# TOMAT SERVICE STATION
## BCP No. C224217

**1815-1825 OCEAN AVENUE**
**BROOKLYN, NEW YORK**
**Block 7656 Lots 56 & 58**

# AIR SPARGING AND SOIL VAPOR EXTRACTION REMEDIAL DESIGN

JULY 28 2017

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# LIST OF ACRONYMS

| Acronym | Definition |
|---|---|
| AMC | AMC Engineering |
| AWQS | Ambient Water Quality Standards |
| BCA | Brownfield Cleanup Agreement |
| BCP | Brownfield Cleanup Program |
| BTEX | Benzene, Toluene, Ethylbenzene and Xylene |
| CQMP | Construction Quality Management Plan |
| DUSR | Data Usability Statement Report |
| EBC | Environmental Business Consultants |
| FER | Final Engineering Report |
| HDPE | High Density Polyethylene |
| IRM | Interim Remedial Measure |
| NYC | New York City |
| NYCDEP | New York City Department of Environmental Protection |
| NYSDEC | New York State Department of Environmental Conservation |
| NYSDOH | New York State Department of Health |
| PS | Public School |
| PVC | Polyvinyl Chloride |
| RAO | Remedial Action Objectives |
| RAWP | Remedial Action Work Plan |
| RI | Remedial Investigation |
| RSCOs | Recommended Site Cleanup Objectives |
| SCG | Standards, Criteria, and Guidelines |
| SMMP | Soil/Materials Management Plan |
| SMP | Site Management Plan |
| SVE | Soil Vapor Extraction |
| SVOCs | Semi-Volatile Organic Compounds |
| USEPA | United States Environmental Protection Agency |
| UST | Underground Storage Tank |
| VOCs | Volatile Organic Compounds |

# CERTIFICATIONS

I, Ariel Czemerinski, certify that I am currently a NYS registered professional engineer as defined in 6 NYCRR Part 375 and that this Remedial Design 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).

| | | |
|---|---|---|
| 076508 | 7/28/2017 | |
| NYS Professional Engineer # | Date | Signature |

# AIR SPARGING / SOIL VAPOR EXTRACTION REMEDIAL DESIGN

## 1.0 INTRODUCTION

Ocean Units LLC entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC) on July 13, 2015, to investigate and remediate a 0.38-acre property located at 1815-1825 Ocean Avenue in Brooklyn, New York. Ocean Units LLC was accepted as a Volunteer in the New York State Brownfield Cleanup Program (BCP). A residential use is proposed for the property. When completed, the Site will be redeveloped with a new 8-story residential building which will cover 60 percent of the Site.

This Remedial Design (RD) was prepared to provide design specifics of the air sparging (AS) / soil vapor extraction (SVE) program to be implemented at the Site. This RD was prepared in accordance with the requirements in NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010.

### 1.1 SITE LOCATION AND DESCRIPTION

The street address for the Site is 1815-1825 Ocean Avenue, Brooklyn, New York 11230 (**Figure 1**). The Site is located in Midwood section of the Borough of Brooklyn (Kings County) and is comprised of two adjacent tax lots that total 16,555 $ft^2$ (0.38 acres). The Site is identified as Block 7656, Lots 55 and 58 on the New York City Tax Map. The two lots combined consist of 150.5 feet of street frontage on Ocean Avenue, and a depth of 100 feet.

The elevation of the Site is approximately 25 feet above the National Geodetic Vertical Datum (NGVD). The area topography gradually slopes to the southwest. The depth to groundwater beneath the Site, as determined from field measurements, is approximately 22.15 to 23.49 feet below grade. Groundwater flow is to the southeast based on surveys and prior investigations.

## 1.2 PROJECT BACKGROUND

The Site was previously developed with a 1-story gasoline service station building (Lot 55) and a parking lot (Lot 58). The building has a footprint of approximately 2,190 $ft^2$ which, according to the NYC Department of Buildings, was constructed in 1931. The building was recently demolished in preparation for the redevelopment of the Site.

The results of sampling performed during the RI identified gasoline-related VOCs in soil at the groundwater interface (approximately 20 to 25 feet below grade) above Restricted Residential Use SCOs. These samples were in the vicinity of the two, 4,000-gallon gasoline underground storage tanks located in front of the gasoline service station building on Lot 55. The contamination at the groundwater interface was found to extend to the southern area of the Site in the direction of groundwater flow.

Petroleum VOCs were detected within groundwater above NYSDEC Ambient Water Quality Standards (GQS) across the Site. The highest concentrations of gasoline-related VOCs in groundwater were detected within the groundwater samples collected closest to the tank pad and immediately down gradient of the two, 4,000-gallon gasoline underground storage tanks (15GW4, 15GW1 and 15GW2).

# 2.0 AS / AVE PILOT TEST

## 2.1 OVERVIEW

The objective of the AS /SVE pilot test was to determine full-scale design parameters for the AS and SVE systems. $C^2$ Environmental installed the injection, extraction and observation wells and provided and operated the test equipment. The test itself was conducted by AMC Engineering on September 23rd, 2016. The test had two main components, SVE only and air sparge only which were run separately to determine the radius of influence for each system. The full test took approximately 6 hrs to complete. Test results are provided in **Tables 1-8**, **Figures 2-9** and **Appendix A**.

### *2.1.1 Deviations from the Pilot Test Work Plan*

The pilot test work plan (AMC 8/2016) contemplated the collection of a an air discharge sample during the SVE-only portion of the test, however since no PID readings were obtained, collection of the sample was determined not to be useful.

### *2.1.2 SVE-Only Test*

The SVE portion of the test was performed first and consisted of attaching a regenerative blower to the extraction well and then recording negative pressure in the nearby observation wells to establish the effective radius of influence.

The SVE-only portion of the test included the following components:

- A single extraction well to a depth of 23.5 feet below grade, consisting of:
    - 10 feet of 0.020-inch slotted screen (**Figure 3**), followed by
    - 12.5 feet of 2-inch diameter PVC riser, followed by
    - A 1 foot, 2” PVC riser secured with bentonite grout, followed by
    - A 2” elbow, followed by
    - A vacuum gauge on the wellhead, followed by
    - A manual-control valve, followed by
    - A vacuum gauge, measuring vacuum at the suction of the blower.

- A 1.5 HP Regenerative Blower (Rotron EN454) capable of drawing 112 cfm @ 10" WC vacuum, connected to
- A vapor phase granulated activated carbon filter (General Carbon 55-gallon drum).
- 5 existing monitoring locations were used to collect data (see **Figure 2**).

Vacuum readings were taken at the blower and wellhead with a diaphragm gauge, and at the observation points with a digital manometer. Flow rates were determined utilizing a vacuum/cfm chart supplied by the manufacturer. The SVE discharge was routed to an activated carbon drum to prevent nuisance odors.

Three SVE tests were run: one at full vacuum, one at 1/3rd (33.3%) full vacuum and one at 2/3rd full vacuum (66.6%). The tests were run from lowest applied vacuum to greatest. Each test was run for approximately 15 minutes to allow for stabilization.

### *2.1.3 Air Sparging Only Test*

The sparge-only portion of the test consisted of supplying air under pressures capable of overcoming the static water column to the installed sparge point. The compressor was fitted with an oil-removing coalescing filter, pressure gauge, regulator and volumetric air flow meter.

The AS test utilized the following components:

- A single injection well installed to a depth of 38 feet below grade, consisting of:
    - 2.5 feet of 0.020-inch slotted screen (**Figure 4**), followed by
    - 34.5 feet of 1-inch diameter PVC riser, followed by
    - 1 foot, 1" PVC riser secured with bentonite grout, followed by
    - 1" elbow, followed by
    - A pressure gauge on the wellhead, followed by
    - A manual-control valve, followed by
    - An air flow meter, connected to
- An 8-gallon, single stage air compressor capable of delivering at least 10 cfm at a maximum pressure of 80 psi (Mi-T-M AM1-PH65-08M).
- 5 existing monitoring locations were used to collect data (see **Figure 2**).

The test was run at two different pressure/flow levels, including pressures 10%, and 20%, over that required to displace the water column in the well (break-out pressure). At each range tested, water level, pressure readings, dissolved oxygen and PID readings were recorded at the observation wells.

Water level readings were recorded at each testing stage with an electronic tape. Dissolved oxygen (DO) levels were recorded with a DO meter. A digital manometer and photoionization detector were used to monitor positive pressure levels and VOCs at the observation points.

## 2.2 TEST RESULTS

Before initiating the test, baseline measurements were taken in all five observation wells. The baseline readings are summarized in the table below.

**Table 1: Baseline Measurements**

| Measurement Type | MW1 | MW2 | MW7 | MW8 | MW9 |
|---|---|---|---|---|---|
| Dissolved Oxygen (mg/L) | 5.6 | 5.8 | 4.08 | 1.05 | 3.2 |
| Depth to Water (ft) | 22.37 | 23.46 | 22.94 | 23.46 | 22.15 |
| Total Depth of well (ft) | 29.4 | 29.5 | 28.8 | 29.32 | 29.0 |

*SVE Only*

This phase of the pilot test including applying three different vacuum / flow rates to the extraction wellhead by restricting the air stream at the test blower as follows:

Test 1: Throttle 1/3 Open

Test 2: Throttle 2/3 Open

Test 3: Throttle Open

Once the system started up and in between tests, fifteen minutes were required to reach stabilization. After stabilization, the vacuum was measured and recorded at each monitoring well and at the well head. Velocity measurements were also collected at the carbon canister discharge. The following table summarizes the findings for the *SVE-Only Phase* of the pilot test:

## Table 2: Soil Vapor Extraction Test - Vacuum Data

| Measurement | Units | Blower | Well Head | 15GW9 | 15GW7 | 15GW8 | 15GW1 | Velocity (ft/min) | Volumetric Flow Rate (CFM) |
|---|---|---|---|---|---|---|---|---|---|
| Distance to Well | feet | 0 | 0 | 8.51 | 27.43 | 28.21 | 54.21 | | |
| Test 1 – 1/3 Open | i.w.c | 22 | 4 | 0.5 | 0.15 | 0.19 | 0 | 2458 | 85 |
| Test 2 – 2/3 Open | i.w.c | 15 | 7 | 0.72 | 0.17 | 0.39 | 0.13 | 3767 | 98 |
| Test 3 – Open | i.w.c | 8 | 8 | 0.85 | 0.32 | 0.34 | 0.18 | 4916 | 110 |

Note: vacuum readings were not obtained from 15GW2 due to an unidentified vacuum loss in the well seal.

**Figure 5** depicts the relationship between distances to SVE extraction well and measured vacuum at each monitoring point. This curve drops asymptotically with distance, as it would be expected. As shown in **Figure 6**, the radius of influence as determined from the Test 3 results (fully open valve) are 50 ft. (straightline trend) and 60 ft (curve extrapolation). PID readings taken before and after carbon treatment yielded no readings above background. We will adopt the more conservative value of 50ft.

*AS Only*

This phase of the pilot test involves operating the AS system under varying wellhead pressures including 10% and 20% over that required to displace the water column ("breakout pressure"). Before determining testing pressures, a depth to water reading was taken to calculate the breakout pressure for the injection well. The measured depth to water in the well was 23.5 feet.

The breakout pressure is the minimum injection pressure required to overcome the water column. For injection pressures less than the breakout pressure, there will be no air flow into formation. Breakout pressure is calculated as follows:

*Breakout Pressure (psi) = (Total Depth (ft) – Depth to Water (ft) – Screen Length (ft)) x 0.43302*

*BP for Test Well = 38ft -23.5 ft - 2.5 = 12 x 0.43302 = 5.19 psi*

The pilot test air sparging system has a breakout pressure of 5.19 psi. The following table summarizes the operating pressures for the air sparging pilot test:

**Table 3: Air Sparging Test - Applied Wellhead Pressures**

| **Measurement** | **Operating Pressure** |
|---|---|
| Breakthrough Pressure | 5.19 psi |
| Test 1 – 10% Above Breakthrough Pressure | 5.71 psi |
| Test 2 – 20% Above Breakthrough Pressure | 6.23 psi |

To begin the test, the compressor was set to the Test 1 conditions (10% above breakthrough pressure). The system stabilized after 15 minutes of operation. After stabilization, the pressure was measured and recorded at each monitoring well. Additionally, PID measurements, depth to water readings and dissolved oxygen readings were collected at each monitoring well. When transitioning from Test 1 to Test 2, 15 minutes were also required to allow for stabilization.

The following tables summarize the results for the *AS-Only Phase* of the pilot test:

**Table 4: Air Sparging Test - Pressure Readings**

| **Test** | **Units** | **Compressor** | **Well Head** | **15 GW 2** | **1 5 GW 9** | **15 GW 1** | **15 GW 8** | **15 GW 7** | **Flow (cfm)** |
|---|---|---|---|---|---|---|---|---|---|
| Distance to Well | feet | | | 9.5 | 23 | 29 | 32 | 52 | |
| Test 1 – 10% Above Breakout Pressure | i.w.c | 20 | 5.7 | 0.1 | 0 | 0.13 | 0.39 | 0 | 6.6 |
| Test 2 - 20% Above Breakout Pressure | i.w.c | 30 | 6 | 0.12 | 0.15 | 0.16 | 0.18 | 0 | 10.2 |

**Table 5: Air Sparging Test - PID Readings**

| **Test** | **Units** | **15GW 2** | **15GW 9** | **15GW 1** | **15GW 8** | **15GW 7** |
|---|---|---|---|---|---|---|
| Distance to Well | feet | 9.5 | 23 | 29 | 32 | 52 |
| Test 1: 10% Above Breakout Pressure | ppm | 3.7 | 0 | 3.5 | 7.3 | 0 |
| Test 2: 20% Above Breakout Pressure | ppm | 5.6 | 0.1 | 11.3 | 22.3 | 0 |

**Table 6: Air Sparging Test - Change in Dissolved Oxygen**

| **Test** | **Units** | **15GW 2** | **15GW 9** | **15GW 1** | **15GW 8** | **15GW 7** |
|---|---|---|---|---|---|---|
| Distance to Well | feet | 9.5 | 23 | 29 | 32 | 52 |
| Test 1: 10% Above Breakout Pressure | mg/L | 2.82 | 5.3 | 2.7 | 7.85 | 4.85 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Test 2: 20% Above Breakout Pressure | mg/L | 0.3 | 5.5 | 0.3 | 7.45 | 5.07 |

**Table 7: Air Sparging Test - Change in Water Levels**

| **Test** | **Units** | **15GW 2** | **15GW 9** | **15GW 1** | **15GW 8** | **15GW 7** |
|---|---|---|---|---|---|---|
| Distance to Well | feet | 9.5 | 23 | 29 | 32 | 52 |
| Test 1: 10% Above Breakout Pressure | feet | -0.09 | 0.19 | 1.23 | -0.21 | -0.09 |
| Test 2: 20% Above Breakout Pressure | feet | -0.05 | 0.85 | 0.86 | -0.21 | -0.09 |

The results for the air sparging test did not produce a clear trend in any of the parameters monitored (see **Figures 7-8a**). Pressure readings above 0.1 inches w.c. and an increase in PID readings were reported in observation wells to a distance of 32 ft and in both cases appeared to increase with distance. Dissolved oxygen levels were reported as far as well GW7 a distance of 52 ft from the sparge well. Increases in water levels were noted to 29 ft.

At the start of the test, PID readings were 0.0 ppm at each monitoring well. The increased VOC measurements indicate that the AS injection well was able to actively transfer sorbed and dissolved phase petroleum VOCs at and beneath the saturated zone to the vapor phase. Dissolved oxygen readings demonstrated a significant increase in all monitoring wells during the test. The changes in DO readings are less dramatic during test 2 (20% of the operating pressure); this difference may be accounted for by the saturation during the first test.

Although dissolved oxygen increases were reported at a distance of 52 feet, increases in pressure and PID readings were limited to a distance 32 feet while increases in water level were not reported beyond 29 feet. Since the increase in water level is directly related to mounding associated with the air injection, it can be considered the most reliable and conservative measure of the radius of influence for a sparging well.

## 2.3 TEST CONCLUSIONS

The following conclusions can be made from the pilot test results:

1. The SVE Design Radius of Influence is 50 feet.
2. The SVE system requires a flow of 110 cfm per well. With a two well system, the blower must draw 220 cfm overall.

3. The AS Radius of Influence is 25 feet.
4. The AS system requires a flow of 7 cfm per well. With a four well on four well off system, the blower must deliver at least 28 cfm. The required wellhead pressure is 6-6.5 psi.

# 3.0 AIR SPARGING / SOIL VAPOR EXTRACTION SYSTEM DESIGN

## 3.1 SYSTEM OVERVIEW

Soil and groundwater testing performed under the RI identified elevated concentrations of petroleum at and just below the water table along the western half of the Site. The source area has been identified as the UST and dispenser area. Residually impacted soil extends from beneath this area to and below the water table surface at approximately 22 to 23 feet below surface grade.

The pilot test provided information on the necessary capacity for the blowers and electrical equipment for the full-scale design. Based on the established radius of influence for each component in the system (air sparging, soil vapor extraction) the dimensions of the treatment area and the structural elements and configuration of the new building system consisting of eight air sparging wells and two soil vapor extraction wells was selected. The sparge wells will be grouped into 2 legs composed of 4 wells each. Each leg will be cycled on a three day on, three day off schedule.

## 3.2 SOIL VAPOR EXTRACTION SYSTEM DESIGN SPECIFICATIONS

According to the pilot test results, a radius of influence of 50 to 60 feet can be achieved when the system draws 110 cfm with 8 i.w.c at each wellhead. Full coverage of the impacted area using a design ROI of 50 feet required two vapor extraction wells. Each SVE well will be installed to a total depth of 23 feet below sidewalk grade. The SVE wells will be constructed of 10-feet of 2-inch diameter, 0.02-inch slotted pvc well screen with approximately 1-foot of 2-inch diameter PVC riser. The wells will be sealed at the surface with bentonite pellets and a 12" diameter manhole.

The wellheads will be completed with a compression plug for access and "Tee'd" to a 2-inch pvc ball valve to isolate the well from the system and allow flow rates to be balanced between the two extraction wells. The wells will be connected to a common 4-inch diameter PVC main extraction header which will be piped to a vacuum blower located in the rear yard area.

Based on the results of the pilot test an air flow rate of 110 cfm at 8 w.c. at the wellhead is required to achieve the design ROI of 50 ft. Friction loss calculations estimate a 2.4 w.c. loss in vacuum across the system from piping, elbow, valves, etc. and a ~2 psi pressure drop from the carbon vessel on the discharge side. To meet these design criteria a 5 HP regenerative blower (Ametek Rotron EN757 or equivalent) with particulate filter and vapor trap is specified.

The layout of the SVE system is shown in **Figure 10**. Well details are depicted in **Figure 12**. Friction loss calculations are provided in **Appendix B**. Equipment details and specifications are provided in **Appendix C**.

### 3.3 AIR SPARGING SYSTEM DESIGN SPECIFICATIONS

The pilot test results indicated an effective radius of influence of 29 feet for a sparging well operating at 10% above breakout pressure. The design ROI selected for this system is 25 ft. Full coverage of the impacted area will require 8 sparging wells.

Each air sparging well will be installed to a total depth of 12.5 feet below the water table (approx. 25 ft below cellar slab grade). The sparging wells will be constructed of 2.5 feet of 1-inch diameter, 0.02-inch slotted pvc well screen with approximately 22.5 feet of 1-inch diameter pvc riser. A morie No. 1 gravel pack will be placed to approximately 6 inches above the top of the screened section followed by a hydrated bentonite plug and grouted to the grade. The wellhead will be completed at the surface with a 12-inch manhole cover to accommodate the system control valve.

The wellheads will be completed with a compression plug for access and "Tee'd" to a 1-inch pvc globe valve. The wells will be connected to a common 2-inch diameter pvc main pressure line which will be connected to a rotary lobe blower located in an equipment shed in the rear yard area. The air sparging system will operate two alternating legs; each consisting of four injection wells. As follows:

- System 1: AS1, AS4, AS5, AS8
- System 2: AS2, AS3, AS6, AS7

A timer will be used to regulate a three-way, electrically-actuated valve which will cycle each leg on a 3 day basis. Based on the results of the pilot test, an air flow rate of 7 cfm at 6.5 psi is required to achieve the design ROI of 25 ft. Friction loss calculations estimate a 1.2 psi loss in pressure vacuum across the system. To meet these design criteria a 3 HP rotary lobe blower (Roots model 22 URAI-DSL blower or equivalent) with inlet / outlet silencers and a pressure relief valve is specified.

The layout of the AS system is provided in **Figure 11**. Well details are depicted in **Figure 13**. Friction loss calculations are provided in **Appendix B**. Equipment specifications and manufacture's cut sheets are provided in **Appendix D**.

## 3.4 TREATMENT SYSTEM

VOCs from the SVE effluent air stream will be treated with vapor phase granular activated carbon (GAC) before discharge to the atmosphere. The selected GAC treatment system includes two 85-gallon General Carbon Corp. canisters arranged in series. There will be a brass tap sampling port on the inlet, between the canisters, and on the effluent. The effluent will discharge through a 2” SCH 40 pvc line which will be located a minimum of 10 feet above the ground surface and a minimum of 15 feet away from any operable window, door or air intake.

NYSDEC requires that VOC emissions do not exceed 0.5 lb/day. The designed SVE system meets this emission rate potential requirement. The emission rate potential was calculated based on the following assumptions:

1. No more than the highest measured total VOCs is expected to be drawn from the effluent.
2. The vapor phase activated carbon system (General Carbon Corporation) has 90% removal efficiencies.
3. The highest concentration of total VOCs measured during past investigations was on 11/17/2015 from 15SV5at 2,937 ug/m$^3$.
4. From the pilot test data, we extrapolated the flow required to achieve 0.1” WC vacuum at a 60 radius of influence. This value is 110 cfm. Multiplying 110 times 2 (two wells are distributed in the site) results in the required volume of 220 cfm.

5. 2,937 ug/$m^3$ exhausted in 220 cfm of air results in 0.058 lb/day.
6. A 90% efficiency removal through the carbon will result in 0.0058 lb/day of emissions.

The above value is a conservative estimate, considering the "worst case" for the critical parameters.

## 3.5 EQUIPMENT SHED

The equipment will be located in a shed to be constructed on the northeast corner of the property. The 10' x 10' shed will be constructed of wood and will house both the AS and SVE equipment and the carbon drums. The equipment shed will include motor starters for each blower and a power panel. The equipment shed will be equipped with a 50 cfm fan for ventilation. See **Figure 14** and **Appendix E** for details of the equipment shed.

