the Signal port and the Reference port and see if you get a positive and then a negative differential pressure indication. Note that the length of the tubing, or the difference in height between the DM1 and the end of the tubing does not affect the differential pressure measurements.

2. Press the Zero Key - When ever the Zero key is pressed, the display is reset to zero, even if the differential pressure between the ports is not zero. This may be what you want to do, especially if you are looking for relative changes in differential pressure and not the absolute differential pressure. When the DM1 is turned on it also resets the display to zero, no matter what the actual differential pressure between the ports is. It is important to always be aware of just what kind of zero you have, so that you can interpret what your reading actually means.

Absolute Differential Pressure – Absolute differential pressure can be measured by first setting the zero of the DM1 with both ports open or connected together, and then using running tubing connected to the Signal port to the location where the differential pressure is to be measured. You will be then be measuring pressure relative to the Reference port. In most cases you will want to start this way, in order to know what the absolute differential pressure is. Then you may want to press the Zero key if you are looking for changes in pressure.

3. Press the Units Key – When you press the Units key the display reading is converted from Pa to "wc, or the reverse. The conversion is 249.7 Pa = 1.000 "wc, or 1 Pa = 0.004 "wc. Your choice of units will probably depend on what business you are in, or where you received your training, or where you are located. In any case you should use the units you are most familiar with. Note that 0.1 Pa = 0.000 "wc, so small

APPENDIX C

Low Flow Groundwater Sampling Procedures

EPA Sampling Procedures Guidance Document
Low Flow Sampling Reporting Form

United States Environmental Protection Agency | Office of Research and Development | Office of Solid Waste and Emergency Response | EPA/540/S-95/504 April 1996

Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

For further information contact: Robert Puls, 405-436-8543, Subsurface Remediation and Protection Division, NRMRL, Ada, Oklahoma.

I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

[1]National Risk Management Research Laboratory, U.S. EPA
[2]University of Michigan

Superfund Technology Support Center for Ground Water

National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
Robert S. Kerr Environmental Research Center
Ada, Oklahoma

Technology Innovation Office
Office of Solid Waste and Emergency Response, US EPA, Washington, DC

Walter W. Kovalick, Jr., Ph.D.
Director

chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling

objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

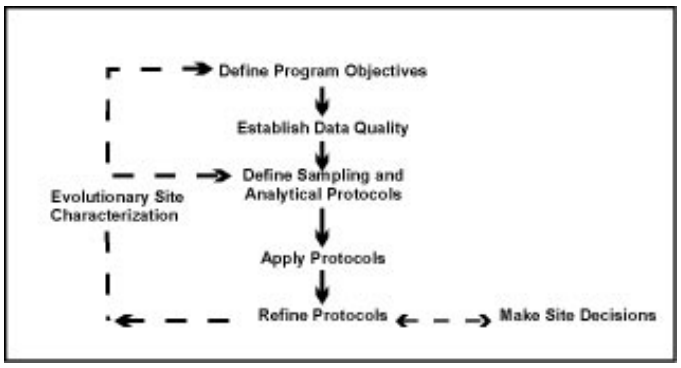


Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-

flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality

indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of

the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described herein as part of its in-house research program and under Contract No. 68-C4-0031 to Dynamac Corporation. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

VIII. References

Backhus, D,A., J.N. Ryan, D.M. Groher, J.K. McFarlane, and P.M. Gschwend. 1993. Sampling Colloids and Colloid-Associated Contaminants in Ground Water. *Ground Water*, 31(3):466-479.

Barcelona, M.J., J.A. Helfrich, E.E. Garske, and J.P. Gibb. 1984. A laboratory evaluation of groundwater sampling mechanisms. *Ground Water Monitoring Review*, 4(2):32-41.

Barcelona, M.J. and J.A. Helfrich. 1986. Well construction and purging effects on ground-water samples. *Environ. Sci. Technol.,* 20(11):1179-1184.

Barcelona, M.J., H.A. Wehrmann, and M.D. Varljen. 1994. Reproducible well purging procedures and VOC stabilization criteria for ground-water sampling. *Ground Water*, 32(1):12-22.

Buddemeier, R.W. and J.R. Hunt. 1988. Transport of Colloidal Contaminants in Ground Water: Radionuclide Migration at the Nevada Test Site. *Applied Geochemistry*, 3: 535-548.

Danielsson, L.G. 1982. On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters. *Water Research*, 16:179.

Enfield, C.G. and G. Bengtsson. 1988. Macromolecular Transport of Hydrophobic Contaminants in Aqueous Environments. *Ground Water,* 26(1): 64-70.

Gschwend, P.M. and M.D. Reynolds. 1987. Monodisperse Ferrous Phosphate Colloids in an Anoxic Groundwater Plume, *J. of Contaminant Hydrol.,* 1: 309-327.