# 4.0 SYSTEM OPERATION AND MAINTENANCE

## 4.1 START-UP

The SVE and AS systems can begin operation once all of the components (piping, equipment, electrical connections, etc.) have been installed and determined to be functional. Following installation of the system, the following items will be inspected to ensure proper operation:

1) Check all exposed/visible piping for evidence of damage, cracks, or leaks.
2) Turn the SVE blower on and off to ensure the start box is functioning properly and then leave blower on;
3) Record vacuum reading at the SVE blower;
4) Record vacuum readings at each extraction wellhead;
5) Balance the vacuum between the two extraction wells by adjusting the ball valves;
6) Take PID readings before, in-between and after carbon vessels;
7) Turn the AS blower on and off to ensure the start box is functioning properly and then leave blower on;
8) Determine which leg of the system is on and adjust the air pressure at each wellhead to 10 -15% above that required to overcome the water column in the well (break-out pressure).
9) Toggle the three-way valve to the second leg and repeat step 7 on the wells connected to the second leg of the system.

The system testing described above will be conducted if, in the course of the AS / SVE system lifetime, the system goes down or significant changes are made to the system and the system must be restarted.

## 4.2 SYSTEM INSPECTIONS AND ADJUSTMENT

The air sparging system will need to be adjusted in response to changes in water level. Such changes will either increase or decrease the amount of pressure needed to overcome the water column and maintain optimal operating conditions. The SVE portion of the system will not require periodic adjustment once the extraction wells are properly balanced.

A visual inspection of the complete system will be conducted during each monitoring event. AS / SVE system components to be monitored include, but are not limited to, the following:

- Vacuum blower; AS Blower;
- General system piping.
- Vacuum gauges at blower.
- Pressure relief valve.
- Control switches.
- PID Readings from influent line, between carbon drums and at the discharge stack.

The adjustment procedures for the dual leg air sparging system are as follows:

**Method 1 (if sparging lines are not air tight and there is access to each sparge point wellhead)**

1. Turn off sparge blower
2. Check actuator valve to determine which leg is in the "ON" cycle.
3. Take depth to water readings & total depth (if not known) at each sparge point.
4. Determine displacement pressure & operating pressure for each point according to following example:
   Displacement pres. (psi) = ((T.D. - DTW) - 2.4) x 0.43302
   Operating pres. (psi) = Disp. pres. x 1.15 (for 15% over)
5. Turn on sparge blower and adjust each point (on leg 1) to calc. operating pressure.
6. Switch actuator valve to second leg and adjust each point (on leg 2 ) to calc. operating pressure.
7. Return actuator valve to original position.
8. Record vacuum/pressure readings at vent wells and observation wells. Balance out vacuum at SVE wells. Take PID readings at SVE emission stack.

**Method 2 (if lines are air tight)**

1. Close off air supply (globe valve) to first sparge point in system. Watch press. gauge and wait for stabilization (approx. 4-4.5 psi for a 10 foot water column). Stabilization psi = displacement psi. Calculate operating psi as described above.
2. Perform procedures 6, 7 and 8 as detailed above.

All results must be recorded on the SVE System Inspection and AS System Inspection forms (**Appendix F).**

# 5.0 REMEDIAL PERFORMANCE MONITORING

*AS/SVE*

Air samples will initially be collected on a monthly basis to evaluate the performance of the system during the first 3 months of operation going to quarterly thereafter.

PID readings will be collected from three locations: system influent (before carbon), between the carbon canisters and from the system discharge (after carbon). Air samples will be collected from the system effluent and submitted to a NYSDOH certified environmental laboratory for analysis of VOCs by USEPA method TO15.

Initial effluent concentrations will be high as accumulated vapors are removed resulting in accelerated carbon depletion rates. However carbon usage will rapidly diminish over time (1-2 weeks) as the accumulated vapors are removed and effluent concentration is determined by transfer from the sorbed to the vapor phase from residually impacted soils. Carbon drums will be set up in series with the between vessel PID readings utilized to determine when break through occurs at the first drum. The threshold PID reading would be 200 ppm and would confirm breakthrough has occurred. Typically readings of 200 ppm and up confirm contamination is present with this instrument. Lower readings with this instrument can be impacted by weather or equipment malfunctions. When this occurs the drum will be changed out and shipped back to the supplier for regeneration. If nuisance odors are observed from the discharge at any time, operation of the system will be temporarily halted until the situation is remedied by changing out the carbon or through other necessary repairs / actions (loose valve / fitting, broken pipe, etc.).

*Groundwater*

In addition to the air samples, downgradient groundwater samples will be collected from monitoring wells for assessing compliance with applicable SCOs. Groundwater quality will be monitored during and after the system operation to monitor improvements overtime and confirm the success of the remedial program. Groundwater performance monitoring samples will be collected from monitoring well locations, installed within and downgradient of the treatment area (see **Figure 15**). Sample analysis will include the following parameters:

- VOCs by Method 8260C

## 5.1 METHODOLOGY

Air samples will be collected from the system influent and effluent using tedlar bags or summa canisters. If using canisters, the canister will be connected to the effluent sampling port using silicone tubing. The sampling port will then be opened as well as the valve on the summa canister. When the vacuum in the canister approaches 10" hg the valve will be closed. If using tedlar bags a vacuum pump will be used to fill the bag. When the bag is half full, pumping will be stopped and the valve on the bag closed.

Groundwater samples will be collected from the monitoring well network either a low-flow peristaltic pump or a stainless steel check valve connected to disposable polyethylene tubing. Sampling will be conducted in accordance with standard sampling methods described below:

- Inspect each well for any damage or evidence of tampering and note condition in field logbook.
- Remove the well cap.
- To avoid cross-contamination, do not let any downhole equipment touch the ground.
- Measure and record the depth to water using a water level meter or interface probe. Record the measurement in the field logbook. Do not measure the depth to the bottom of the well at this time (to avoid disturbing any sediment that may have accumulated).
- Calculate the number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
- Calculate the total volume of water (V) in the casing. Well purge data sheets will be used in the field to perform these calculations.
- Connect the polyethylene tubing to the check valve and lower the tubing into the well to approximately the middle of the screen. Tubing should be a minimum of 2 feet above the bottom of the well as this may cause mobilization of any sediment present in the bottom of the well. Purging the well into a container and continue purging until the purge volume

has been extracted. The following field parameters will be measured during well purging; temperature, PH, conductivity, dissolved oxygen and turbidity. A minimum of 3-5 well volumes will be purged and samples will be collected once the parameters stabilize and turbidity is less than 50 nephelometric turbidity units (NTUs).

- Collect the samples directly from the end of the tubing.
- Use pre-preserved (HCl) 40 ml glass vials as provided by the contract laboratory. Fill each container with sample to just overflowing so that no air bubbles are entrapped inside. Fill all sample bottles by allowing the pump discharge to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled.
- Label the sample vials, and record them on the chain of custody form. Place immediately into a cooler for shipment and maintain at 4 deg C.
- Remove the tubing from the well. The polyethylene tubing must be discarded after each use. If dedicated, the tubing should be placed in a large plastic garbage bag, sealed, and labeled with the appropriate well identification number.
- Close and lock the well.

Collected groundwater samples will be placed in pre-cleaned laboratory supplied glassware, and placed in a cooler packed with ice for transport to the laboratory. Sample analysis will be provided by Phoenix Environmental to Phoenix Environmental Laboratories (Phoenix) of 587 East Middle Turnpike, Manchester, CT 06040, a New York State ELAP certified environmental laboratory (ELAP Certification No. 11301). Transport to the laboratory will be through a Phoenix courier under strict chain-of custody documentation

Samples will be submitted to the laboratory for a standard turnaround time, which is estimated to be 5 to 7 business days. Any change in sampling locations or frequency will be made in concurrence with the NYSDEC Project Manager.

### 5.2 QA/QC

The fundamental QA objective with respect to accuracy, precision, and sensitivity of analysis for laboratory analytical data is to achieve the QC acceptance of the analytical protocol. The accuracy, precision and completeness requirements will be addressed by the laboratory for all data generated.

Collected samples will be appropriately packaged, placed in coolers and shipped via overnight courier or delivered directly to the analytical laboratory by field personnel. Samples will be stored in the field in a cooler containing ice or cold-pak(s) to maintain a temperature of 4 degrees C. Samples will be containerized in appropriate laboratory provided glassware and shipped in plastic coolers. Samples will be preserved through the use of ice or cold-pak(s) to maintain a temperature of 4$^{o}$C, +/- 2 $^{o}$C.

Dedicated disposable sampling materials will be used for both groundwater samples, eliminating the need to prepare field equipment (rinsate) blanks. However, if non-disposable equipment is used, field rinsate blanks will be prepared at the rate of 1 for every eight samples collected. Field blanks will be prepared by pouring distilled or deionized water over decontaminated equipment and collecting the water in laboratory provided containers.

Trip blanks will accompany samples each time they are transported to the laboratory. Matrix spike and matrix spike duplicates (MS/MSD) will be collected at the rate of one per 20 samples submitted to the laboratory.

*DUSR*

The DUSR provides a thorough evaluation of analytical data with full third party data validation. The primary objective of a DUSR is to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and data use. Verification and/or performance monitoring samples collected under this RAWP will be reviewed and evaluated in accordance with the Guidance for the Development of Data Usability Summary Reports as presented in Appendix 2B of DER-10. The completed DUSR for verification/performance samples collected during implementation of this RAWP will be included in the Final Engineering Report.

## 5.3 REPORTING

Sample analysis will be provided by a New York State ELAP certified environmental laboratory. Laboratory reports will include Analytical Systems Protocol July 2005 (ASP) category B data deliverables for use in the preparation of a data usability summary report (DUSR). All results will be provided in accordance with the NYSDEC Environmental Information Management

System (EIMS) electronic data deliverable (EDD) format. All monitoring results will be reported to NYSDEC on a periodic basis in the Periodic Review Report. A letter report will also be prepared subsequent to each quarterly air sampling event. The report (or letter) will include, at a minimum:

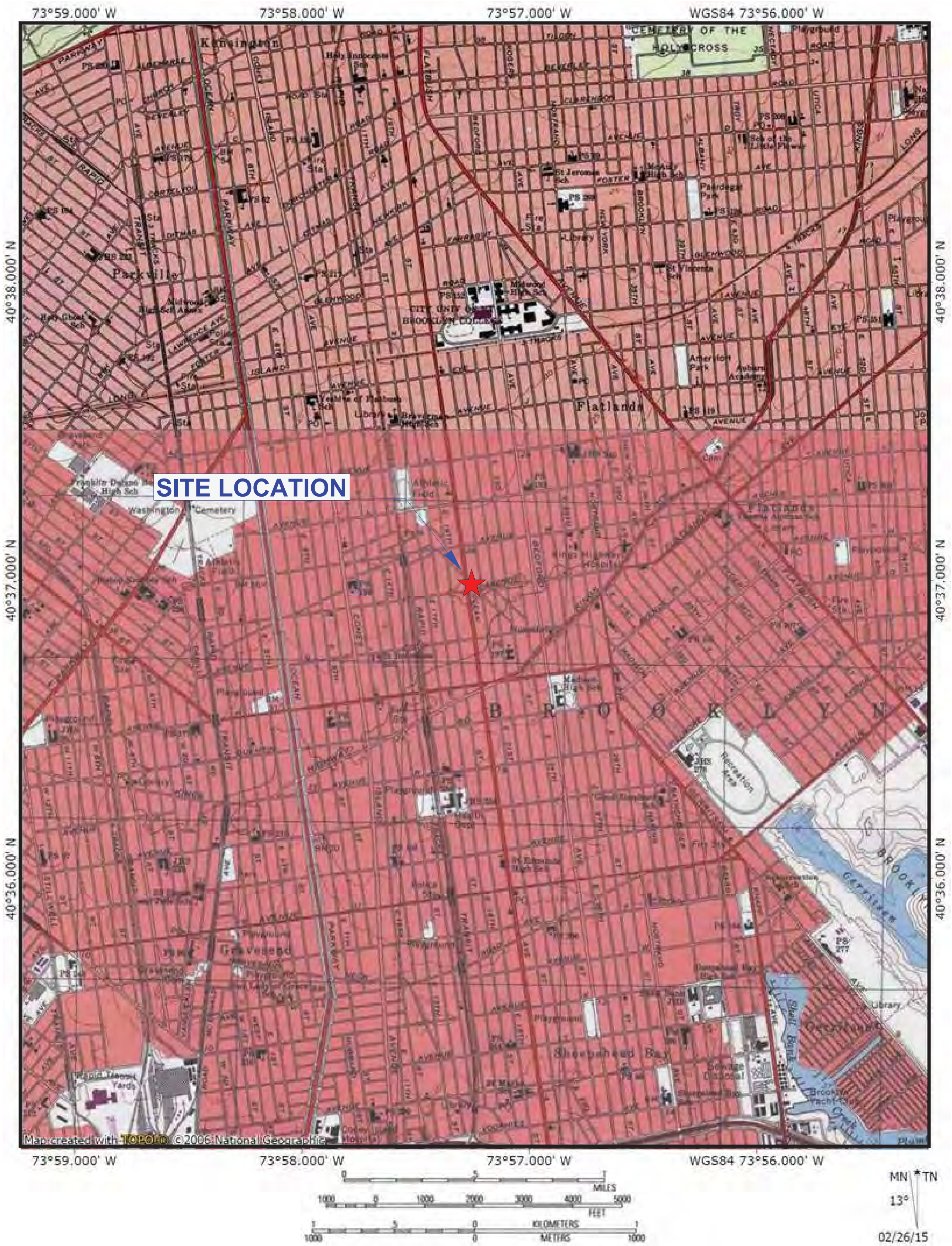
- Date of event;
- Personnel conducting sampling;
- Description of the activities performed;
- Type of samples collected (e.g., sub-slab vapor, indoor air, outdoor air, etc);
- Copies of all field forms completed (e.g., well sampling logs, chain-of-custody documentation, etc.);
- Sampling results in comparison to appropriate standards/criteria;
- A figure illustrating sample type and sampling locations;
- Copies of all laboratory data sheets and the required laboratory data deliverables required for all points sampled (o be submitted electronically in the NYSDEC-identified format);
- Any observations, conclusions, or recommendations; and
- A determination as to whether conditions have changed since the last reporting event.

The Final Engineering Report will provide a tabular and map summary of all initial performance monitoring and post-remedial sample results collected prior to the issuance of the Certificate of Completion. Performance data collected after the COC is issued will be reported in the periodic review report.

## 5.4 PERMITS / AUTHORIZATION

Air discharge under the NYSBCP will not require a permit from the NYSDEC. An industrial process equipment application will be filed with the NYC Department of Environmental Protection, Bureau of Environmental Compliance.

# ***FIGURES***

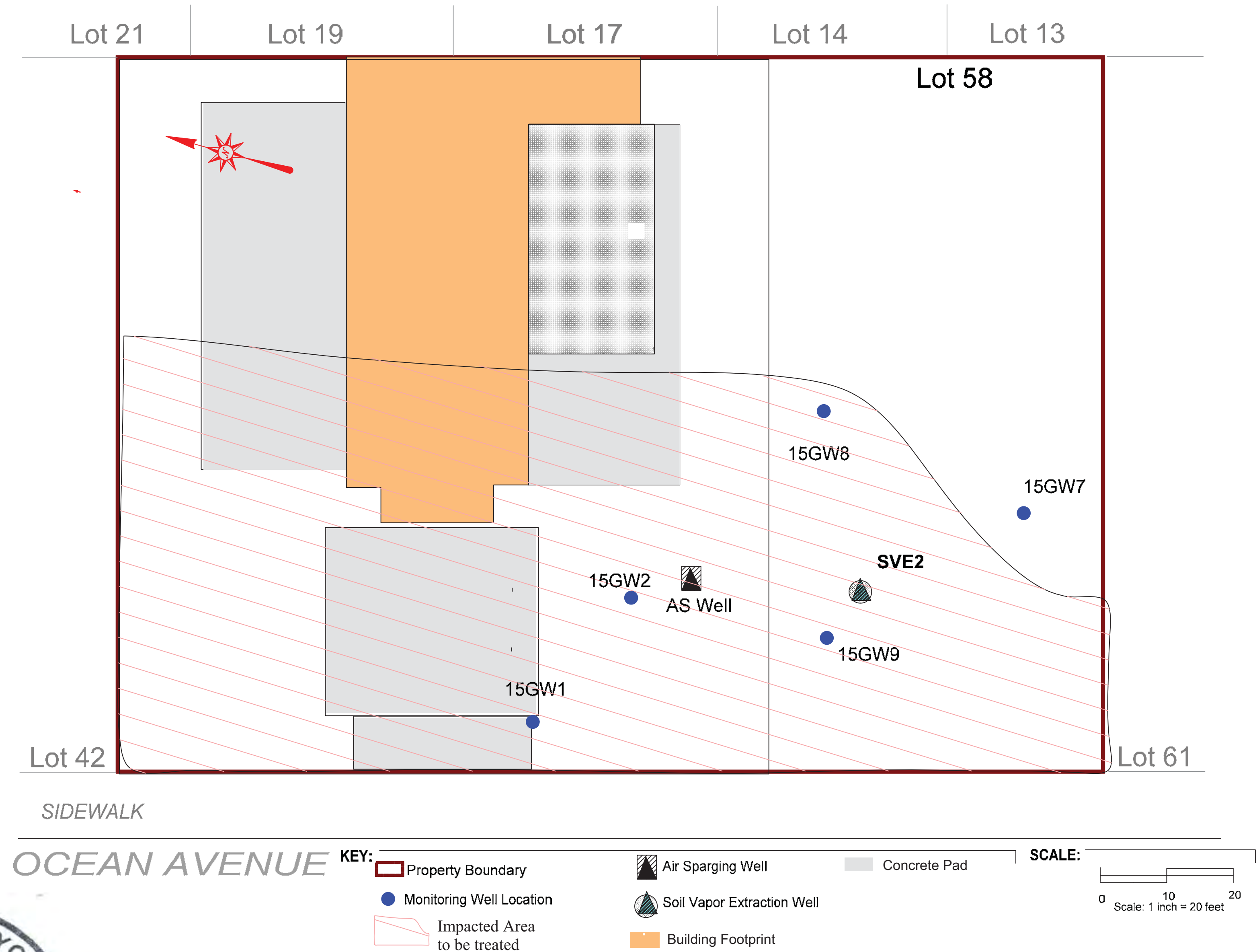



USGS Central Park, NY Quadrangle 1995, Contour Interval = 10 feet


EBC
Phone 631.504.6000
Fax 631. 924 .2870
ENVIRONMENTAL BUSINESS CONSULTANTS


TOMAT SERVICE STATION
1815-1825 OCEAN AVENUE, BROOKLYN, NY

FIGURE 1 SITE LOCATION MAP





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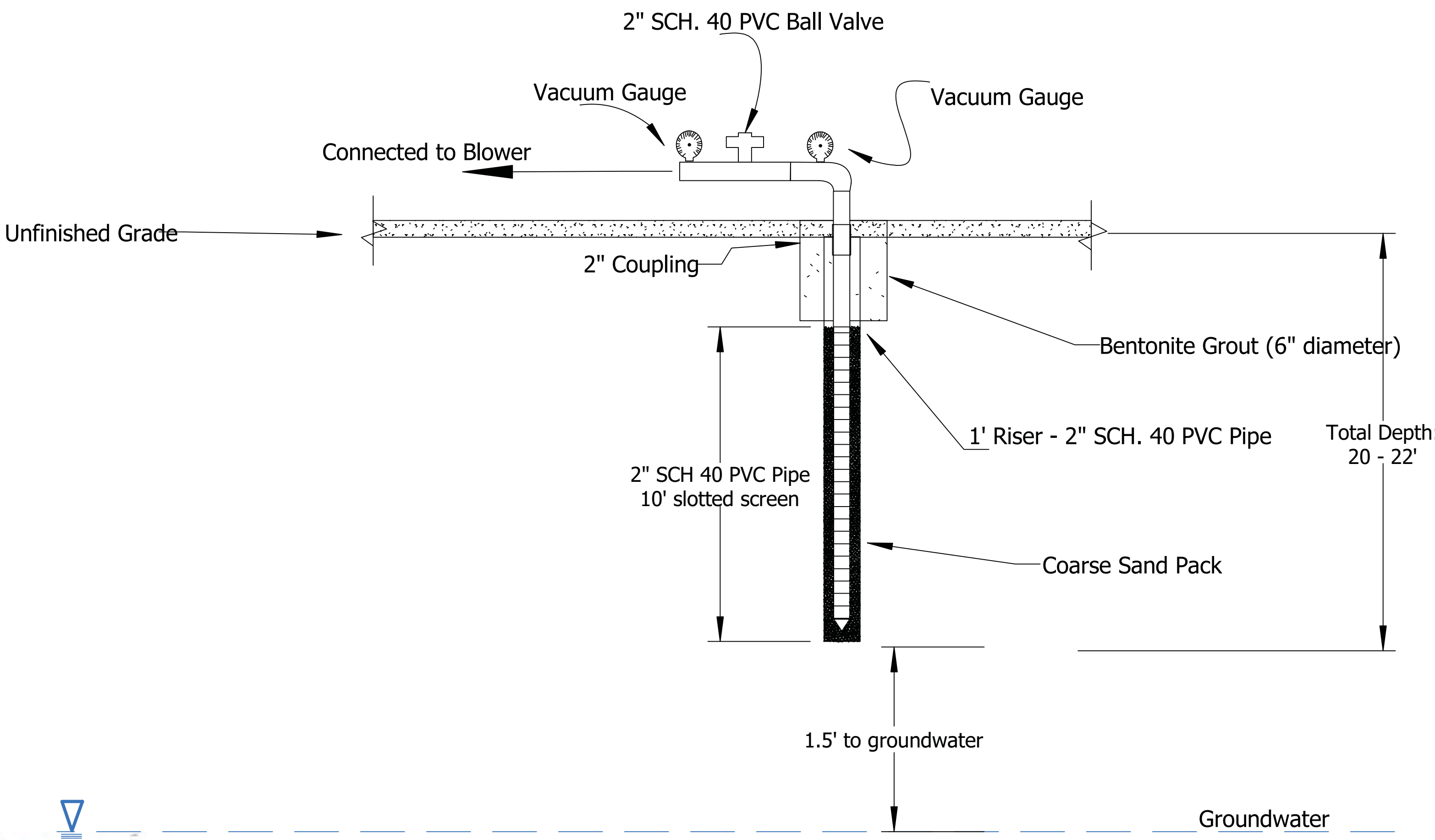
18-36 42nd Street
Astoria, NY 11105

*Figure No.*
**2**

Site Name: TOMAT SERVICE STATION

Site Address: 1815-1825 OCEAN AVENUE, BROOKLYN, NY

Drawing Title: AS/SVE PILOT TEST LOCATIONS




# CONSTRUCTION DETAIL

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| AMC ENGINEERING PLLC<br>1836 42nd Street<br>Astoria, NY 11105<br>Office: 516-417-8588 | | PROJECT | Tomat Service Station<br>1815-1825 Ocean Avenue<br>Brooklyn, NY 11219 |
| DATE DEC 7, 2016 | DRAWING BY AC | TITLE | Figure 3 - Pilot Test:<br>SVE Well Detail |

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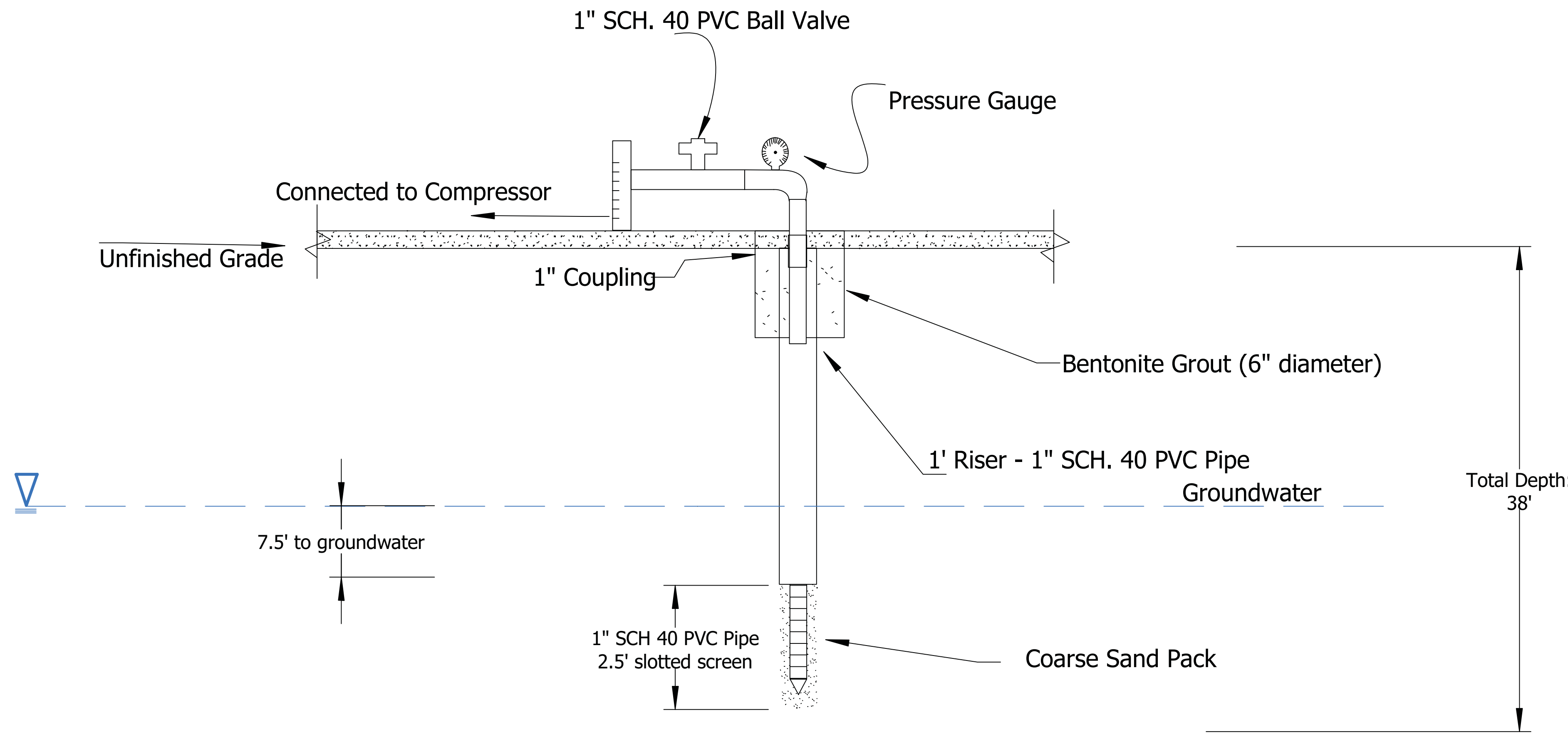


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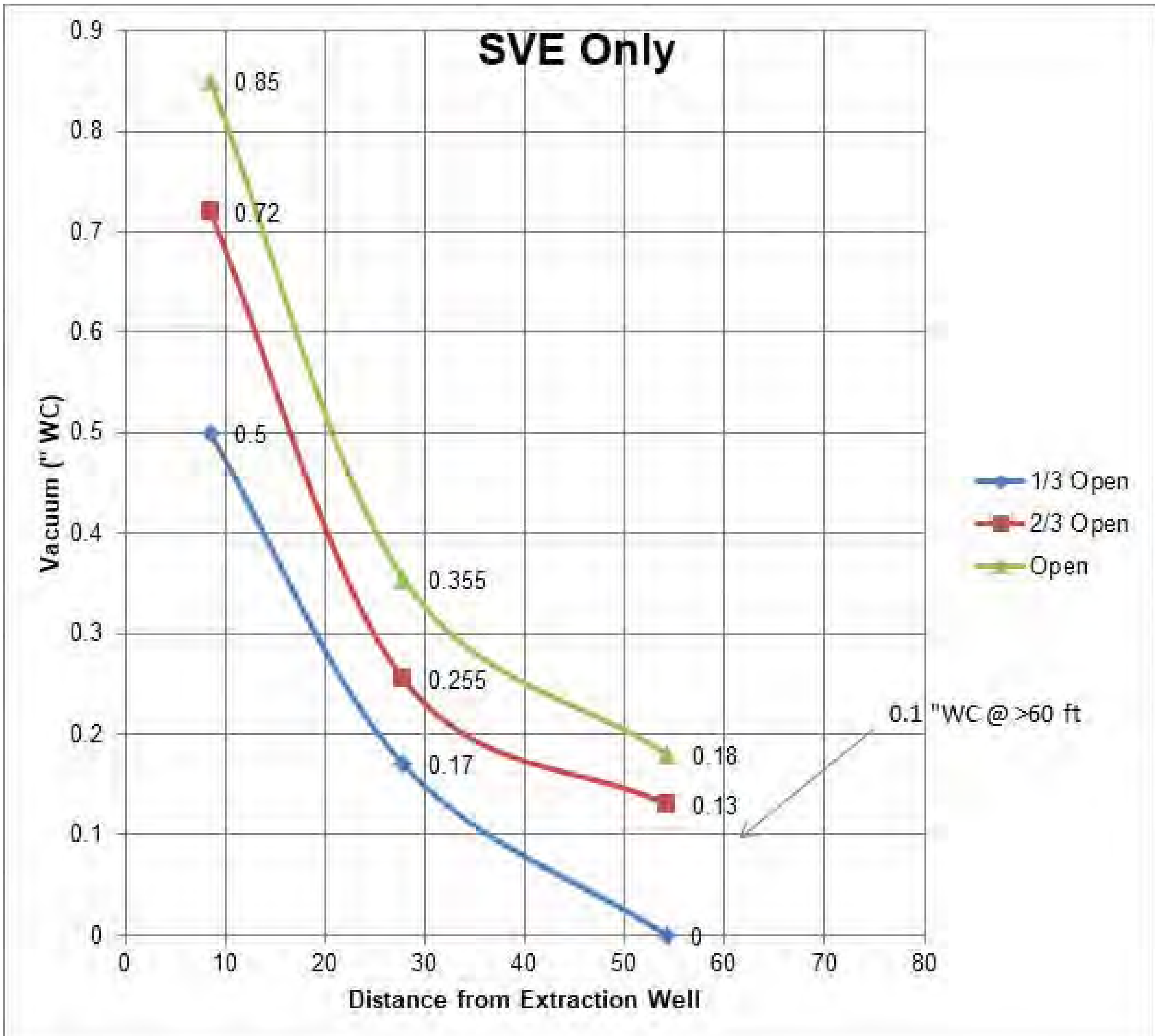
PROJECT
Tomat Service Station
1815-1825 Ocean Avenue
Brooklyn, NY 11219

DATE DEC 7, 2016

DRAWING BY: AC

TITLE Figure 4 - Pilot Test: AS Well Detail




| Test | Blower | Well Head | Vacuum Measurements (iwc) GW 1 | GW 2 | GW 8 | GW 9 | GW 7 | Velocity (ft/min) |
|---|---|---|---|---|---|---|---|---|
| 1 – 33 degrees | 22 | 4 | 0 | 0 | 0.19 | 0.5 | 0.15 | 2458 |
| 2 – 66 degrees | 15 | 7 | 0.13 | 0 | 0.34 | 0.72 | 0.17 | 3767 |
| 3 – Open | 8 | 8 | 0.18 | 0 | 0.39 | 0.85 | 0.32 | 4916 |
| Distance to Well | 0 | 0 | 54.21 | 48.67 | 28.21 | 8.5 | 27.43 | |

Notes:

1. Since all readings to reading to GW2 resulted in "0", we suspect there was a problem with this observation well, therefore this well was not considered in the analysis.
2. Readings from GW7 and GW8 were averaged for plotting, given their similar distance to the extraction well.
3. A conservative distance of 60 ft will yield a vacuum of 0.1" wc.

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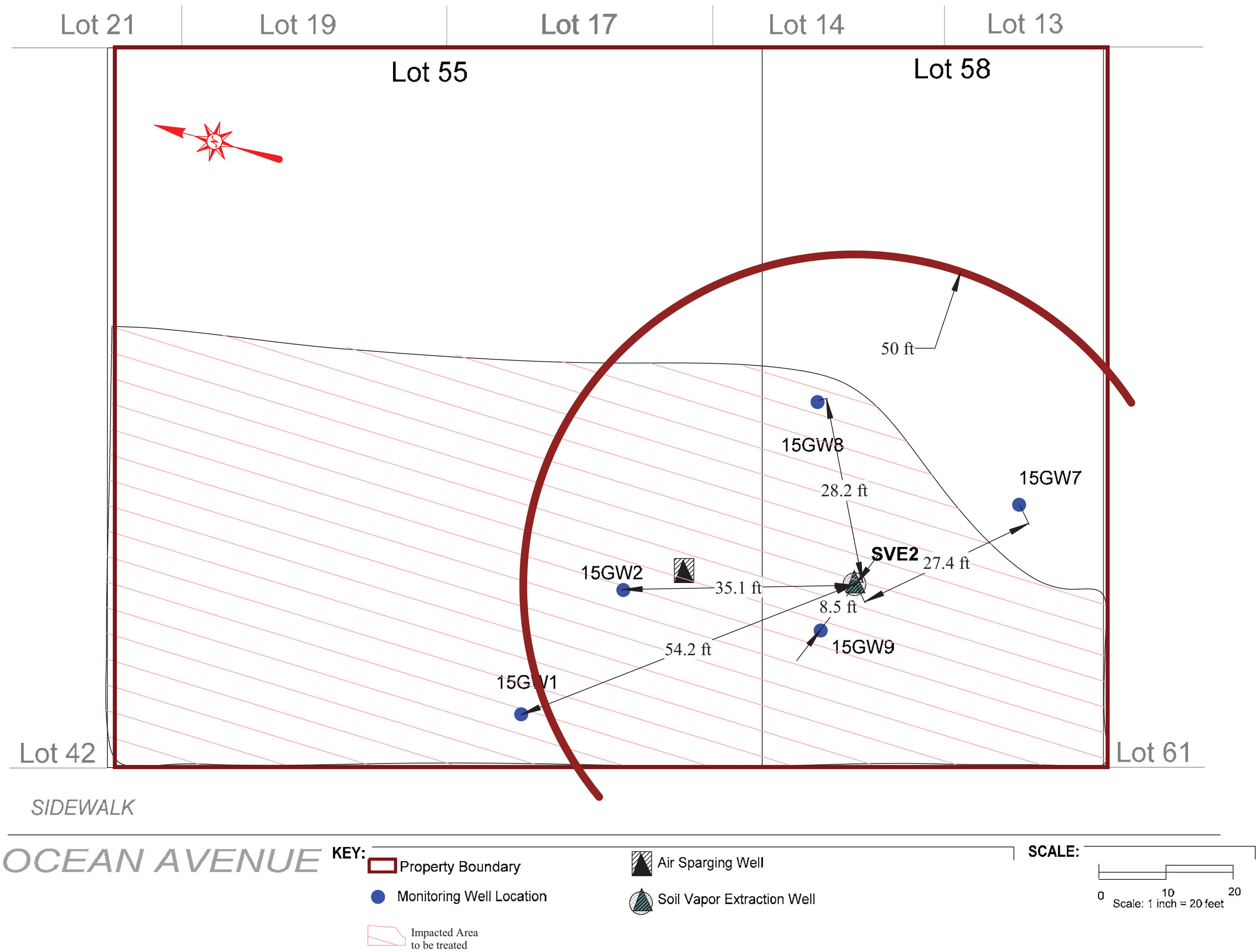
Brooklyn, NY 11219

DATE: JUL 13, 2017 | DRAWING BY: AC

TITLE: Figure 5 - SVE Test

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DATE: JUL 13, 2017

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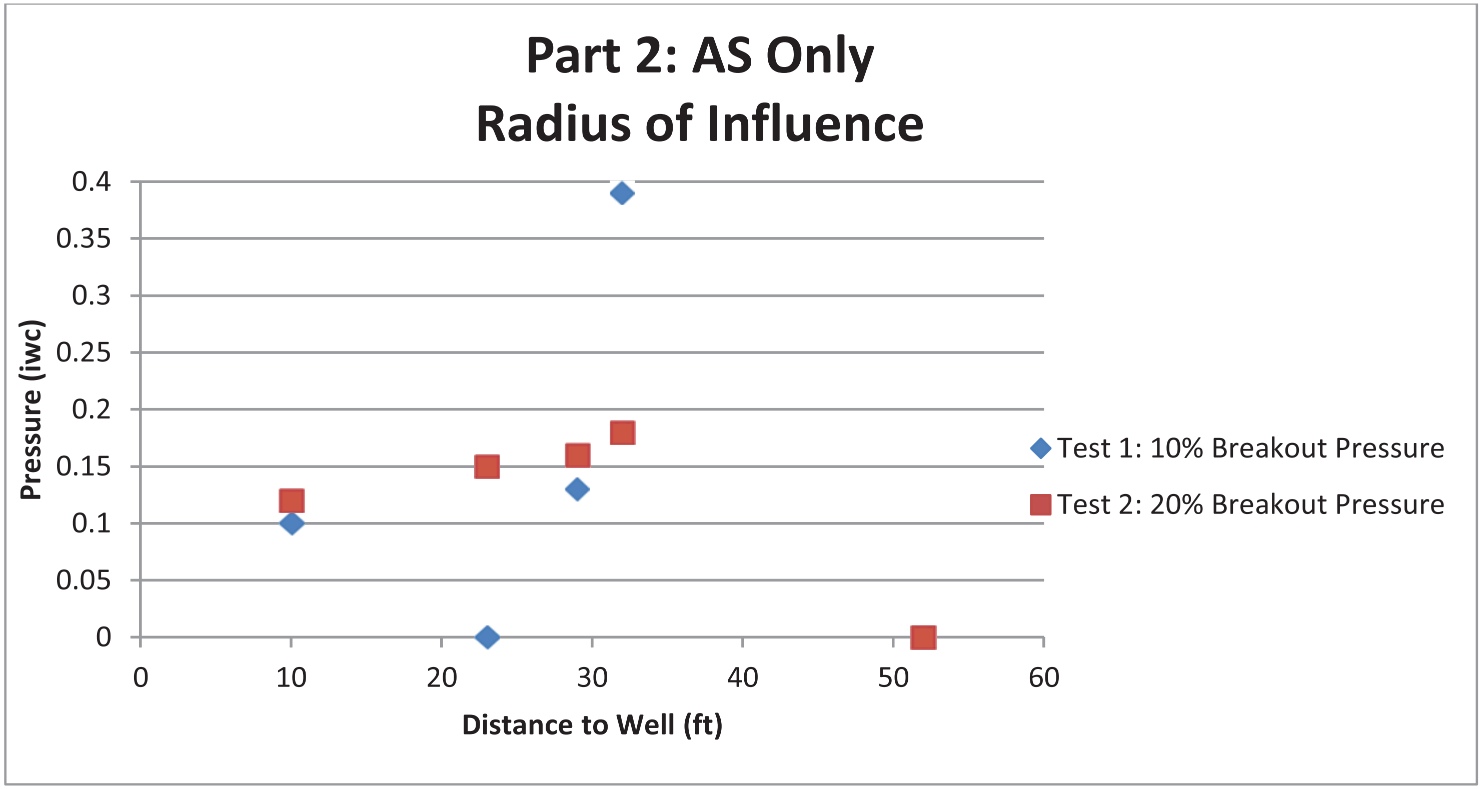
TITLE: Figure 6 - SVE Radius of Influence




| | Pressure Readings (iwc) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Test | Compressor | Well Head | GW 2 | GW 9 | GW 1 | GW 8 | GW 7 | Flow (cfm) |
| Test 1: 10% Breakout Pressure | 20 | 5.7 | 0.1 | 0 | 0.13 | 0.39 | 0 | 6.6 |
| Test 2: 20% Breakout Pressure | 30 | 6 | 0.12 | 0.15 | 0.16 | 0.18 | 0 | 10.2 |
| Distance to Well | | | 10 | 23 | 29 | 32 | 52 | |



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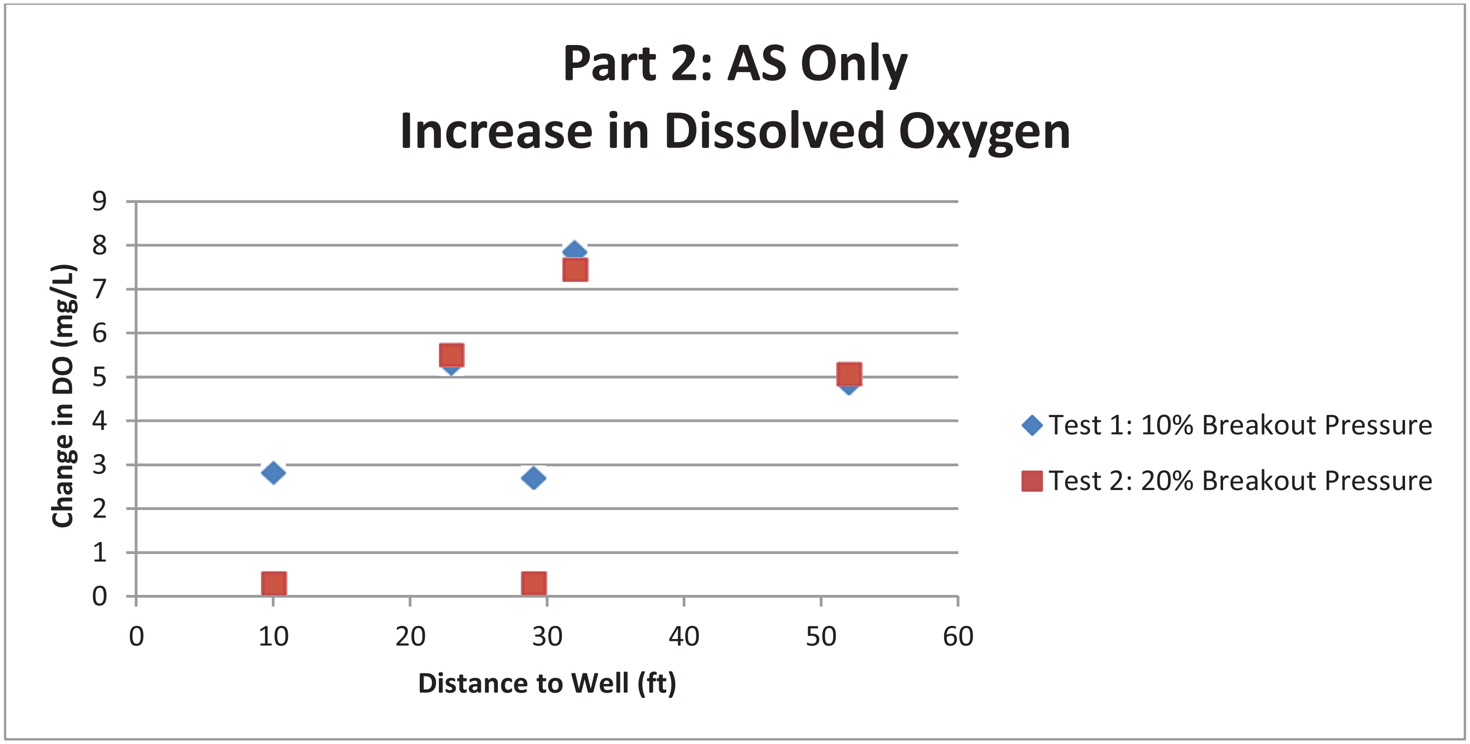
TITLE: Figure 7 - AS Test 2
Radius of Influence




| Increase in Dissolved Oxygen (mg/L) | | | | | |
|---|---|---|---|---|---|
| **Test** | **GW 2** | **GW 9** | **GW 1** | **GW 8** | **GW 7** |
| Test 1: 10% Breakout Pressure | 2.82 | 5.3 | 2.7 | 7.85 | 4.85 |
| Test 2: 20% Breakout Pressure | 0.3 | 5.5 | 0.3 | 7.45 | 5.07 |