Herzog, B., J. Pennino, and G. Nielsen. 1991. Ground-Water Sampling. In **Practical Handbook of Ground-Water Monitoring** (D.M. Nielsen, ed.). Lewis Publ., Chelsea, MI, pp. 449-499.

Horowitz, A.J., K.A. Elrick, and M.R. Colberg. 1992. The effect of membrane filtration artifacts on dissolved trace element concentrations. *Water Res.,* 26(6):753-763.

Laxen, D.P.H. and I.M. Chandler. 1982. Comparison of Filtration Techniques for Size Distribution in Freshwaters. *Analytical Chemistry*, 54(8):1350.

McCarthy, J.F. and J.M. Zachara. 1989. Subsurface Transport of Contaminants, *Environ. Sci. Technol.*, 5(23):496-502.

McCarthy, J.F. and C. Degueldre. 1993. Sampling and Characterization of Colloids and Ground Water for Studying Their Role in Contaminant Transport. In: Environmental Particles (J. Buffle and H.P. van Leeuwen, eds.), Lewis Publ., Chelsea, MI, pp. 247-315.

Parker, L.V. 1994. The Effects of Ground Water Sampling Devices on Water Quality: A Literature Review. *Ground Water Monitoring and Remediation*, 14(2):130-141.

Penrose, W.R., W.L. Polzer, E.H. Essington, D.M. Nelson, and K.A. Orlandini. 1990. Mobility of Plutonium and Americium through a Shallow Aquifer in a Semiarid Region, *Environ. Sci. Technol.*, 24:228-234.

Puls, R.W. and M.J. Barcelona. 1989. Filtration of Ground Water Samples for Metals Analyses. *Hazardous Waste and Hazardous Materials,* 6(4):385-393.

Puls, R.W., J.H. Eychaner, and R.M. Powell. 1990. Colloidal-Facilitated Transport of Inorganic Contaminants in Ground Water: Part I. Sampling Considerations. EPA/600/M-90/023, NTIS PB 91-168419.

Puls, R.W. 1990. Colloidal Considerations in Groundwater Sampling and Contaminant Transport Predictions. *Nuclear Safety*, 31(1):58-65.

Puls, R.W. and R.M. Powell. 1992. Acquisition of Representative Ground Water Quality Samples for Metals. *Ground Water Monitoring Review,* 12(3):167-176.

Puls, R.W., D.A. Clark, B.Bledsoe, R.M. Powell, and C.J. Paul. 1992. Metals in Ground Water: Sampling Artifacts and Reproducibility. *Hazardous Waste and Hazardous Materials*, 9(2): 149-162.

Puls, R.W. and C.J. Paul. 1995. Low-Flow Purging and Sampling of Ground-Water Monitoring Wells with Dedicated Systems. *Ground Water Monitoring and Remediation,* 15(1):116-123.

Ryan, J.N. and P.M. Gschwend. 1990. Colloid Mobilization in Two Atlantic Coastal Plain Aquifers. *Water Resour. Res.*, 26: 307-322.

Thurnblad, T. 1994. Ground Water Sampling Guidance: Development of Sampling Plans, Sampling Protocols, and Sampling Reports. Minnesota Pollution Control Agency.

U. S. EPA. 1992. RCRA Ground-Water Monitoring: Draft Technical Guidance. Office of Solid Waste, Washington, DC EPA/530/R-93/001, NTIS PB 93-139350.

U. S. EPA. 1995. Ground Water Sampling Workshop -- A Workshop Summary, Dallas, TX, November 30 - December 2, 1993. EPA/600/R-94/205, NTIS PB 95-193249, 126 pp.

U. S. EPA. 1982. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846. Office of Solid Waste and Emergency Response, Washington, D.C.

Figure 2. **Ground Water Sampling Log**

Project _____ **Site** _____ **Well No.** _____ **Date** _____
Well Depth _____ **Screen Length** _____ **Well Diameter** _____ **Casing Type** _____
Sampling Device _____ **Tubing type** _____ **Water Level** _____
Measuring Point _____ **Other Infor** _____

_____

Sampling Personnel _____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

_____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project _____ **Site** _____ **Well No.** _____ **Date** _____
Well Depth _____ **Screen Length** _____ **Well Diameter** _____ **Casing Type** _____
Sampling Device _____ **Tubing type** _____ **Water Level** _____
Measuring Point _____ **Other Infor** _____

_____

Sampling Personnel _____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

_____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

The following is a list of contractors that you could consider to complete the remediation. This list does not include all available licensed contractors that could be chosen to complete the work. Any contractor must me licensed by the State of New Jersey.