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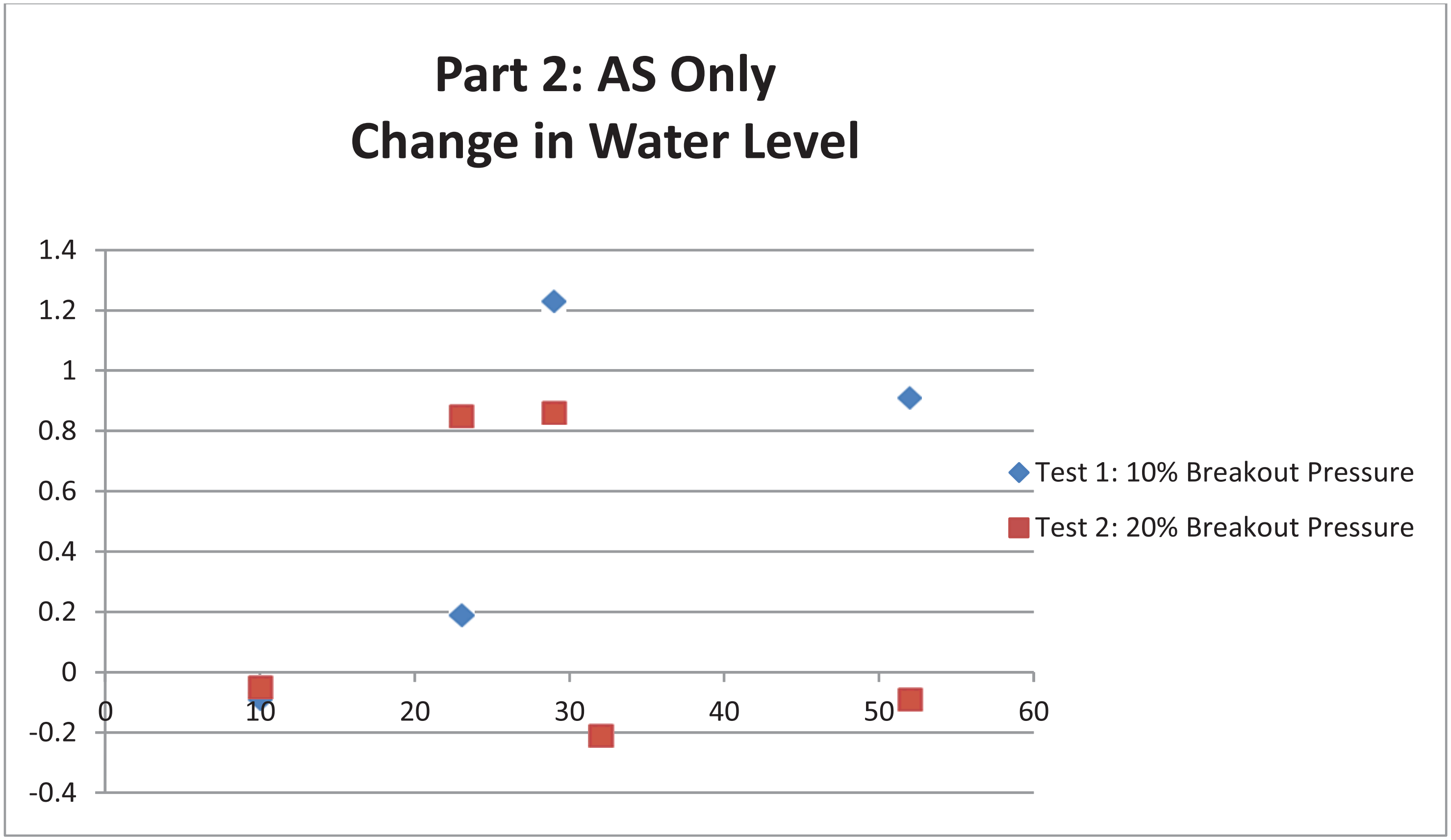
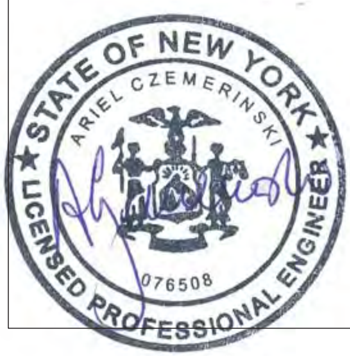
TITLE: Figure 8 - AS Test 2
Increase in Dissolved Oxygen




| Change in Water Level (ft) | | | | | |
|---|---|---|---|---|---|
| Test | GW 2 | GW 9 | GW 1 | GW 8 | GW 7 |
| Test 1: 10% Breakout Pressure | -0.09 | 0.19 | 1.23 | -0.21 | 0.91 |
| Test 2: 20% Breakout Pressure | -0.05 | 0.85 | 0.86 | -0.21 | -0.09 |

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DATE: JUL 13, 2017
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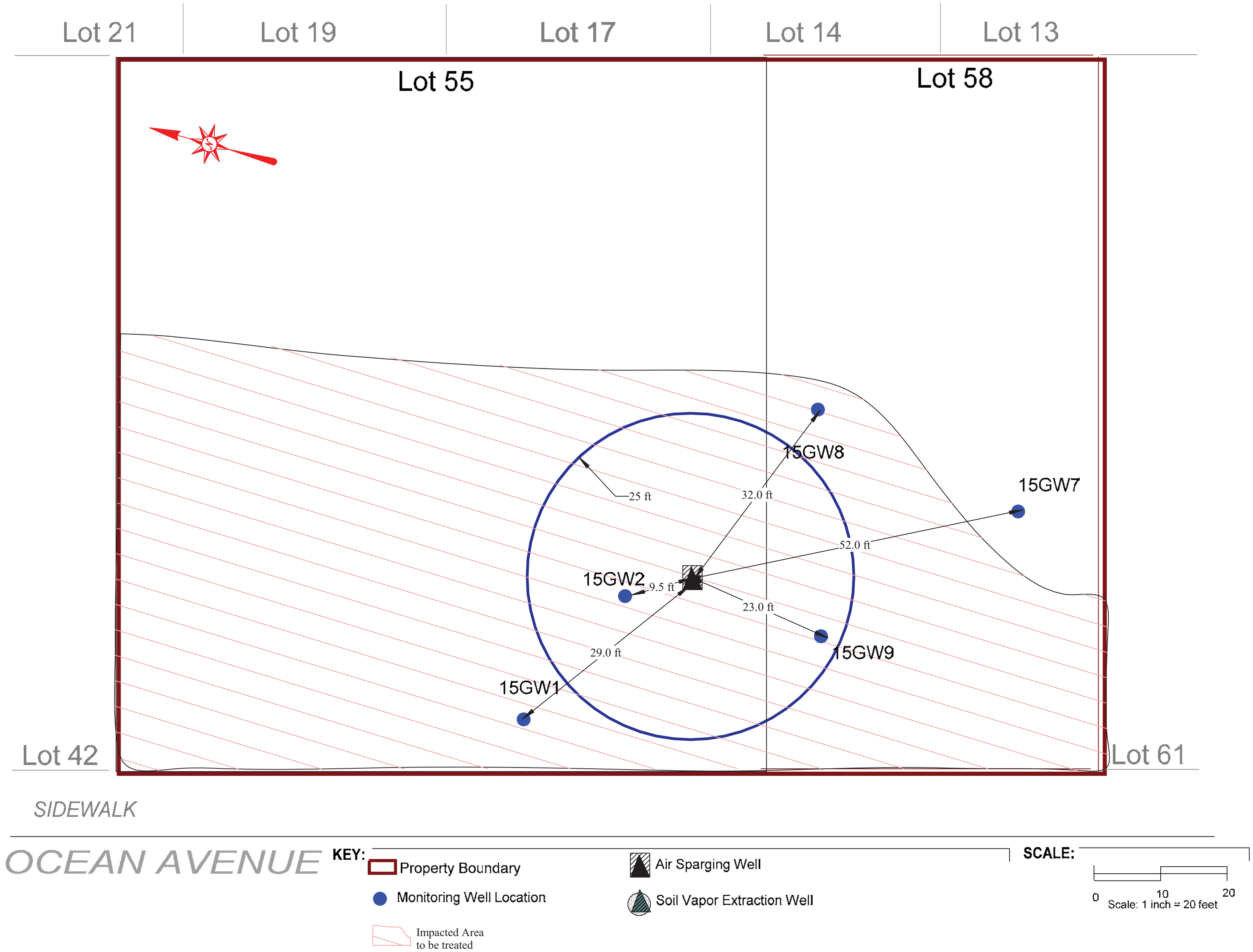
TITLE: Figure 8a - AS Test 2 Change in Water Level

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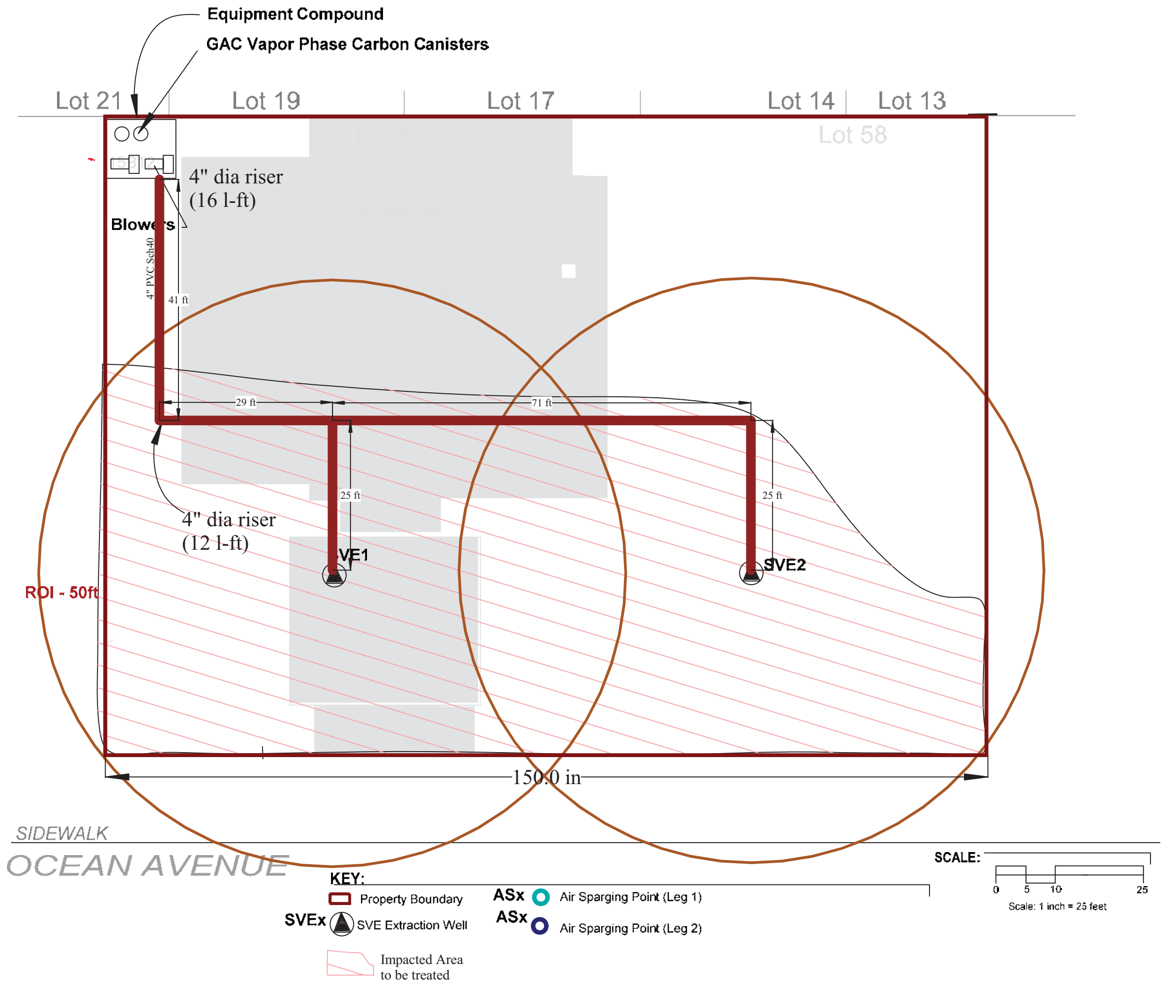
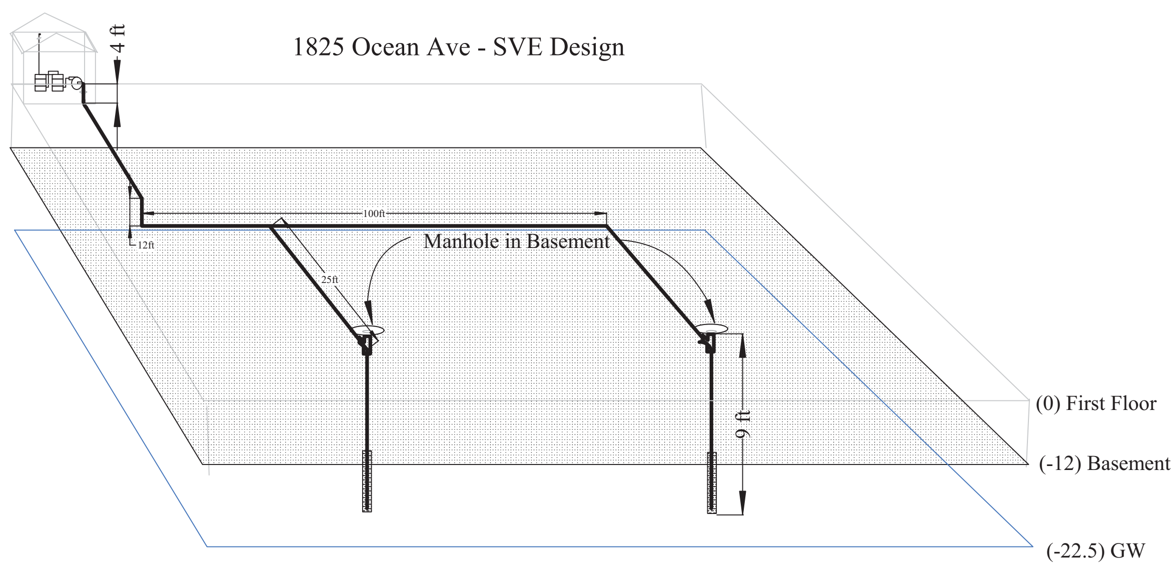
TITLE: Figure 9 - AS Radius of Influence

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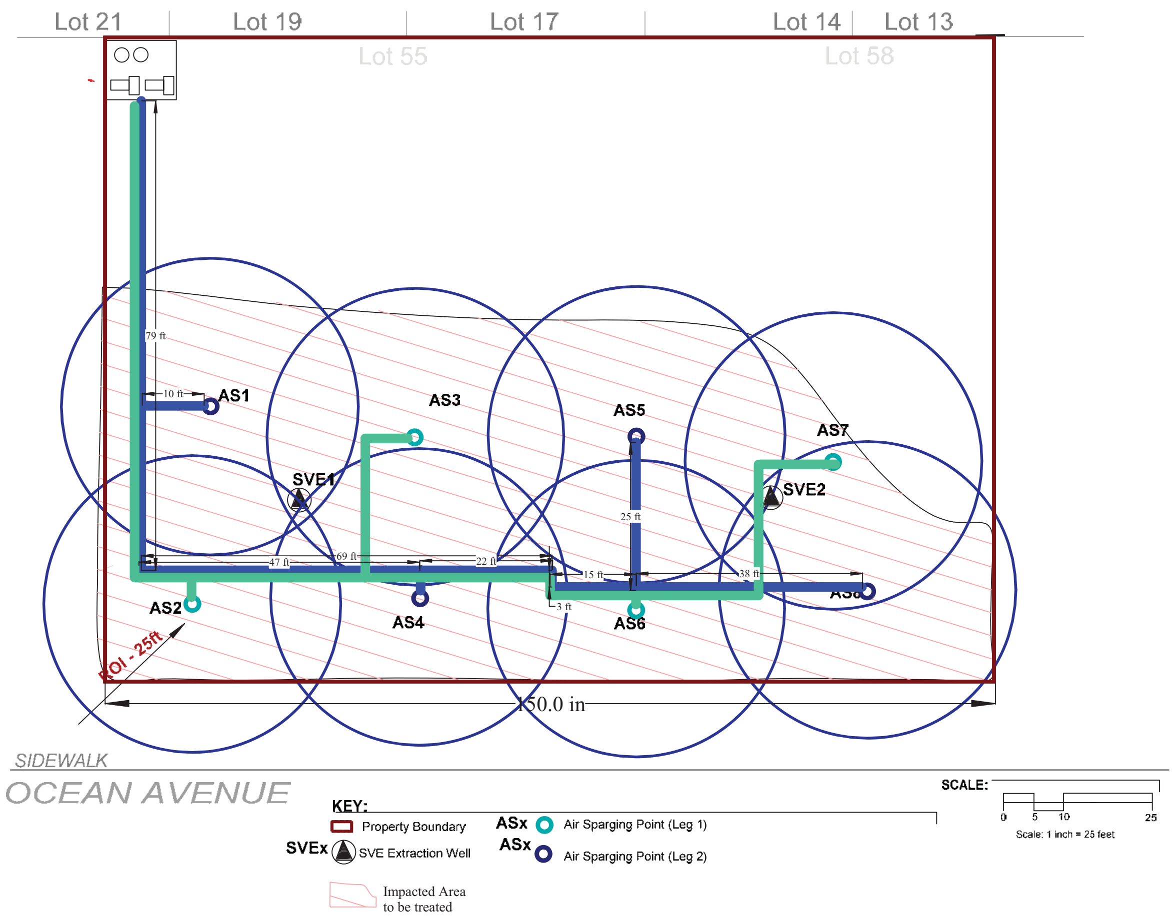
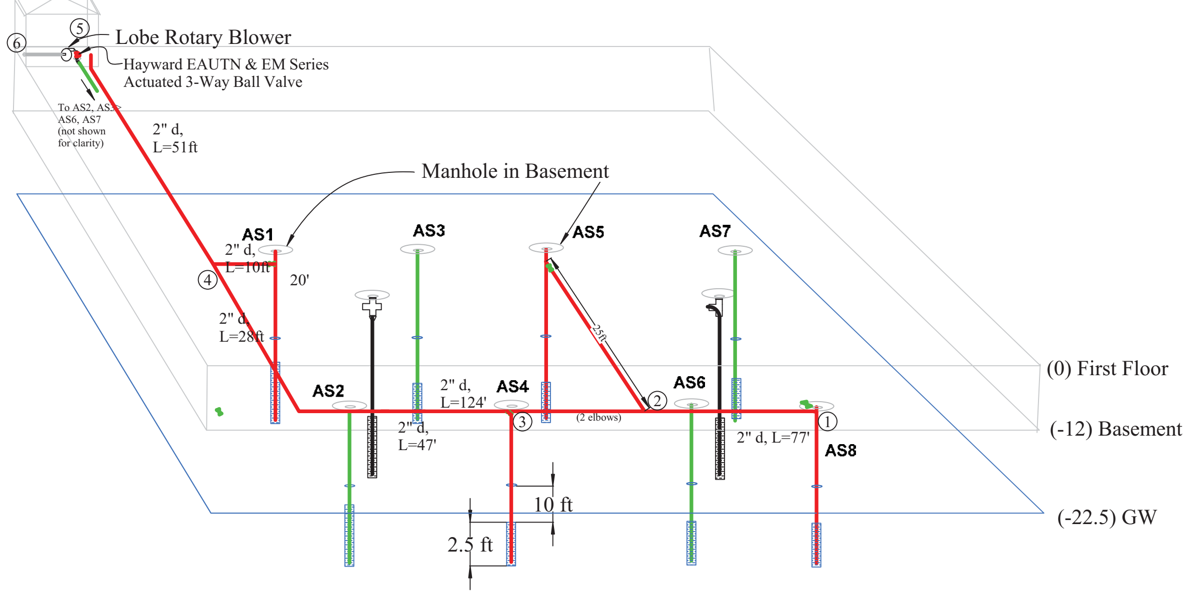
TITLE: Figure 10 - SVE piping proposed




1825 Ocean Ave - AS Design





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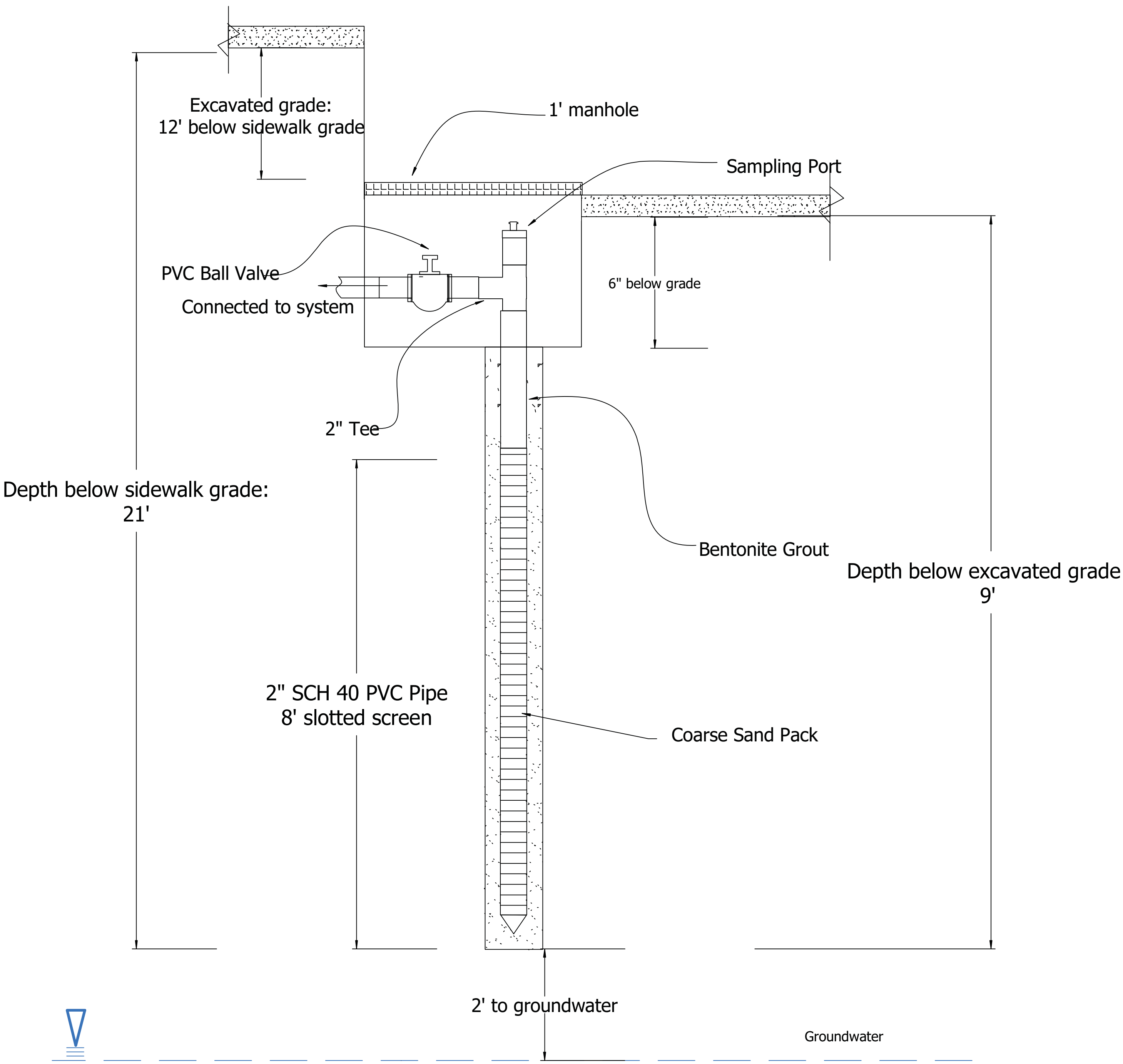
|---|---|
| DATE: JUL 13, 2017 \| DRAWING BY: AC | TITLE: Figure 11 - AS piping proposed |

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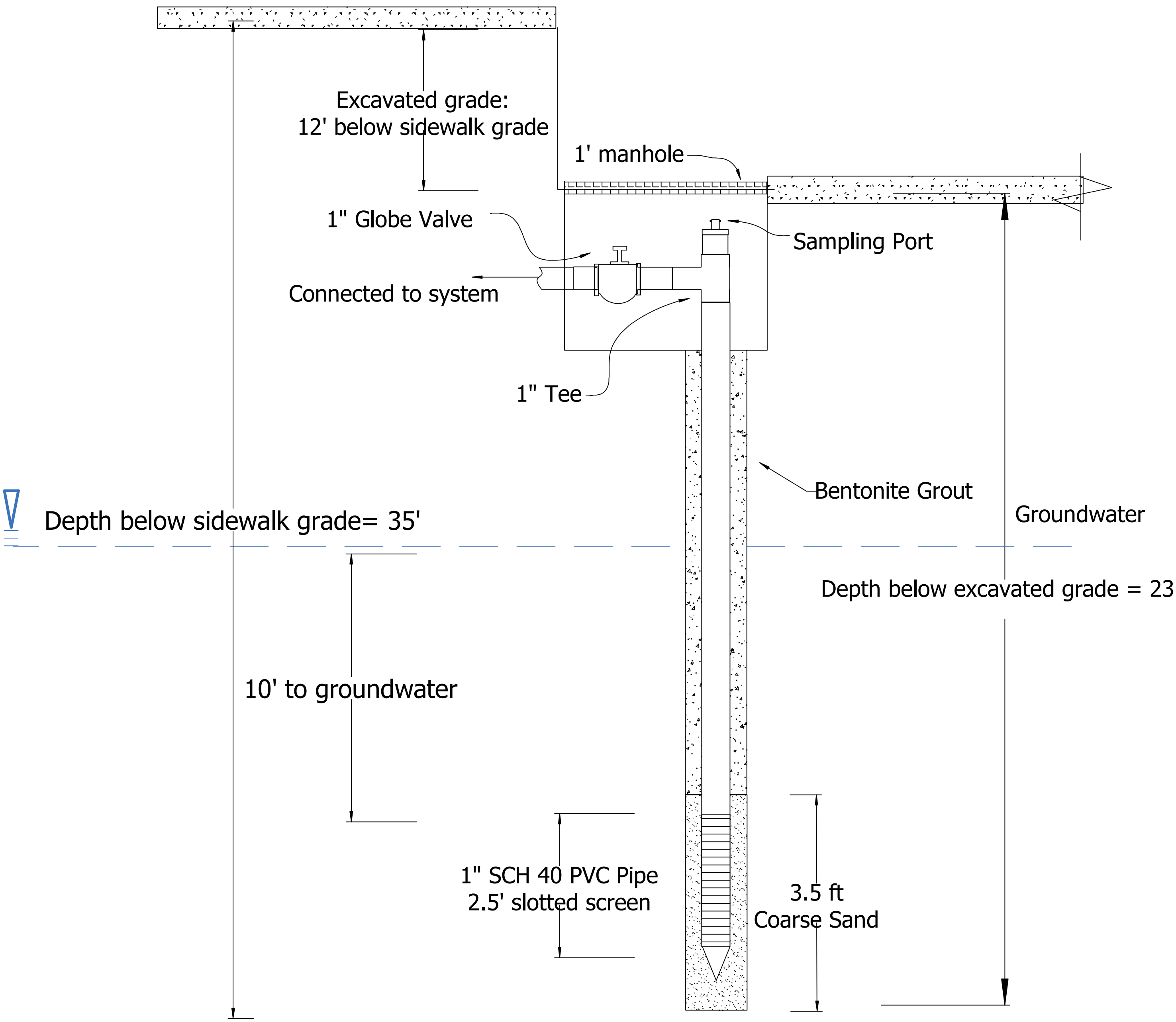
| DATE DEC 5, 2016 | DRAWING BY AC | TITLE<br>Figure 12 - Proposed SVE Well Detail |

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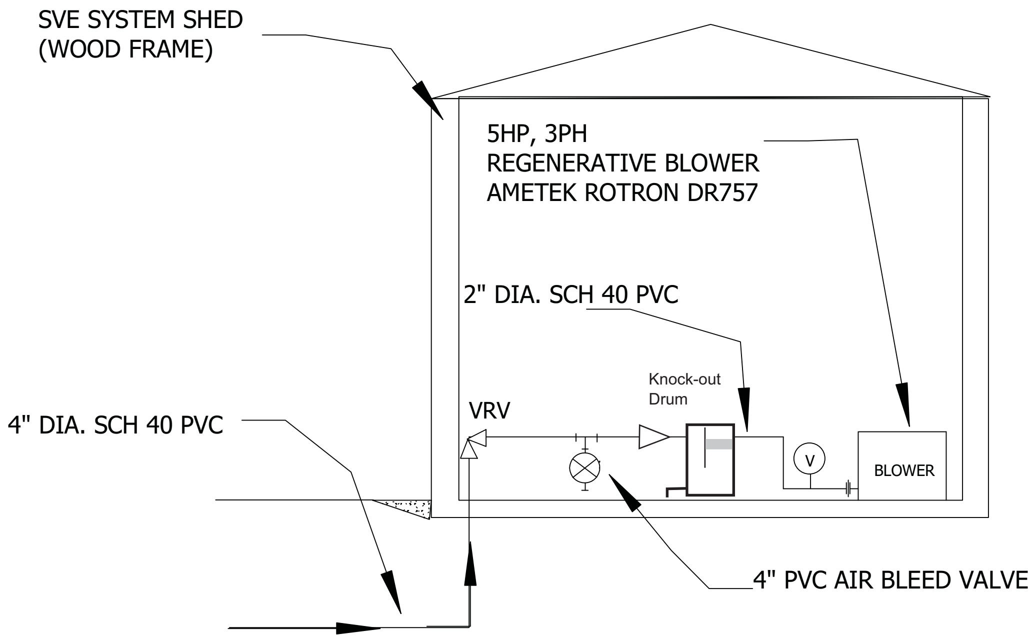
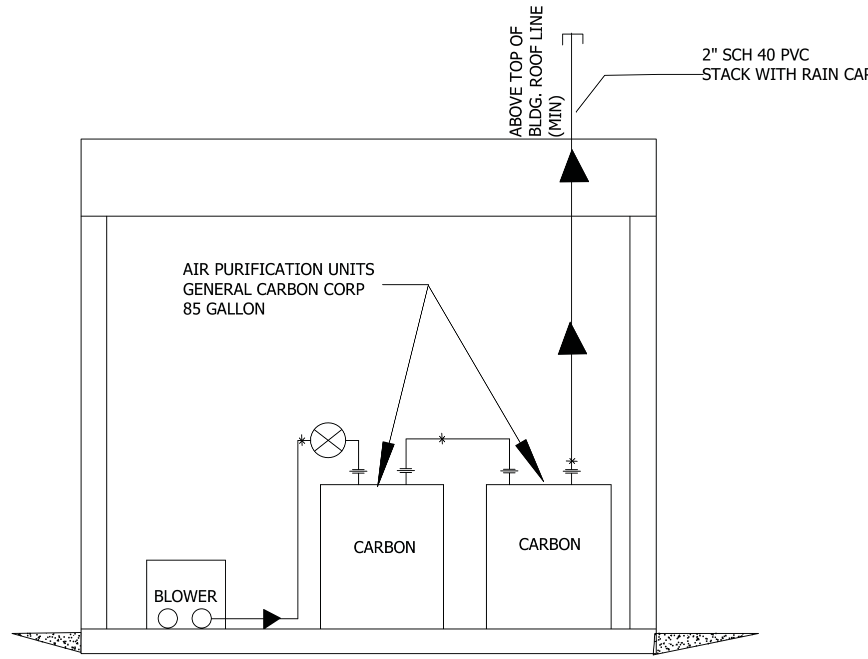
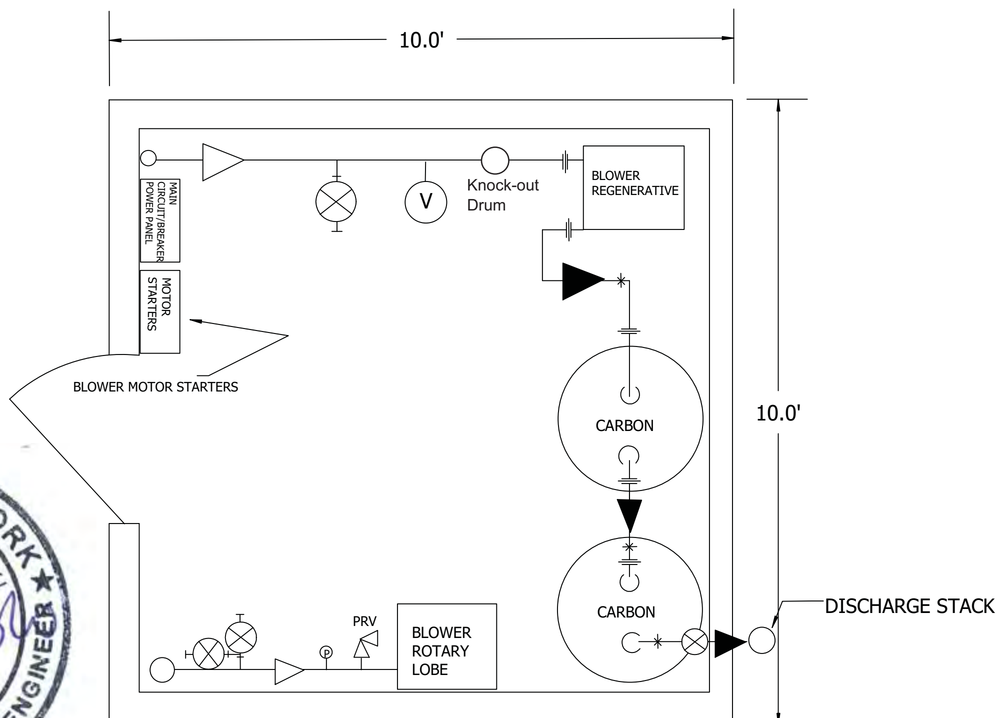
DATE DEC 5, 2016
DRAWING BY AC

TITLE
Figure 13 - Proposed AS Well Detail

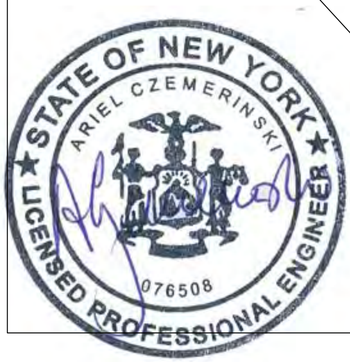



# LEGEND

- 4"x2" SCH 40 PVC REDUCER
- V — VACUUM GAUGE
- P — PRESSURE GAUGE
- VRV — VACUUM RELIEF VALVE
- PRV — PRESSURE RELIEF VALVE
- 2" DIA SCH 40 PVC BALL VALVE
- BRASS SAMPLE TAP
- UNION OR QUICK CONNECT
- FLOW DIRECTION
- 3-WAY ELECTRICALLY ACTUATED BALL VALVE

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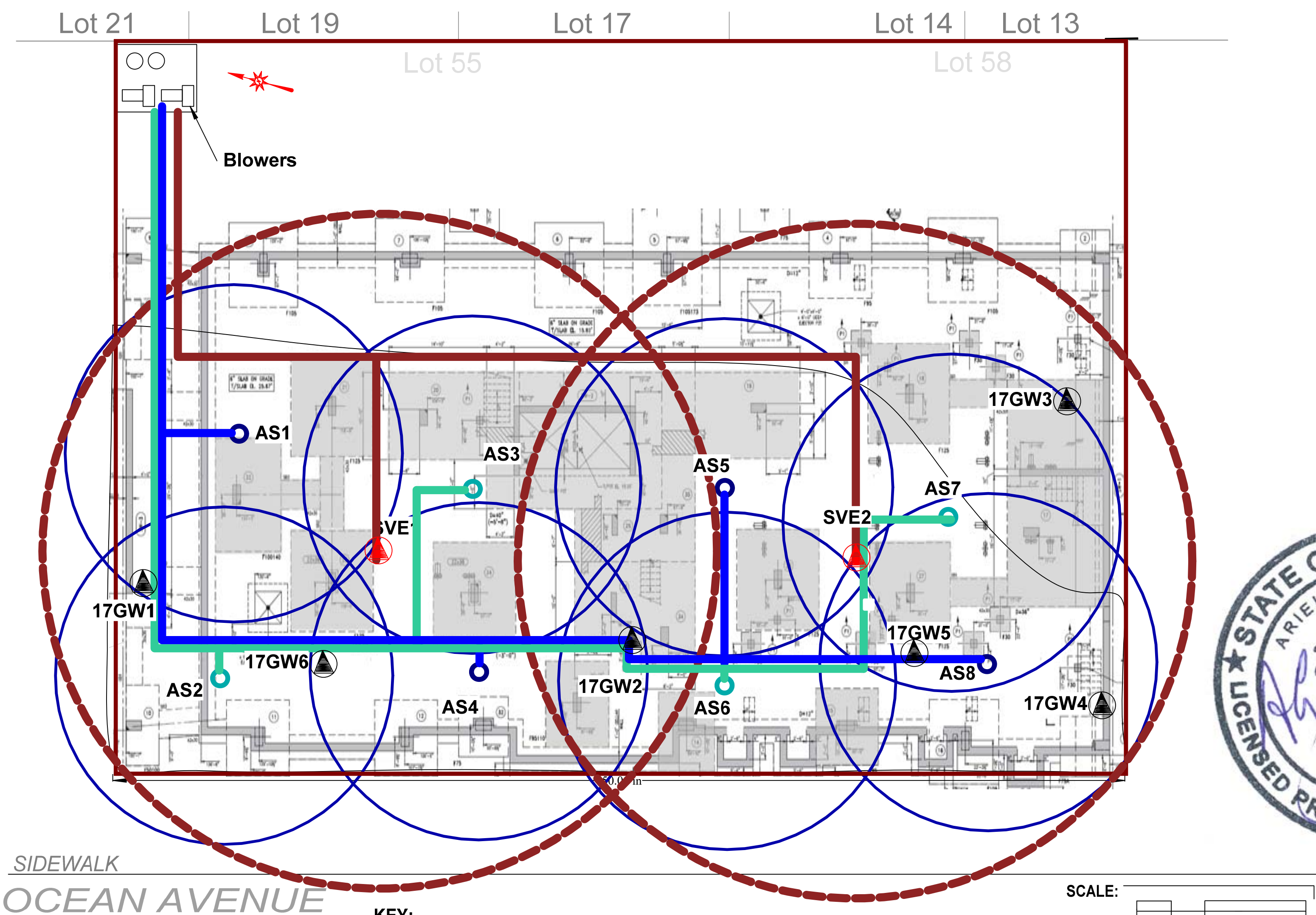
DATE: DEC 12, 2016 | DRAWING BY: AC

TITLE:
Figure 14 - Shed Detail





KEY:

- Property Boundary
- SVEx SVE Extraction Well
- ASx Air Sparging Point (Leg 1)
- ASx Air Sparging Point (Leg 2)
- 17GWx GW Monitoring Well
- New Footings
- Impacted Area to be treated

SCALE: 0 5 10 25

Scale: 1 inch = 25 feet

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1815-1825 Ocean Avenue
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DATE: AUG 1, 2017

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TITLE: Figure 15 - Proposed System Layout and Monitoring Wells

# ***APPENDIX A***

# ***Pilot Test Results***

# *SVE / AIR SPARGE TEST PROCEDURES*

**PRIOR TO STARTING**

1. Take depth to water and total depth readings at all observation wells.

2. Take DO readings at all observation wells.

3. Zero out the digital manometer. Calibrate the PID.

4. Fit observation wells with cap / hose barb fitting.

5. Measure the distance from the SVE test well to each of the observations wells and then measure the distance from the sparging test well to each of the observation wells.

6. Take vacuum / pressure readings with manometer and PID readings at all observation wells.

**SVE ONLY**

1. Connect SVE blower to SVE test well. Open bypass valve on blower.

2. Turn on generator and then blower.

3. Fully close bypass valve on blower and note maximum vacuum at SVE well vacuum gauge. Reduce vacuum by adjusting bypass valve until vacuum at wellhead is $1/3^{rd}$ of maximum.

4. Record vacuum readings in the observation wells with a manometer. Record the vacuum at the blower and at the wellhead with the vacuum gauges. Do not use manometer for vacuum readings at blower as it will damage the unit.

5. Run the test at this vacuum for 15 minutes or until vacuum at the observation wells stabilize. Record air flow at discharge point and take pid readings in the influent air stream (before carbon).

6. Increase the vacuum at the well head to 2/3rds maximum and repeat steps 4 and 5.

7. Increase the vacuum at the well head to  maximum and repeat steps 4 and 5.

**AIR APARGING ONLY**

1. Determine displacement pressure & operating pressure according to following example:

   Displacement pres. (psi) = ((T.D. - DTW) - 2.4) x 0.43302

   Operating pres. (psi) = Disp. pres. x 1.10 (for 10% over), 1.2 for 20%, etc.

2. Turn on air compressor and adjust the pressure at to the calculated operating pressure for 10% over the displacement pressure by adjusting the flow meter until the desired pressure is reached at the wellhead. Record well head pressure and cfm at the flow meter.

3. Record pressure readings at the observation wells. Wait for readings to stabilize before proceeding.

4. Take PID readings at the observation wells.

5. Remove caps at the observation wells and record DTW and DO. Replace well caps.

6. Increase pressure at the wellhead to 20% over displacement pressure and repeat steps 3-5

## 1815 – 1825 Ocean Avenue – SVE/AS Pilot Test Results

Test Witnesses: Elbio, Chawinie, Aine

Time: Start – 8:30am; End – 2:30pm

Temperature: AM – 75; PM – 85

Conditions: Sunny

**Pre-Test:**

Distance (ft)

| Location | MW 1 | MW 2 | MW 8 | MW 9 | MW 7 |
|---|---|---|---|---|---|
| SVE Well | 54.2 | 35.1 | 22.2 | 8.5 | 27.4 |
| AS Well | 29 | 9.5 | 32 | 23 | 52 |

### Dissolved Oxygen (mg/L)

| MW 1 | MW 2 | MW 8 | MW 9 | MW 7 |
|---|---|---|---|---|
| 5.6 | 5.8 | 1.05 | 3.2 | 4.08 |

### Depth to Water (ft)

| MW 1 | MW 2 | MW 8 | MW 9 | MW 7 |
|---|---|---|---|---|
| 22.37 | 23.74 | 23.46 | 22.15 | 22.94 |

### Total Depth (ft)

| MW 1 | MW 2 | MW 8 | MW 9 | MW 7 |
|---|---|---|---|---|
| 29.4 | 29.5 | 29.32 | 29 | 28.8 |

### Pressure Reading (iwc)

| MW 1 | MW 2 | MW 8 | MW 9 | MW 7 |
|---|---|---|---|---|
| 0.01 | 0 | 0 | 0 | 0 |

### PID (ppm)

| MW 1 | MW 2 | MW 8 | MW 9 | MW 7 |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |

**Notes:**

After completing this test, the sensitivity of the PID came into question, however, a new PID produced similar results in the following test.

The DO meter was difficult to operate in these conditions. The results fluctuated greatly and would not stabilize. There appears to be a gradient of dissolved oxygen values based on the meter's location within the water table.

## Part 1 – SVE Only:

| | | | Vacuum Measurements (iwc) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test | Blower | Well Head | MW 1 | MW 2 | MW 8 | MW 9 | MW 7 | Velocity (ft/min) | Pre-Carbon PID (ppm) | Post-Carbon PID (ppm) |
| 1 – 33 degrees | 22 | 4 | 0 | 0 | 0.19 | 0.5 | 0.15 | 2458 | 0 | 0 |
| 2 – 66 degrees | 15 | 7 | 0.13 | 0 | 0.39 | 0.72 | 0.17 | 3767 | 0 | 0 |
| 3 – Open | 8 | 8 | 0.18 | 0 | 0.34 | 0.85 | 0.32 | 4916 | 0 | 0 |

**Notes:**
When the valve is fully closed, the wellhead has a pressure of 1 i.w.c and the blower reaches 45 i.w.c. Original PID appears to be possibly malfunctioning. A new PID was retrieved and also produced measurements of 0.0 ppm so we cannot confirm that the PID is malfunctioning.

Over 20 minutes passed before results were taken for the first test.
15 minutes passed between sampling for T1 and T2.
17 minutes passed between T2 and T3.