T.R. Weniger Environmental Services
P.O. Box 775
Green Brook, NJ 08812
(732) 968-3450

Meridian Environmental Services, Inc.
1520 Route 37 West - Unit #3
Toms River, NJ 08755
(732) 281-1900

AWT Environmental Services, Inc.
P.O. Box 128
Sayreville, NJ 08871
(732) 613-1660
(973) 538-8233
Tim Roper (troper@awtenvironmental.com)

Excel Environmental Resources, Inc.
111 North Center Drive
North Brunswick, NJ 08902
(732) 545-9525

Environmental Management Associates
5303 State Highway 33/34
Farmingdale, NJ 07727
(732) 919-0595

LOW FLOW SAMPLING
DATA SHEET

Sheet _____ of _____

SITE: _____
DATE: _____ CONSULTING FIRM: _____
WEATHER: _____ FIELD PERSONNEL: _____

MONITOR WELL #: _____ WELL DEPTH: _____ SCREENED/OPEN INTERVAL:
WELL PERMIT #: _____ WELL DIAMETER: _____ inches

PID/FID READINGS (ppm):
BACKGROUND: _____ PUMP INTAKE DEPTH: _____ ft below TOC
BENEATH OUTER CAP: _____ DEPTH TO WATER BEFORE PUMP INSTALLATION: _____ ft below
BENEATH INNER CAP: _____

TIME	PURGING	SAMPLING	pH (pH Units)		Specific Conductivity (mS/cm)		TURBIDITY (NTU)		Dissolved Oxygen (mg/L)		TEMPERATURE (degrees C)		Redox Potential (mv)		PUMPING RATE (ml/min)	DEPTH TO WATER (ft below TOC)
			READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*	READING	CHANGE*		
				NA		NA		NA		NA		NA		NA		

COMMENTS:

*INDICATOR PARAMETERS HAVE STABILIZED WHEN 3 CONSECUTIVE READINGS ARE WITHIN: +/- 0.1 for pH; +/- 3% for Specific Conductivity and Temperature; +/- 10 mv for Redox Potential; and +/- 10% for Dissolved Oxygen and Turbidity.

APPENDIX D

Air Sampling Procedures

Air Sample Collection Procedures
Sample COC and Field Data Sheet
COC Instructions

SUMMA CANISTER - FLOW CONTROLLER
SAMPLING INSTRUCTIONS

THE FLOW CONTROLLER IS CALIBRATED AT THE LABORATORY TO THE SAMPLERS SPECIFICATIONS PRIOR TO SHIPPING. THIS VALVE IS SEALED WITH A PROTECTIVE LOCKED CAP AND MUST NOT BE ADJUSTED IN THE FIELD.

- WEATHER CONSIDERATIONS – OUTSIDE SAMPLING DURING PRECIPITATION MAY CLOG FLOW CONTROLLER FILTER CAUSING A REDUCTION OR STOPPAGE OF FLOW. SAMPLING IN THIS TYPE OF WEATHER SHOULD BE AVOIDED.
- REMOVE THE CAP ON THE SUMMA CANISTER AND THE 1/4" PLUG ON THE FLOW CONTROLLER. DO NOT OPEN THE SUMMA CANISTER!
- CONNECT THE FLOW CONTROLLER TO THE CANISTER
- CONNECT INERT TUBING FROM SOURCE SAMPLE PORT TO CANISTER SAMPLE PORT
- RECORD STARTING DATE AND TIME ON THE SAMPLE LABEL AND CHAIN OF CUSTODY.
- OPEN SAMPLING VALVE BY TURNING KNOB COUNTER CLOCKWISE. TURN KNOB UNTIL IT MOVES EASILY. THE VACUUM GAUGE SHOULD READ NEAR 30"HG (VAC) WHEN OPENED.
- WHEN SAMPLING HAS BEEN COMPLETED, CLOSE THE VALVE TIGHTLY. DO NOT OVERTIGHTEN THE VALVE. OVERTIGTENING THE VALVE CAN PERMANENTLY DAMAGE THE SEAL.
- REMOVE FLOW CONTROLLER AND REPLACE THE CAP ON THE SAMPLING PORT.
- RECORD SAMPLING STOP DATE AND TIME ON LABEL AND CHAIN OF CUSTODY.
- PLACE FLOW CONTROLLER BACK INTO THE PROTECTIVE PACKING USED FOR SHIPPING. CONTROLLERS CAN BE DAMAGED EASILY AND ARE EXPENSIVE TO REPLACE.
- TRANSPORT CANISTERS AT AMBIENT TEMPERATURE. ICING OR REFRIGERATION IS NOT REQUIRED.
- IF DIFFICULTIES OR QUESTIONS COME UP IN THE FIELD, CALL ACCUTEST LABS (732) 329-0200.