**Part 2 – AS Only**
Depth to Water: 23.6'
Break-Out Pressure = (Total Depth – Water Depth – Screen)*0.43302 = 5.152938 psi
10% Operating Pressure = Break-Out Pressure * 1.10 = 5.6682318 psi
20% Operating Pressure = Break-Out Pressure * 1.20 = 6.1835256 psi

| | Pressure Readings (iwc) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Test | Compressor | Well Head | GW 1 | GW 2 | GW 8 | GW 9 | GW 7 | Flow (cfm) |
| 10% Operating Pressure | 20 | 5.7 | 0.13 | 0.1 | 0.39 | 0 | 0 | 6.6 |
| 20% Operating Pressure | 30 | 6 | 0.16 | 0.12 | 0.18 | 0.15 | 0 | 10.2 |

**Dissolved Oxygen (mg/L)**

| Test | GW 1 | GW 2 | GW 8 | GW 9 | GW 7 |
|---|---|---|---|---|---|
| 10% Operating Pressure | 8.3 | 8.62 | 8.9 | 8.5 | 8.93 |
| 20% Operating Pressure | 5.9 | 6.1 | 8.5 | 8.7 | 9.15 |

## Depth to Water (ft)

| Test | GW 1 | GW 2 | GW 8 | GW 9 | GW 7 |
|---|---|---|---|---|---|
| 10% Operating Pressure | 23.6 | 23.65 | 23.25 | 22.34 | 23.85 |
| 20% Operating Pressure | 23.23 | 23.69 | 23.25 | 23 | 22.85 |

| | VOC (ppm) | | | | |
|---|---|---|---|---|---|
| Test | GW 1 | GW 2 | GW 8 | GW 9 | GW 7 |
| 10% Operating Pressure | 3.5 | 3.7 | 7.3 | 0 | 0 |
| 20% Operating Pressure | 11.3 | 5.6 | 22.3 | 0.1 | 0 |

* Values as high as 14 were noted

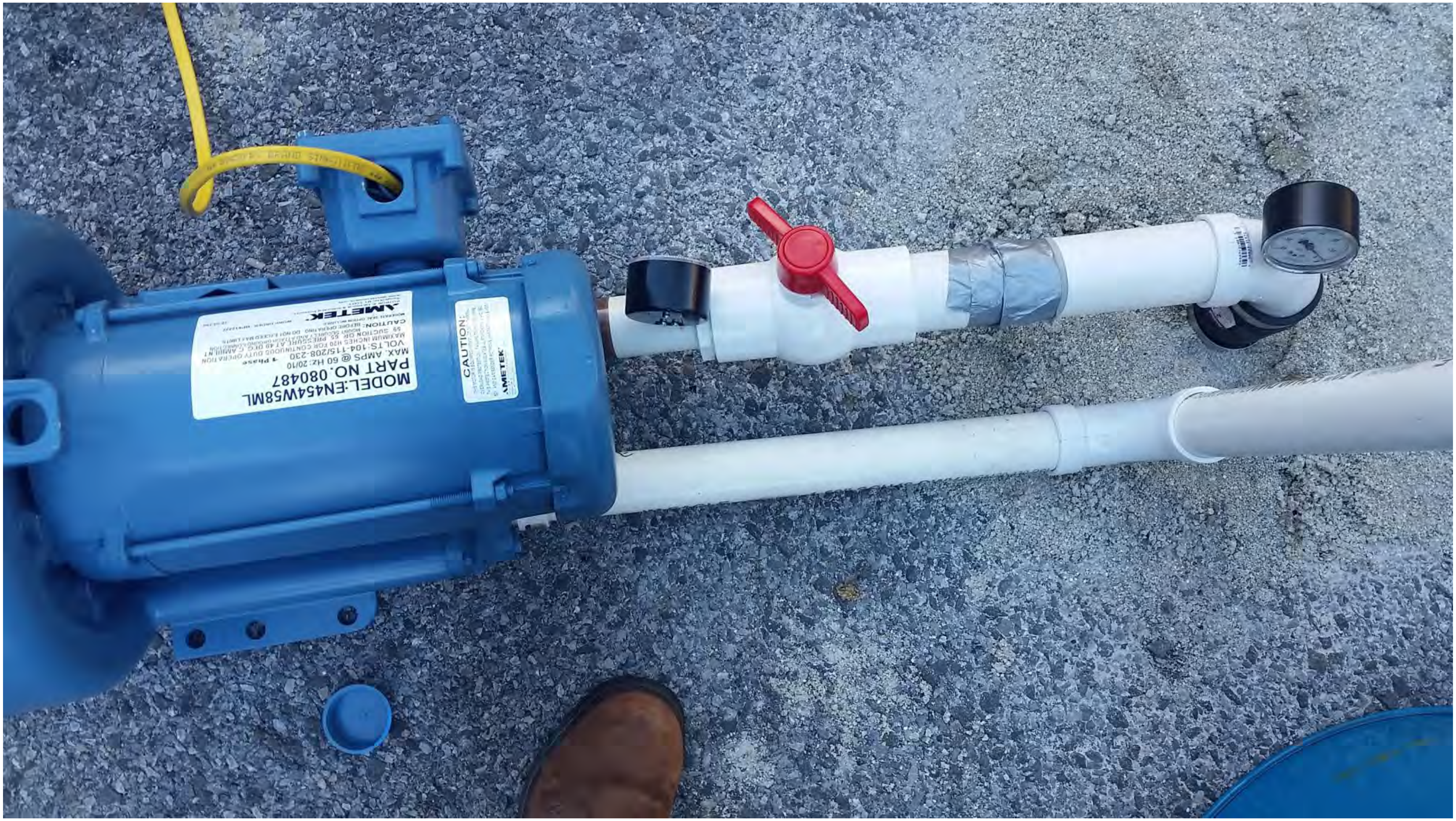
**Notes:**

Each measurement was taken after allowing the system to stabilize and operate for at least 15 minutes. The PID had large fluctuations, the above results indicate the highest value measured during a 3-miute period.

## Photos


E GENERAL
AIR POLLUTION
CONTROL BARREL
OUTLET
RYOBI


JM EAGLE
1.50" SCH40 DWV PVC1120 330 PSI
CARBON CORPORATION


AMETEK
MODEL:EN454W58ML
PART NO. 080487
CAUTION: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ON
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MODE
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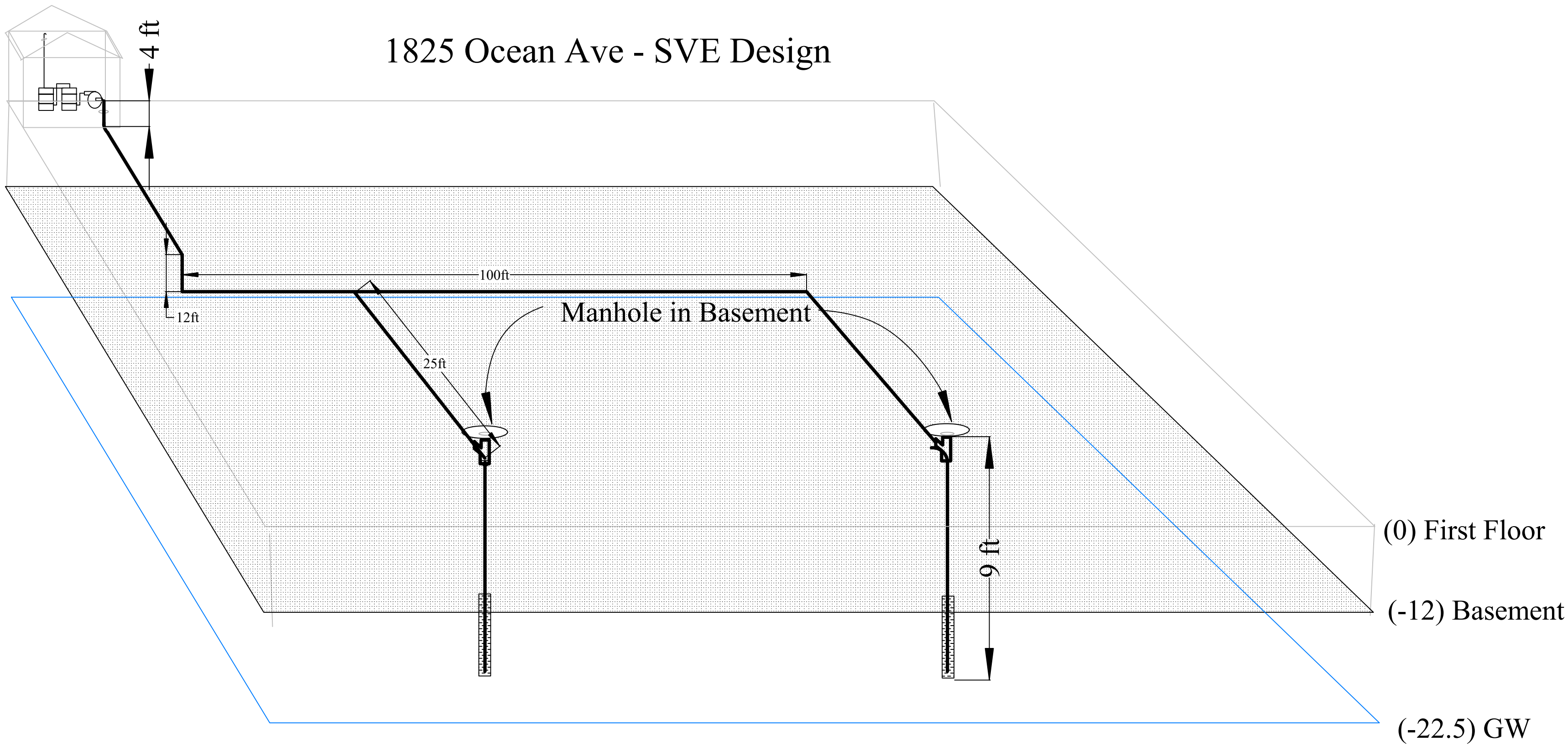
# *APPENDIX B*

# *Friction Loss Calculations*

# 1825 Ocean Ave - SVE Design



Vertical head loss calculations using darcy-weisbach equation for air losses

SVE2

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Flow Rate | 110 | scfm | Material | k | e(ft) | | |
| k | 0.000005 | | HDPE /PVC | 5E-06 | 0.000005 | | |
| Diameter | 4 | in | | | | | |
| Length | 126 | ft | Re | rho v D/mu gc | | f | colbrook |
| Wellhead pressure | 8 | in wc | | 45348.6 | | | 0.0214 |
| Temp | 60 | F | f | (-2*LOG10(e/D/3.72+2.51/Re/ff^(0.5)))^(-2) | | | |
| | | | | | | | |
| Diameter | 0.333 | ft | Ts | 72 | F | | |
| Area | 0.087 | ft2 | Ps | 1 | atm | | |
| Flow Rate | 110 | acfm | gc | 32.174 | lbm-ft/lbf-s2 | | |
| Pressure | 0.980 | atm | | | | | |
| Temp | 520 | R | | | | | |
| Velocity | 20.95 | ft/s | | | | | |
| Density | 0.0769 | lb/ft3 | | | | | |
| Viscosity | 3.68E-07 | lb sec/ft2 | | | | | |

| Pipe Losses | Number | K(4"dia) | Leq |
|---|---|---|---|
| straight pipe | 96 | 1 | 96 |
| Exit | 0 | | 0 |
| 90 Elbow | 1 | 13 | 13 |
| 45 Elbow | 0 | 5.5 | 0 |
| 50 Red | 0 | | 0 |
| 50 Exp | 0 | 32 | 0 |
| Tee, Straight Out | 1 | 17 | 17 |
| Tee, Side out | 0 | 21 | 0 |
| Check Valve | 0 | 38 | 0 |
| Gate Vale, Open | 0 | 2.5 | 0 |
| Ball Valve, Open | 0 | 110 | 0 |
| Butterfly Valve, Open | 0 | | 0 |
| Diaphragm Valve, Open | 0 | | 0 |
| | | | 126 |

Darcy Weisbach Equation for Gases

| | | |
|---|---|---|
| Dp | ff*L/D*rho*v^2/2/gc/144 | |
| | 0.0295 | psi |
| | 0.82 | " WC. |
| Vac at SVE1 node | 8.82 | |

Vertical head loss calculations using darcy-weisbach equation for air losses
SVE1+SVE2

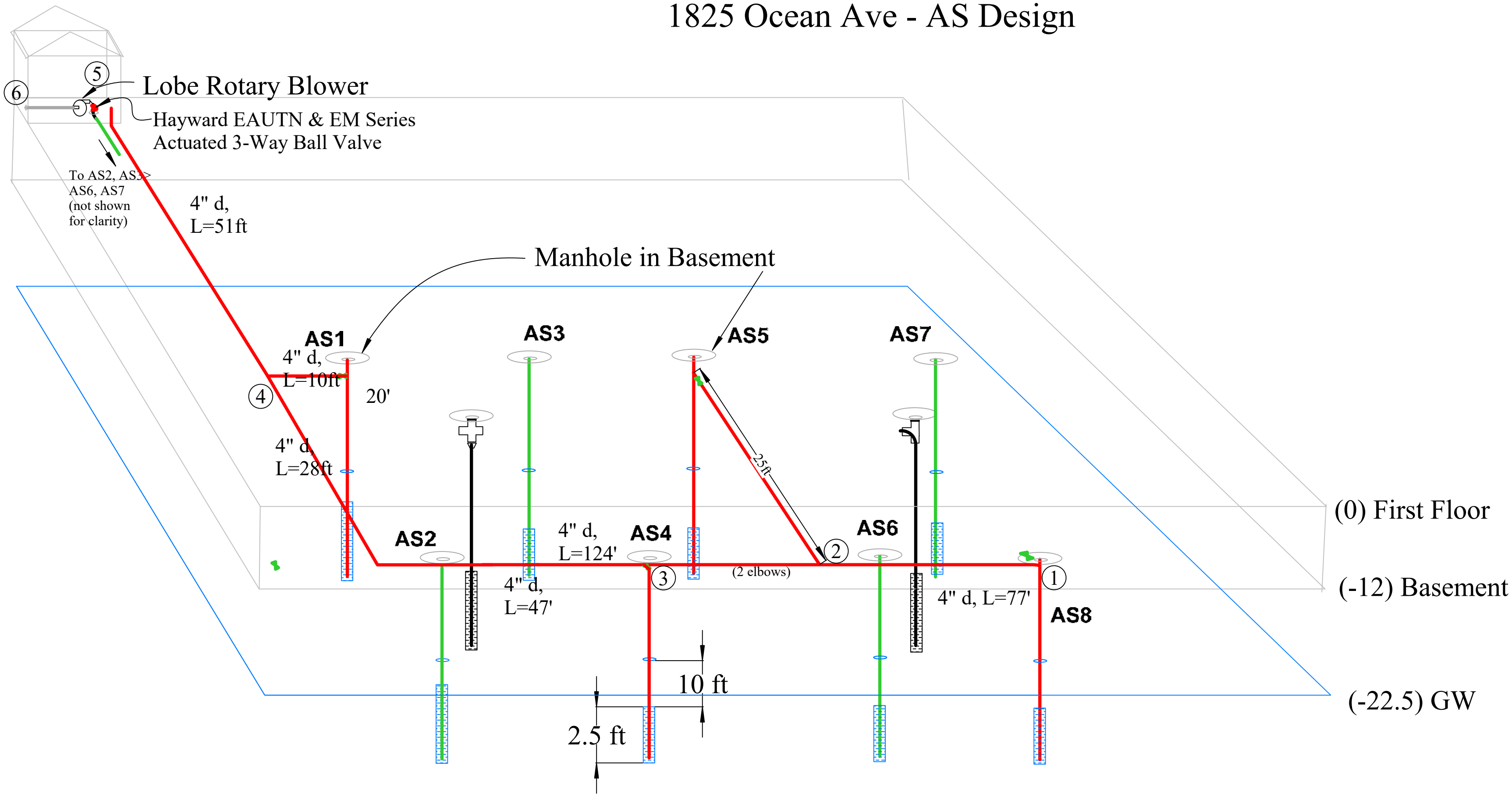
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Flow Rate | 220 | scfm | Material | k | e(ft) | | |
| k | 0.000005 | | HDPE /PVC | 5E-06 | 0.000005 | | |
| Diameter | 4 | in | | | | | |
| Length | 107 | ft | Re | rho v D/mu gc | | f | colbrook |
| Previous node | 8.82 | in wc | | 90883.3 | | | 0.01843 |
| Temp | 60 | F | f | (-2*LOG10(e/D/3.72+2.51/Re/ff^(0.5)))^(-2) | | | |
| | | | | | | | |
| Diameter | 0.333 | ft | Ts | 72 | F | | |
| Area | 0.087 | ft2 | Ps | 1 | atm | | |
| Flow Rate | 220 | acfm | gc | 32.174 | lbm-ft/lbf-s2 | | |
| Pressure | 0.978 | atm | | | | | |
| Temp | 520 | R | | | | | |
| Velocity | 41.979 | ft/s | | | | | |
| Density | 0.0769 | lb/ft3 | | | | | |
| Viscosity | 3.68E-07 | lb sec/ft2 | | | | | |

| Pipe Losses | Number | K(4"dia) | Leq |
|---|---|---|---|
| straight pipe | 86 | 1 | 86 |
| Exit | 0 | | 0 |
| 90 Elbow | 4 | 13 | 52 |
| 45 Elbow | 0 | 5.5 | 0 |
| 50 Red | 0 | | 0 |
| 50 Exp | 0 | 32 | 0 |
| Tee, Straight Out | 1 | 17 | 17 |
| Tee, Side out | 0 | 21 | 0 |
| Check Valve | 0 | 38 | 0 |
| Gate Vale, Open | 0 | 2.5 | 0 |
| Ball Valve, Open | 0 | 110 | 0 |
| Butterfly Valve, Open | 0 | | 0 |
| Diaphragm Valve, Open | 0 | | 0 |
| | | | 155 |

Darcy Weisbach Equation for Gases

| | | |
|---|---|---|
| Dp | ff*L/D*rho*v^2/2/gc/144 | |
| | 0.0865 | psi |
| | 2.40 | " WC. |
| Vac at Blower Discharge | 11.21 | " WC. |
| pressure drop carbon | 50.0 | "WC |

# 1825 Ocean Ave - AS Design



Vertical head loss calculations using darcy-weisbach equation for air losses

Node 1-2 (AS8)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Flow Rate | 7 | scfm | Material | k | e(ft) | | |
| k | 0.000005 | | HDPE /PVC | 5E-06 | 0.000005 | | |
| Diameter | 1 | in | | | | | |
| Length | 100.5 | ft | Re | rho v D/mu gc | | f | colbrook |
| Wellhead pressure | 6.5 | psi | | 25339.1 | | | 0.02459 |
| Temp | 55 | F | f | (-2*LOG10(e/D/3.72+2.51/Re/ff^(0.5)))^(-2) | | | |
| Diameter | 0.083 | ft | Ts | 72 | F | | |
| Area | 0.005 | ft2 | Ps | 1 | atm | | |
| Flow Rate | 15 | acfm | gc | 32.174 | lbm-ft/lbf-s2 | | |
| Pressure | 0.442 | atm | | | | | |
| Temp | 515 | R | | | | | |
| Velocity | 46.817 | ft/s | | | | | |
| Density | 0.0769 | lb/ft3 | | | | | |
| Viscosity | 3.68E-07 | lb sec/ft2 | | | | | |

| Pipe Losses | Number | K(2") | Leq | K(1") | K(2") | K(4"dia) |
|---|---|---|---|---|---|---|
| straight pipe | 38 | | 38 | | | 1 |
| Exit | 0 | | 0 | | | |
| 90 Elbow | 1 | 8.5 | 8.5 | 5.2 | 8.5 | 13 |
| 45 Elbow | 0 | | 0 | | | 5.5 |
| 50 Red | 0 | | 0 | | | |
| 50 Exp | 0 | | 0 | 420 | | 32 |
| Tee, Straight Out | 0 | 7.7 | 0 | 3.2 | 7.7 | 17 |
| Tee, Side out | 0 | 12 | 0 | 6.6 | 12 | 21 |
| Check Valve | 0 | 19 | 0 | 11 | 19 | 38 |
| Gate Vale, Open | 0 | 1.5 | 0 | 0.8 | 1.5 | 2.5 |
| Ball Valve, Open | 1 | 54 | 54 | 17 | 54 | 110 |
| | 0 | | 0 | | | |
| | | | 100.5 | | | |

Darcy Weisbach Equation for Gases

| | | |
|---|---|---|
| Dp | ff*L/D*rho*v^2/2/gc/144 | |
| | 0.5394 | psi |
| Pnode | 7.0 | |

Vertical head loss calculations using darcy-weisbach equation for air losses

Node 2-3: AS8+AS5

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Flow Rate | 14 | scfm | Material | k | e(ft) | | |
| k | 0.000005 | | HDPE /PVC | 5E-06 | 0.000005 | | |
| Diameter | 2 | in | | | | | |
| Length | 128.7 | ft | Re | rho v D/mu gc | | f | colbrook |
| Prior Node | 7.0 | psi | | 23397.4 | | | 0.02498 |
| Temp | 55 | F | f | (-2*LOG10(e/D/3.72+2.51/Re/ff^(0.5)))^(-2) | | | |
| | | | | | | | |
| Diameter | 0.167 | ft | Ts | 72 | F | | |
| Area | 0.022 | ft2 | Ps | 1 | atm | | |
| Flow Rate | 28 | acfm | gc | 32.174 | lbm-ft/lbf-s2 | | |
| Pressure | 0.479 | atm | | | | | |
| Temp | 515 | R | | | | | |
| Velocity | 21.614 | ft/s | | | | | |
| Density | 0.0769 | lb/ft3 | | | | | |
| Viscosity | 3.68E-07 | lb sec/ft2 | | | | | |

| Pipe Losses | Number | K(2") | Leq | K(1") | K(2") | K(4"dia) |
|---|---|---|---|---|---|---|
| straight pipe | 50 | | 50 | | | 1 |
| Exit | 0 | | 0 | | | |
| 90 Elbow | 2 | 8.5 | 17 | 5.2 | 8.5 | 13 |
| 45 Elbow | 0 | | 0 | | | 5.5 |
| 50 Red | 0 | | 0 | | | |
| 50 Exp | 0 | | 0 | 420 | | 32 |
| Tee, Straight Out | 1 | 7.7 | 7.7 | 3.2 | 7.7 | 17 |
| Tee, Side out | 0 | 12 | 0 | 6.6 | 12 | 21 |
| Check Valve | 0 | 19 | 0 | 11 | 19 | 38 |
| Gate Vale, Open | 0 | 1.5 | 0 | 0.8 | 1.5 | 2.5 |
| Ball Valve, Open | 1 | 54 | 54 | 17 | 54 | 110 |
| | 0 | | 0 | | | |
| | | | 128.7 | | | |

Darcy Weisbach Equation for Gases

| | | |
|---|---|---|
| Dp | ff*L/D*rho*v^2/2/gc/144 | |
| | 0.0748 | psi |
| Pnode | 7.1142 | |

Vertical head loss calculations using darcy-weisbach equation for air losses

Node 3-4: AS8+AS5+AS4

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Flow Rate | 21 | scfm | Material | k | e(ft) | | |
| k | 0.000005 | | HDPE /PVC | 5E-06 | 0.000005 | | |
| Diameter | 2 | in | | | | | |
| Length | 145.2 | ft | Re | rho v D/mu gc | | f | colbrook |
| Prior Node | 7.11 | psi | | 34727 | | | 0.02278 |
| Temp | 55 | F | f | (-2*LOG10(e/D/3.72+2.51/Re/ff^(0.5)))^(-2) | | | |
| | | | | | | | |
| Diameter | 0.167 | ft | Ts | 72 | F | | |
| Area | 0.022 | ft2 | Ps | 1 | atm | | |
| Flow Rate | 42 | acfm | gc | 32.174 | lbm-ft/lbf-s2 | | |
| Pressure | 0.484 | atm | | | | | |
| Temp | 515 | R | | | | | |
| Velocity | 32.081 | ft/s | | | | | |
| Density | 0.0769 | lb/ft3 | | | | | |
| Viscosity | 3.68E-07 | lb sec/ft2 | | | | | |

| Pipe Losses | Number | K(2") | Leq | K(1") | K(2") | K(4"dia) |
|---|---|---|---|---|---|---|
| straight pipe | 75 | | 75 | | | 1 |
| Exit | 0 | | 0 | | | |
| 90 Elbow | 1 | 8.5 | 8.5 | 5.2 | 8.5 | 13 |
| 45 Elbow | 0 | | 0 | | | 5.5 |
| 50 Red | 0 | | 0 | | | |
| 50 Exp | 0 | | 0 | 420 | | 32 |
| Tee, Straight Out | 1 | 7.7 | 7.7 | 3.2 | 7.7 | 17 |
| Tee, Side out | 0 | 12 | 0 | 6.6 | 12 | 21 |
| Check Valve | 0 | 19 | 0 | 11 | 19 | 38 |
| Gate Vale, Open | 0 | 1.5 | 0 | 0.8 | 1.5 | 2.5 |
| Ball Valve, Open | 1 | 54 | 54 | 17 | 54 | 110 |
| | 0 | | 0 | | | |
| | | | 145.2 | | | |

Darcy Weisbach Equation for Gases

| | | |
|---|---|---|
| Dp | ff*L/D*rho*v^2/2/gc/144 | |
| | 0.1695 | psi |
| Pnode | 7.2838 | |

Vertical head loss calculations using darcy-weisbach equation for air losses

Node 4-5: AS8+AS5+AS4+AS1 to Blower

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Flow Rate | 28 | scfm | Material | k | e(ft) | | |
| k | 0.000005 | | HDPE /PVC | 5E-06 | 0.000005 | | |
| Diameter | 2 | in | | | | | |
| Length | 169 | ft | Re | rho v D/mu gc | | f | colbrook |
| Prior node | 7.28 | psi | | 45225.1 | | | 0.02147 |
| Temp | 55 | F | f | (-2*LOG10(e/D/3.72+2.51/Re/ff^(0.5)))^(-2) | | | |
| | | | | | | | |
| Diameter | 0.167 | ft | Ts | 72 | F | | |
| Area | 0.022 | ft2 | Ps | 1 | atm | | |
| Flow Rate | 55 | acfm | gc | 32.174 | lbm-ft/lbf-s2 | | |
| Pressure | 0.496 | atm | | | | | |
| Temp | 515 | R | | | | | |
| Velocity | 41.779 | ft/s | | | | | |
| Density | 0.0769 | lb/ft3 | | | | | |
| Viscosity | 3.68E-07 | lb sec/ft2 | | | | | |

| Pipe Losses | Number | K(2") | Leq | K(1") | K(2") | K(4"dia) |
|---|---|---|---|---|---|---|
| straight pipe | 77.5 | 1 | 77.5 | | | 1 |
| Exit | 0 | | 0 | | | |
| 90 Elbow | 3 | 8.5 | 25.5 | 5.2 | 8.5 | 13 |
| 45 Elbow | 0 | | 0 | | | 5.5 |
| 50 Red | 0 | | 0 | | | |
| 50 Exp | 0 | | 0 | 420 | | 32 |
| Tee, Straight Out | 0 | 7.7 | 0 | 3.2 | 7.7 | 17 |
| Tee, Side out | 1 | 12 | 12 | 6.6 | 12 | 21 |
| Check Valve | 0 | 19 | 0 | 11 | 19 | 38 |
| Gate Vale, Open | 0 | 1.5 | 0 | 0.8 | 1.5 | 2.5 |
| Ball Valve, Open | 1 | 54 | 54 | 17 | 54 | 110 |
| | 0 | | 0 | | | |
| | | | 169 | | | |

Darcy Weisbach Equation for Gases

| | | |
|---|---|---|
| Dp | ff*L/D*rho*v^2/2/gc/144 | |
| | 0.3155 | psi |
| Pnode | 7.5993 | |

Vertical head loss calculations using darcy-weisbach equation for air losses

Compressor to intake

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Flow Rate | 28 | scfm | Material | k | e(ft) | | |
| k | 0.000005 | | HDPE /PVC | 5E-06 | 0.000005 | | |
| Diameter | 2 | in | | | | | |
| Length | 25 | ft | Re | rho v D/mu gc | | f | colbrook |
| Blower Suction | 7.60 | psi | | 43347.4 | | | 0.02747 |
| Temp | 55 | F | f | (-2*LOG10(e/D/3.72+2.51/Re/ff^(0.5)))^(-2) | | | |
| | | | | | | | |
| Diameter | 0.167 | ft | Ts | 72 | F | | |
| Area | 0.022 | ft2 | Ps | 1 | atm | | |
| Flow Rate | 52 | acfm | gc | 32.174 | lbm-ft/lbf-s2 | | |
| Pressure | 0.517 | atm | | | | | |
| Temp | 515 | R | | | | | |
| Velocity | 40.044 | ft/s | | | | | |
| Density | 0.0769 | lb/ft3 | | | | | |
| Viscosity | 3.68E-07 | lb sec/ft2 | | | | | |

| Pipe Losses | Number | K(2") | Leq | K(1") | K(2") | K(4"dia) |
|---|---|---|---|---|---|---|
| straight pipe | 8 | 1 | 8 | | | 1 |
| Exit | 0 | | 0 | | | |
| 90 Elbow | 2 | 8.5 | 17 | 5.2 | 8.5 | 13 |
| 45 Elbow | 0 | | 0 | | | 5.5 |
| 50 Red | 0 | | 0 | | | |
| 50 Exp | 0 | | 0 | 420 | | 32 |
| Tee, Straight Out | 0 | 7.7 | 0 | 3.2 | 7.7 | 17 |
| Tee, Side out | 0 | 12 | 0 | 6.6 | 12 | 21 |
| Check Valve | 0 | 19 | 0 | 11 | 19 | 38 |
| Gate Vale, Open | 0 | 1.5 | 0 | 0.8 | 1.5 | 2.5 |
| Ball Valve, Open | 0 | 54 | 0 | 17 | 54 | 110 |
| | 0 | | 0 | | | |
| | | | 25 | | | |

Darcy Weisbach Equation for Gases

| | | |
|---|---|---|
| Dp | ff*L/D*rho*v^2/2/gc/144 | |
| | 0.0548 | psi |
| Pnode downtream | 7.6541 | |
| Pnode upstream | 7.71 | |

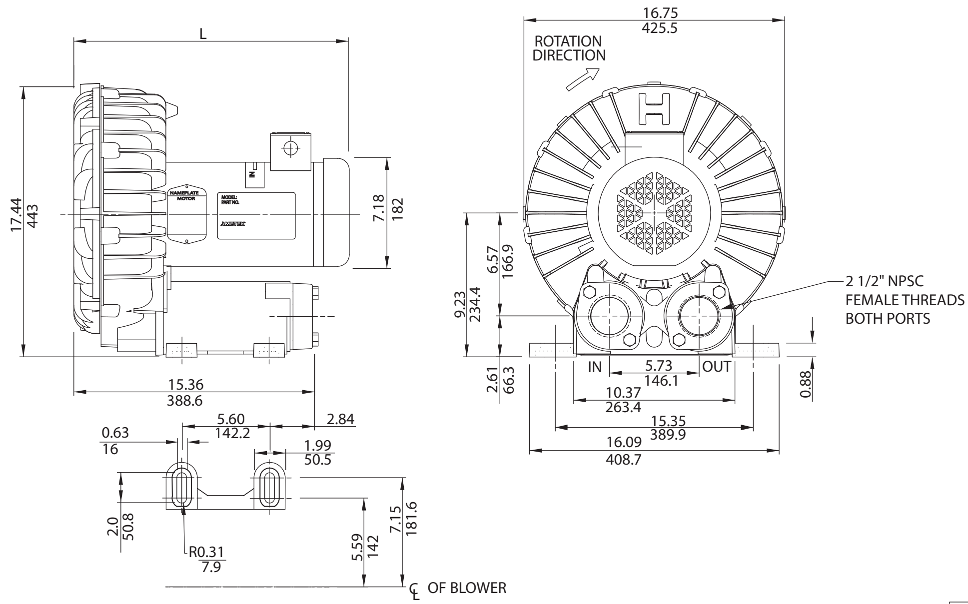
# ***APPENDIX C***

# ***SVE System Specifications***

# EN 757 & CP 757

ROTRON®

3.0 / 5.0 HP Sealed Regenerative w/Explosion-Proof Motor




NOTES
1 TERMINAL BOX CONNECTOR HOLE .75 NPT.
2 DRAWING NOT TO SCALE, CONTACT FACTORY FOR SCALE CAD DRAWING.
3 CONTACT FACTORY FOR BLOWER MODEL LENGTHS NOT SHOWN.

| MODEL | L (IN/MM) |
|---|---|
| EN757M72XL | 19.72/500.9 |
| EN757F72XL | 21.00/533.4 |

| | | Part/Model Number | | | | |
|---|---|---|---|---|---|---|
| | | EN757M72XL | EN757M86XL | EN757F72XL | CP757FW72XLR | CP757FU72XLR |
| Specification | Units | 081176 | 081177 | 081174 | 081180 | 081181 |
| Motor Enclosure - Shaft | - | XP-CS | XP-CS | XP-CS | CHEM XP-SS | CHEM XP-SS |
| Mtl. Horsepower | - | 3.0 | 3.0 | 5.0 | 5.0 | 3.0 |
| Voltage | AC | 208-230/460 | 575 | 208-230/460 | 208-230/460 | 208-230/460 |
| Phase - Frequency | - | Three-60 Hz | Three-60 Hz | Three - 60 Hz | Three-60 Hz | Three - 60 Hz |
| Insulation Class | - | B | B | B | B | B |
| NEMA Rated Motor Amps | Amps (A) | 7.2/3.6 | 3.0 | 14/7 | 14/7 | 7.2/3.6 |
| Service Factor | - | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Maximum Blower Amps | Amps (A) | 10/5 | 4.0 | 15/7.5 | 15/7.5 | 10/5 |
| Locked Rotor Amps | Amps (A) | 54/47 | 22 | 152/76 | 152/76 | 54/27 |
| Starter Size | - | 0/0 | 0 | 1/1 | 1/1 | 0/0 |
| Shipping Weight | Lbs | 158 | 158 | 158 | 158 | 158 |
| | Kg | 71.7 | 71.7 | 71.7 | 71.7 | 71.7 |

**Voltage** - ROTRON motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

**Operating Temperatures** - Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

**Maximum Blower Amps** - Corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

**XP Motor Class - Group** - See Explosive Atmosphere Classification Chart in Section I



**AMETEK DYNAMIC FLUID SOLUTIONS**
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**USA: +1 215-256-6601 - Europe: +49 7703 930909 - Asia: +86 21 5763 1258**
**Customer Service Fax: +1 215.256.1338**
**www.ametekdfs.com**



AMETEK® PRECISION MOTION CONTROL DYNAMIC FLUID SOLUTIONS

## Environmental / Chemical Processing Blowers

## EN 757 & CP 757

3.0 / 5.0 HP Sealed Regenerative w/Explosion-Proof Motor

# ROTRON®

## FEATURES

- Manufactured in the USA - ISO 9001 and NAFTA compliant
- Maximum flow: 310 SCFM
- Maximum pressure: 80 IWG
- Maximum vacuum: 75 IWG
- Standard motor: 5.0 HP, explosion-proof
- Cast aluminum blower housing, impeller , cover & manifold; cast iron flanges (threaded); teflon® lip seal
- UL & CSA approved motor with permanently sealed ball bearings for explosive gas atmospheres Class I Group D minimum
- Sealed blower assembly
- Quiet operation within OSHA standards

## MOTOR OPTIONS

- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

## BLOWER OPTIONS

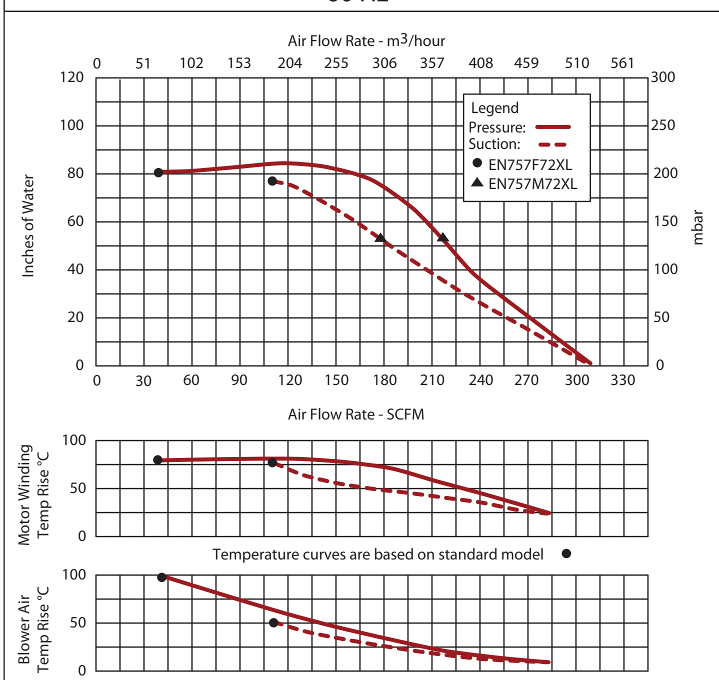
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

## ACCESSORIES

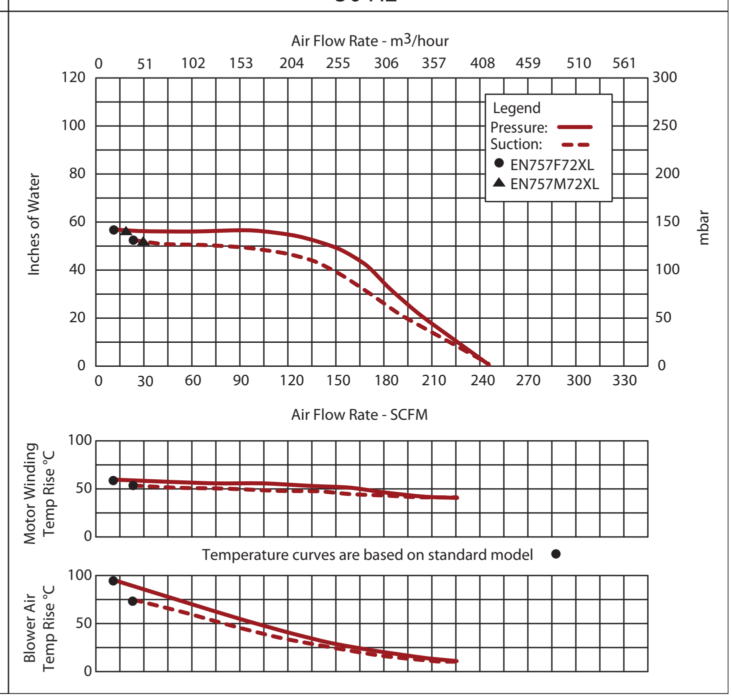
- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges, & relief valves
- Switches - air flow, pressure, vacuum, or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

## Blower Performance at Standard Conditions

### 60 Hz




### 50 Hz

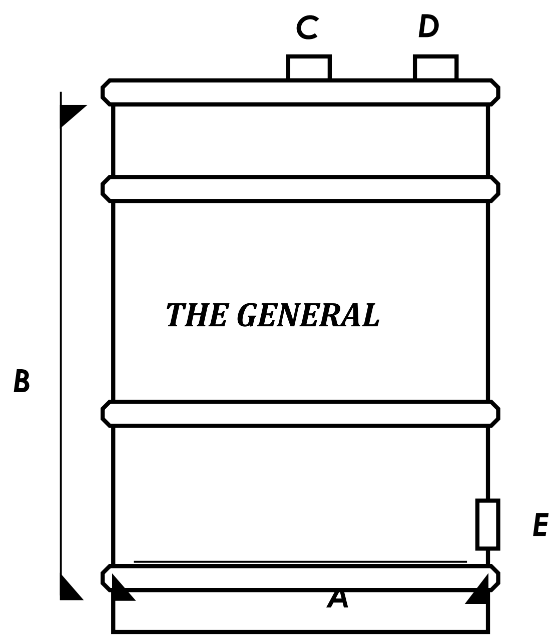



*This document is for informational purposes only and should not be considered as a binding description of the products or their performance in all applications. The performance data on this page depicts typical performance under controlled laboratory conditions. AMETEK is not responsible for blowers driven beyond factory specified speed, temperature, pressure, flow or without proper alignment. Actual performance will vary depending on the operating environment and application. AMETEK products are not designed for and should not be used in medical life support applications. AMETEK reserves the right to revise its products without notification. The above characteristics represent standard products. For product designed to meet specific applications, contact AMETEK Technical & Industrial Products Sales department.*

# THE GENERAL

air pollution control barrels

**THE GENERAL AIR POLLUTION CONTROL BARRELS** are ready to use, low cost, self-contained air purification adsorbers designed to treat airflows streams of up to 250 CFM. The units are available in four different sizes to better serve your treatment applications.




| SPECIFICATIONS | 30 GALLON | 55 GALLON | 85 GALLON | 110 GALLON |
|---|---|---|---|---|
| A - Diameter, Outside | 19 -1/2" | 24" | 28" | 32" |
| B – Height, Outside | 29" | 35" | 39" | 43" |
| Inlet Fitting | E - 2" MPT | E - 2" MPT | C - 4" FPT | C - 4" FPT |
| Outlet Fitting | C - 2" MPT | C - 2" MPT | D - 4" FPT | D - 4" FPT |
| Drain Fitting | E - 2" FPT | E - 2" FPT | E - 1" FPT | E - 1" FPT |
| Carbon Weight, lbs. | 90 | 150 | 300 | 400 |
| Max. Recommended Flow Rate, CFM | 100 | 100 | 180 | 250 |
| Maximum Pressure, psig | 7 | 10 | 7 | 7 |
| Maximum Design Temp., Deg F | 140 | 140 | 140 | 140 |
| Flow Direction | Upflow | Upflow | Upflow | Upflow |

**Activated Carbon -** The General vapor adsorbers are filled with virgin, high activity, activated carbon. Any of virgin coal, coconut shell, reactivated or impregnated carbons are available as well.

**Removable Lid -** 16 gauge lid with ring & bolt closure, poly-clad cellulose gasket.

**Connections -** Metal connections with standard pipe threads insure easy, durable and leak proof hookup to your system. Unions or quick connect fittings are advised to make drum exchange easy. Drains let you remove any accumulated condensate.

**Flow Distributors -** The 55 gallon barrel uses an air chamber to insure even distribution of the airflow through the carbon. Low-pressure drop slotted Schedule 40 PVC collectors are used in the 85 gallon and 110 gallon drums for proper flow distribution. Stainless Steel internals and drums are available for special applications.

**Coatings -** The General pollution control barrels are coated on the inside with heat cured phenolic epoxy. The outside coating is industrial enamel. A polyethylene liner is available for extra corrosion resistance for the 55 gallon and 85 gallon units.

**Installation & Start Up -** The General air pollution control barrel requires no special procedure for startup. Just connect the inlet and outlet to the treatment system and start it up. Multiple units are usually connected in series with testing advised between the units to determine when the first unit needs to be changed out.

**Maintenance -** Once connected, The General requires no maintenance other than the monitoring of the influent and effluent air streams and the operating pressure of the system. Monitoring the air stream into the last Air Pollution Control Barrel in series mode is a recommended safeguard against breakthrough in the final discharge. When the concentration of contaminants in the outflow equals the concentration in the inflow, The General has reached its removal capacity and should be removed from service. The working life of each adsorber is dependent upon the type of contaminant in the air as well as its concentration and the airflow rate. A pressure relief device is advised to prevent damage to the canister in the event of excessive pressure buildup.

**Recharging The General -** Once the carbon has reached its pollutant removal capacity, the unit should be removed and replaced with a fresh one. To purchase replacement carbon or to arrange for a carbon change out, please contact our office.

**Disposal -** Dispose of the spent carbon in accordance with Federal, State and Local regulations.

***Caution!***

*Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels. Confined space / low oxygen procedures should be put in place before any entry is made. Such procedures should comply with all applicable local, state and federal guidelines.*

33 Paterson Street, Paterson, New Jersey 07501 Tel: 973 523 2223 Fax: 973 523 1494
www.generalcarbon.com sales@generalcarbon.com

GENERAL CARBON CORP.

# GC 4 x 8B

granular activated carbon

**GC 4x8B** is a virgin activated carbon. Derived from bituminous coal, it is granular in form. Its high activity and surface area makes it ideal for most vapor phase applications including general odor removal and the adsorption of organic contaminates from vapor streams.

**Specifications**

| | |
|---|---|
| Mesh Size - 4x8, %: | 90 (min) |
| Less than No. 4, %: | 5 (min) |
| Greater than No. 8, %: | 5 (max) |
| $CCl_4$ Activity, %: | 60 (min) |
| Iodine No., mg/g: | 900 (min) |
| Hardness, %: | 95 (min) |
| Surface Area, sq. m/g: | 950 (min) |
| Moisture, % (as packaged): | 3 (max) |
| Typical Density, lbs./cu.ft: | 27 – 30 |
| g/cc: | 0.43 – 0.48 |

***Standard packaging is in 55 lb. vinyl bags. Other packaging is available upon request.

***Caution!***

*Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels. Confined space/low oxygen procedures should be put in place before any entry is made. Such procedures should comply with all applicable Local, State and Federal guidelines.*

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www.generalcarbon.com sales@generalcarbon.com

Gasho
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460 West Gay Street
West Chester, PA 19380
610-692-5650 Fax 610-692-5837
cs@gasho.org

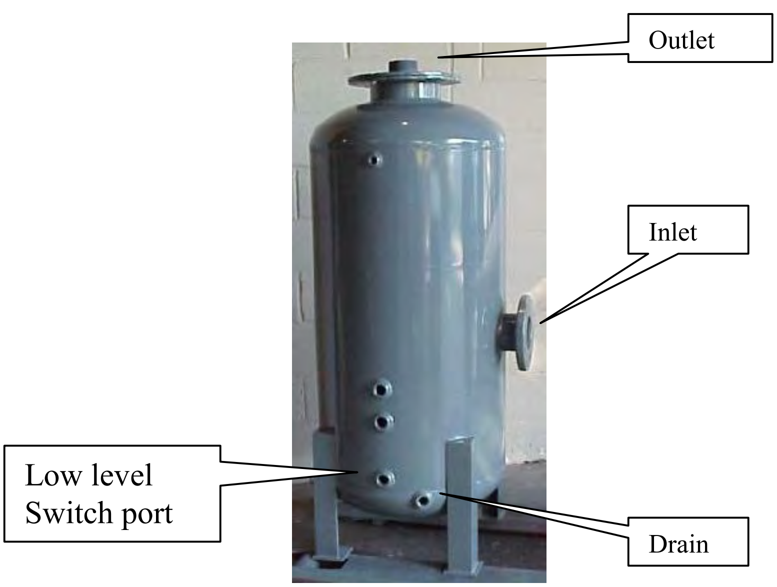
# Moisture Separators

Moisture separators are used to remove water and other liquids from air streams. They are typically used on the inlet of vacuum systems to remove water and other contaminants before they enter the vacuum pump. The air volume of the moisture separator reduces the velocity of the air stream to allow liquids to precipitate. Up to 95% water removal is possible. The models GX-30 & GX-60 are rated for full vacuum. Other moisture separators are rated to 18 in. Hg. higher vacuum ratings available.