Air Sampling Chain of Custody Instructions

- **Client Reporting Information**

  -Enter all pertinent information for contacts and project specifics.

  -Sampler's full name(s) is important to fill out in case the laboratory determines a sampling anomaly. The name(s) will correspond with the sampler's initials under sampling start/stop parameters.

- **Weather Parameters**

  -This information can be obtained with a portable thermometer/barometer or from http://www.weather.gov or http://www.wunderground.com the day of sampling.

- **Field ID/Point of Collection** – Descriptive identification for sample locations on final report.

- **Air Type** – Designate "I" for indoor air, "SV" for soil vapor, "A" for ambient air as in outdoor background samples.

- **Sampling Equipment Information**

  Canister Serial # - As labeled on each canister vessel. (Example, A324)

  Canister Size – 6 Liter or 1 Liter

  Flow Controller Serial # - As labeled on each flow controller (Example, FC45). This documentation will facilitate troubleshooting if insufficient sample volume is collected at a particular sampling point.

- **Start Sampling Information**

  Date – month/day/year

  Time – Use 24 hour nomenclature. (Example, 2:15pm is 14:15)

  Canister Pressure ("Hg") – This is recorded off the flow controller pressure/vacuum gauge attached to the flow controller as soon as the sampling valve is opened. Initial vacuums should read between 29"Hg – 30"Hg to indicate a canister under full vacuum. For any vacuums less than 29"Hg, the lab should be notified as to a potential problem. It is possible the field gauge is out of calibration and you may be instructed to continue sampling as the gauge will be checked upon re-submittal to the laboratory. Any anomalies should be notated in the comment field.

- **Stop Sampling Information**

  -Same protocol for Date, Time, Interior Temp, and Sampler's initials as described above in "Start Sampling Information."

  Canister Pressure ("Hg") – Flow controllers are calibrated to fill canisters to approximately 90% of its contents over the predetermined sampling period. The final vacuum should be less than 5"Hg. For soil vapor, when a relatively short sampling period occurs, the canister can be reconnected to the vapor probe and opened to achieve <5"Hg vacuum. If the <5"Hg vacuum can't be achieved, record the final vacuum and notate field practices in the comment field. Excessive vacuums of >10"Hg may require contacting the governing agency for guidance.

- **Requested Analysis** – Designate standard TO-15 reporting list or approved subset.

- **Turnaround Time (business days)** – Check off the appropriate turnaround as previously pre-arranged with the laboratory representative.

- **Data Deliverable Information** – All results submitted for TO-15 must be Full Category A deliverables.

- **Sample Custody Transfer** – All sample transfers must be signed and dated by the person relinquishing the samples and the person receiving the samples. This includes transfer of canisters from the laboratory to sampling consultants.

CHAIN OF CUSTODY

Air Sampling Field Data Sheet

ACCUTEST Laboratories

2235 US Highway 130, Dayton, NJ 08810
V: 732.329.0200 F: 732.329.3499 www.accutest.com

FED-EX Tracking #	Bottle Order Control #
Lab Quote #	Lab Job #

PAGE ___ OF ___

Client / Reporting Information			Project Information		Weather Parameters	Requested Analysis
Company Name			Project Name:		Temperature (Fahrenheit) Start: Maximum:	
Address			Street		Stop Minimum:	
City	State	Zip	City	State	Atmoshpheric Pressure (inches of Hg) Start: Maximum:	
Project Contact	E-mail		Project #		Stop: Minimum:	
Phone #	Fax #		Client Purchase Order #			
Sampler(s) Name(s)					Other weather comment:	

		Air Type	Sampling Equipment Info			Start Sampling Information					Stop Sampling Information					
Lab Sample #	Field ID / Point of Collection	Indoor(I) Soil Vap(SV) Ambient(A)	Canister Serial #	Canister Size 6L or 1L	Flow Controller Serial #	Date	Time (24hr clock)	Canister Pressure ("Hg)	Interior Temp (F)	Sampler Init.	Date	Time (24hr clock)	Canister Pressure ("Hg)	Interior Temp (F)	Sampler Init.	

Turnaround Time (Business days)

Standard - 15 Days	
10 Day	
5 Day	
3 Day	
2 Day	
1 Day	
Other	

Approved By: _____

Date: _____

Data Deliverable Information

All NJDEP TO-15 is mandatory Full T1

Comm A	
Comm B	
Reduced T2	
Full T1	
Other:	

Comments / Remarks

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Laboratory: 1	Date Time:	Received By: 1	Relinquished By: 2	Date Time:	Received By: 2
Relinquished by: 3	Date Time:	Received By: 3	Relinquished By: 4	Date Time:	Received By: 4
Relinquished by: 5	Date Time:	Received By: 5	Custody Seal #		