Standard accessories include a sight gauge, drain valve, and a hand operated sludge pump. Inside the top of the separators is a basket with "tri-packs" demister material to promote condensation of vapors.

Options include: 1 to 3 level switches, automatic pump down systems, heat tracing, vacuum gauges, and thermometers.

| Model Number | Nominal Flow Rate | Liquid Capacity | Diameter (inches) | Height (inches) | Inlet Size | Discharge Size | Cleanout Size | Weight (Pounds) |
|---|---|---|---|---|---|---|---|---|
| GX-30 | 250 | 8 | 16 | 47 | 3" | 3" | 4" | 125 |
| GX-60 | 500 | 22 | 20 | 57 | 4" | 4" | 4" | 175 |
| GX-90 | 1200 | 30 | 24 | 57 | 6" Flange | 6" Flange | 4" | 240 |
| GX-120 | 2000 | 40 | 24 | 70 | 8" Flange | 8" Flange | 4" | 260 |
| GX-200 | 2000 | 95 | 30 | 85 | 8" Flange | 8" Flange | 4" | 350 |



# *APPENDIX D*

# *AS System Specifications*

R&M equipment co.

# QUOTATION

PO Box 937, Royersford, Pa. 19468
(610) 495-9700 Ext. 104
(610) 495-9710 FAX
E-Mail: JohnK@ramequipment.com
Web site: www.ramequipment.com

**AMC Engineering**

**Attention: Ariel**
**Reference: Air Sparge Blower**

**Quote # : 7015**
**Date: 7/10/2017**

| QTY | | | | |
|---|---|---|---|---|
| 1 | Blower: | Roots Blower 32 URAI-DSL | | |
| | | Airflow: 40 SCFM | Discharge Pressure: | 10 PSIG |
| | | Gas: Air | Specific Gravity: | 1.0 |
| | | Inlet Pres: 14.7 psia | Inlet Temperature: | 68°F |
| | | Speed: 1812 | Brake Horsepower: | 3.77 |
| | Blower Connections | Inlet: 1.25" thd. | Discharge: | 1.25" thd. |
| 1 | Base: | Elevated Steel Baseplate | | |
| 1 | Drive: | V-Belt Drive 1.4 Service Factor | | |
| 1 | Drive Guard: | OSHA Enclosed Style | | |
| 1 | Relief Valve: | Pressure Weighted 1" set @ 11 PSIG, BHP = 4.13 | | |
| 1 | Inlet Filter: | RMIF-1 1/2" with Supports | | |
| 1 | Inlet Silencer: | RMIS- 1 1/2" with Supports | | |
| 1 | Discharge Silencer: | RMDS- 1" with Supports | | |
| 1 | Motor: | 5 HP, 1750 RPM, TEFC, 230/460/3/60, Prem. Eff. | | |
| 1 | Slide Base: | 184 T | | |
| 1 | Layout & Mount: | Yes | | |
| 2 | Flexible Connectors: | RM Standard with Inlet Spool | | |
| 1 | Crating: | Domestic | | |
| | Accessories: | | | |
| 1 | Pressure Gauge: | Liquid Filled 2-1/2" dial 0-10 psig with Stop Cock | | |
| 1 | Check Valve: | Threaded Type 1" Techno Chek | | |
| 1 | Paint & Assembly: | Fully Assembled & Finish Painted R&M Standard | | |
| 1 | Lubricant: | First Fill of Synthetic Lube | | |
| 1 | Engineering: | Electrical Submittals & O&M Manuals R&M Standard | | |

**Price for One (1) Blower Package: $ 4,650.00**

THANK YOU FOR THE OPPORTUNITY
TO SUBMIT OUR PROPOSAL

John M. Kolcun
Director of Sales

**TERMS: Ex Works Manufactures Shipping Point See Attached**
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www.howden.com

Howden

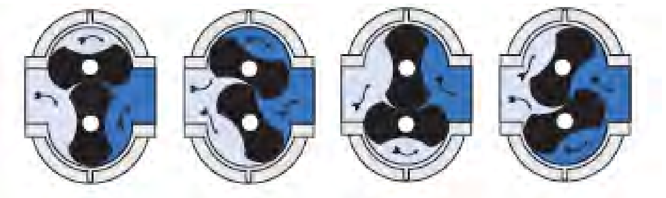
# Roots* Rotary Lobe Positive Displacement Blowers

Universal RAI* Series | RAM* Series | RCS* Series | DVJ and DPJ Series

## Insert document heading here

Revolving Around You™

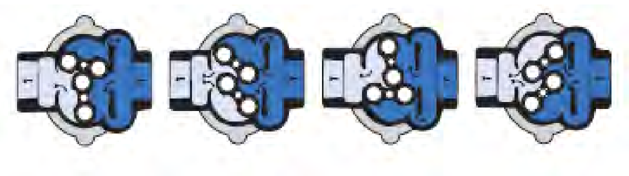
## Operating Principles



### Bi-Lobe Principle

**URAI, URAI-DSL, URAI-G, RAM, RCS Series**

Two figure-eight lobe impellers mounted on parallel shafts rotate in opposite directions. As each impeller passes the blower inlet, it traps a finite volume of air and carries it around the case to the blower outlet, where the air is discharged. With constant speed operation, the displaced volume is essentially the same regardless of pressure, temperature or barometric pressure. Timing gears control the relative position of the impellers to each other and maintain small but finite clearances. This allows operation without lubrication being required inside the lobe cavity.



### WHISPAIR* Principle

**URAI-J, URAI-J DSL, RAM-J, RAM-GJ, RAM-VJ, RCS-J**

Incoming air is trapped by the impellers. Simultaneously, pressurized air (right) is being discharged. As the impeller passes the wrap-around flange, the Whispair jet equalizes pressure between trapped air and discharge area, aiding impeller movement and reducing power. Impellers move air into the discharge area. Backflow is controlled, resulting in reduction of noise and pulsation relative to conventional blowers.

### DVJ/DPJ Principle

**2504 DVJ, RAM DVJ, 721 DVJ, 406 DPJ**

Incoming air is trapped between the impellers. Simultaneously, pressurized air is being discharged. As the impeller passes the jet plenum, cooled, pressurized air flows into the space between the impeller and cylinder. This cools the trapped air, helps control thermal growth and allows higher pressure ratios. The trapped air is then moved into the discharge flange. Backflow is reduced, resulting in lower operating noise level and reduced shock loading on the equipment.

### Warranty

Proven designs, manufacturing and material provide assurance for superior operation. Local, factory trained, service centers offer timely response to your unique needs. Roots products are sold subject to Howden Roots general terms of sale and warranty policy; contact your nearest Howden Roots office for more information.

# Universal RAI Series Rotary Positive Displacement Blowers

All Universal RAI (URAI) series blowers are heavy duty rotary blowers in a compact, sturdy design engineered for continuous duty and maximum reliability. These blowers have a time tested lubrication system. Howden Roots exclusive “figure-8” gearbox design improves oil distribution to the timing gears and lengthens bearing life.

This series features a grey iron casing, carburized and ground alloy steel spur timing gears secured to steel shafts with a taper fit and locknut, and grey iron involute impellers. Oversized anti-friction bearings are used, with a heavy duty cylindrical roller bearing at the drive shaft to withstand V-belt pull. Viton™ lip seals maintain proper lubricant at the bearings

### Universal RAI Blower

Frame Sizes 22 thru 718

The standard URAI blower features convenient grease lubrication on the drive end. The feet permit easy in-field adaptation to either vertical or horizontal installation requirements and any of four drive shaft positions – top, bottom, right or left hand. All frame sizes are center-timed to allow for rotation in either direction.

### Universal RAI DSL Blower

Frame Sizes 32 thru 615

This URAI blower features Dual Splash Lubrication (DSL). There is splash lubrication at the gear end and the drive end. The drive end has two shaft-mounted slingers and the gear end features Howden Roots exclusive “figure-eight” gearbox design that work together to improve oil distribution and to maximize gear and bearing life. The oil reservoirs feature sight glasses for accurate oil level confirmation.

### Universal RAI-G Gas Blower

Frame Sizes 32GJ thru 615GJ

URAI gas blowers feature mechanical seals and Viton™ o-rings. The seal system is designed to meet or exceed gas industry safety standards, including provisions for purge gas in the headplates. The URAI gas blower uses detachable steel mounting feet for adaptation of drive shaft position to meet vertical or horizontal installation requirements.

### Universal RAI-J WHISPAIR Blower

Frame Sizes 33J thru 56J

Howden Roots refined the standard URAI line using computer-aided design techniques to incorporate the Roots exclusive WHISPAIR jet. The WHISPAIR jet uses shock suppression techniques for noise and pulsation reduction. This exclusive WHISPAIR feature can reduce noise 3-5 dB on typical installations. Like the standard URAI blower, the URAI-J features universal detachable steel mounting feet to permit easy in-field adaptation to any of four positions and grease lubrication on the drive end.

### Universal RAI-J DSL Blower

Frame Sizes 33J thru 56J

This URAI blower combines the WHISPAIR design with the dual splash lubrication feature to offer the longest life and quietest performance of the URAI series.

## Universal RAI Blower Performance Table

| Frame Size | Speed RPM | 1 psi | | 6 psi | | 7 psi | | 10 psi | | 12 psi | | 13 psi | | 14 psi | | 15 psi | | Max Vacuum | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CFM | BHP | CFM | BHP | CFM | BHP | CFM | BHP | CFM | BHP | CFM | BHP | CFM | BHP | CFM | BHP | "HGV | CFM | BHP |
| | 1160 | 10 | 0.1 | | | | | | | | | | | | | | | 4 | 6 | 0.2 |
| 22 | 3600 | 49 | 0.3 | 38 | 1.6 | 36 | 1.8 | 32 | 2.6 | 29 | 3.1 | | | | | | | 14 | 28 | 1.8 |
| | 5275 | 76 | 0.5 | 64 | 2.4 | 63 | 2.7 | 59 | 3.8 | 56 | 4.6 | | | | | | | 15 | 53 | 2.8 |
| | 1160 | 26 | 0.2 | | | | | | | | | | | | | | | 6 | 12 | 0.5 |
| 24 | 3600 | 102 | 0.6 | 83 | 3.1 | 81 | 3.6 | | | | | | | | | | | 14 | 69 | 3.5 |
| | 5275 | 156 | 0.9 | 137 | 4.6 | 135 | 5.4 | | | | | | | | | | | 15 | 119 | 5.5 |
| | 1160 | 40 | 0.2 | 21 | 1.4 | 19 | 1.6 | | | | | | | | | | | 10 | 18 | 1.1 |
| 32[3,5] | 2800 | 113 | 0.6 | 95 | 3.4 | 93 | 3.9 | 86 | 5.6 | 82 | 6.7 | 81 | 7.2 | 79 | 7.8 | 77 | 8.3 | 15 | 78 | 4.1 |
| | 3600 | 149 | 0.9 | 131 | 4.4 | 129 | 5.2 | 122 | 7.3 | 118 | 8.7 | 117 | 9.4 | 115 | 10.1 | 113 | 10.8 | 16 | 110 | 5.3 |
| | 1160 | 55 | 0.3 | 31 | 1.9 | 28 | 2.2 | | | | | | | | | | | 10 | 27 | 1.5 |
| 33[3,4,5] | 2800 | 156 | 0.9 | 132 | 4.6 | 129 | 5.4 | 120 | 7.7 | 116 | 9.2 | | | | | | | 14 | 113 | 5.2 |
| | 3600 | 205 | 1.2 | 181 | 6.1 | 178 | 7 | 170 | 9.9 | 165 | 11.9 | | | | | | | 15 | 159 | 7.3 |
| | 1160 | 95 | 0.5 | 61 | 3.1 | 57 | 3.6 | | | | | | | | | | | 10 | 55 | 2.5 |
| 36[3,4,5] | 2800 | 262 | 1.5 | 229 | 7.7 | 224 | 8.9 | | | | | | | | | | | 12 | 213 | 7.5 |
| | 3600 | 344 | 2.1 | 310 | 10.1 | 306 | 11.7 | | | | | | | | | | | 15 | 278 | 12.1 |
| | 860 | 38 | 0.2 | 18 | 1.4 | 15 | 1.6 | | | | | | | | | | | 8 | 19 | 0.9 |
| 42[3,5] | 1760 | 92 | 0.5 | 72 | 2.8 | 69 | 3.3 | 62 | 4.7 | 58 | 5.6 | | | | | | | 14 | 56 | 3.2 |
| | 3600 | 204 | 1.4 | 183 | 6.1 | 181 | 7.1 | 173 | 9.9 | 169 | 11.8 | 167 | 12.8 | 165 | 13.7 | 163 | 14.7 | 16 | 160 | 7.7 |
| | 860 | 79 | 0.5 | 42 | 2.7 | 37 | 3.2 | | | | | | | | | | | 8 | 46 | 1.8 |
| 45[3,4,5] | 1760 | 188 | 1 | 151 | 5.7 | 146 | 6.6 | 133 | 9.4 | | | | | | | | | 12 | 134 | 5.5 |
| | 3600 | 410 | 2.7 | 374 | 12.2 | 369 | 14.1 | 356 | 19.8 | | | | | | | | | 16 | 332 | 15.4 |
| | 860 | 105 | 0.6 | 59 | 3.6 | 53 | 4.2 | | | | | | | | | | | 8 | 63 | 2.4 |
| 47[3,4,5] | 1760 | 249 | 1.3 | 203 | 7.5 | 196 | 8.7 | | | | | | | | | | | 12 | 181 | 7.3 |
| | 3600 | 542 | 3.5 | 496 | 16.1 | 490 | 18.6 | | | | | | | | | | | 15 | 452 | 19.1 |
| | 700 | 72 | 0.4 | 42 | 2.4 | 38 | 2.8 | | | | | | | | | | | 10 | 36 | 2 |
| 53[3,5] | 1760 | 211 | 1.2 | 181 | 6.3 | 177 | 7.3 | 167 | 10.3 | 160 | 12.3 | 157 | 13.3 | 155 | 14.4 | | | 14 | 158 | 7.1 |
| | 2850 | 355 | 2.5 | 325 | 10.7 | 321 | 12.3 | 310 | 17.2 | 304 | 20.5 | 301 | 22.1 | 298 | 23.8 | 295 | 25.4 | 16 | 291 | 13.4 |
| | 700 | 123 | 0.7 | 78 | 4.1 | 72 | 4.7 | | | | | | | | | | | 10 | 70 | 3.3 |
| 56[3,4,5] | 1760 | 358 | 2 | 312 | 10.5 | 306 | 12.2 | 290 | 17.3 | 280 | 20.6 | 276 | 22.3 | | | | | 14 | 276 | 11.8 |
| | 2850 | 598 | 4 | 553 | 17.7 | 547 | 20.5 | 531 | 28.7 | 521 | 34.2 | 517 | 37 | | | | | 16 | 501 | 22.4 |
| | 700 | 187 | 1 | 130 | 5.9 | | | | | | | | | | | | | 8 | 135 | 3.9 |
| 59[3,5] | 1760 | 529 | 2.9 | 472 | 15.3 | 464 | 17.8 | | | | | | | | | | | 12 | 445 | 14.9 |
| | 2850 | 881 | 5.9 | 824 | 26 | 816 | 30 | | | | | | | | | | | 15 | 770 | 30.8 |
| | 700 | 140 | 0.8 | 93 | 4.5 | 86 | 5.3 | 70 | 7.5 | | | | | | | | | 12 | 71 | 4.4 |
| 65[3,5] | 1760 | 400 | 2.4 | 353 | 11.9 | 347 | 13.8 | 330 | 19.4 | 320 | 23.2 | 316 | 25.1 | 311 | 27 | 307 | 28.9 | 16 | 300 | 15.2 |
| | 2350 | 546 | 3.8 | 499 | 16.4 | 492 | 19 | 475 | 26.5 | 466 | 31.6 | 461 | 34.1 | 457 | 36.6 | 452 | 39.1 | 16 | 445 | 25.6 |
| | 700 | 224 | 1.2 | 149 | 7.3 | 139 | 8.5 | | | | | | | | | | | 10 | 135 | 5.9 |
| 68[3,5] | 1760 | 643 | 3.7 | 567 | 18.9 | 557 | 21.9 | 530 | 31 | 515 | 37 | 507 | 40.1 | 500 | 43.1 | | | 15 | 495 | 22.7 |
| | 2350 | 876 | 5.6 | 801 | 25.9 | 790 | 29.9 | 763 | 42.1 | 748 | 50.2 | 740 | 54.2 | 733 | 58.3 | | | 16 | 715 | 32.8 |
| | 700 | 420 | 2.3 | 279 | 13.6 | 260 | 15.9 | | | | | | | | | | | 8 | 292 | 8.9 |
| 615[3,5] | 1760 | 1205 | 6.6 | 1063 | 34.9 | 1044 | 40.6 | | | | | | | | | | | 12 | 997 | 33.9 |
| | 2350 | 1641 | 9.7 | 1500 | 47.6 | 1481 | 55.2 | | | | | | | | | | | 14 | 1389 | 53.4 |
| | 575 | 192 | 1.1 | 134 | 6.1 | 126 | 7.1 | 105 | 10.2 | | | | | | | | | 12 | 117 | 6 |
| 76 | 1400 | 527 | 3 | 468 | 15.4 | 460 | 17.8 | 439 | 25.3 | 427 | 30.2 | 421 | 32.7 | 415 | 35.1 | 410 | 37.6 | 16 | 413 | 19.7 |
| | 2050 | 790 | 5.3 | 731 | 23.4 | 723 | 27 | 702 | 37.9 | 690 | 45.1 | 684 | 48.7 | 679 | 52.4 | 673 | 56 | 16 | 674 | 29.5 |
| | 575 | 362 | 1.9 | 271 | 11.1 | 258 | 13 | 226 | 18.6 | | | | | | | | | 12 | 228 | 10.9 |
| 711 | 1400 | 970 | 5.2 | 880 | 27.7 | 867 | 32.2 | 835 | 45.7 | | | | | | | | | 15 | 793 | 33.5 |
| | 2050 | 1450 | 8.8 | 1359 | 41.8 | 1347 | 48.4 | 1315 | 68.2 | | | | | | | | | 16 | 1256 | 53.1 |
| | 575 | 600 | 3.1 | 470 | 18.1 | | | | | | | | | | | | | 10 | 446 | 14.8 |
| 718 | 1400 | 1590 | 8.1 | 1460 | 44.8 | | | | | | | | | | | | | 12 | 1398 | 43.6 |
| | 2050 | 2370 | 13.3 | 2240 | 66.9 | | | | | | | | | | | | | 12 | 2178 | 64.7 |

**Notes:**
1. Pressure ratings based on inlet air at standard pressure of 14.7 psia, standard temperature of 68° F, and specific gravity of 1.0.
2. Vacuum ratings based on inlet air at standard temperature of 68° F, discharge of 30" Hg and specific gravity of 1.0.
3. Available with Dual Splash Lube (DSL) feature.
4. Available with Whispair Jet (URAI-J) feature.
5. Available with mechanical seals (see performance for URAI-G).

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- Comes with EPDM constructed double O-ring threaded stem seals
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Hayward QVC1020TS 2-Inch White QVC Ser Compact Ball Valve w Threaded End Connec
$16.87

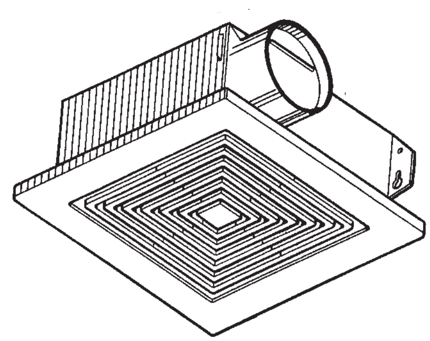
# ***APPENDIX E***

# ***Equipment Shed Specifications***

BROAN®

# SPECIFICATION SHEET

# MODEL 670
# CEILING/WALL FANS



**Simple installation and dependability make this odor and moisture removing fan a real value.**

## FEATURES

GRILLE:
- White polymeric - blends well with any decor
- Torsion spring grille mounting - no tools required
- Metal grille kit available - (purchase separately)

MOTOR:
- Plug-in, permanently lubricated
- Broan-designed polymeric blower wheel
- Snap in/out motor assembly for easy cleaning - no screws to drive or drop

HOUSING:
- Compact, 25 gage galvanized steel - attaches easily to wall or ceiling joists
- Double strength mounting flanges with keyhole slots
- Removable wiring cover - make connections away from tight corners
- No electrical knockout to remove
- Polymeric duct fitting with tapered sleeve for easy, positive duct connection
- Quiet polymeric damper prevents cold backdrafts - no metallic clatter

**Model 1667H:** Rough-in housing for 1670F finish assemblies (packed 6 per carton).
- U.L. listed for tub or shower enclosure with GFCI branch wiring

CONTROLS: Designed by Broan for use with this product (purchase separately)
- Model 57V (Ivory)/57W(White) electronic variable speed control
- Model 59V (Ivory)/59W(White) 60-Minute Time Control
- Model 61V/61W 15-Minute Time Control

**TYPICAL SPECIFICATION**
Ventilator shall be Broan Model 670.

Ventilator shall have galvzanized steel housing with double-strength mounting flanges. It shall be ducted vertically (hoirizontally) to a roof cap (wall cap).

Motor assembly shall be removable and permanently lubricated.

Air delivery shall be no less and sound levels no greater than listed. All air and sound ratings shall be certified by AMCA and/or HVI. Units shall be U.L. listed.

"Broan-NuTone LLC certifies that the models shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 (and AMCA Publication 311 if sound is also certified) and comply with the requirements of the AMCA Certified Ratings Program."

**Broan-NuTone LLC,** 926 West State Street, Hartford, WI 53027 (1-800-637-1453)

| REFERENCE | QTY. | REMARKS | Project |
|---|---|---|---|
| | | | Location |
| | | | Architect |
| | | | Engineer |
| | | | Contractor |
| | | | Submitted by Date |

# PERFORMANCE RATINGS - MODEL 670

## AMCA LICENSED PERFORMANCE

| Model | Sones @ | CFM @ Static Pressure (Ps - Inches of $H_20$) | | | | | | Total | | Duct | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | 0.0" S.P. | 0.0 | 0.1 | .125 | .250 | .375 | .500 | Volts | Watts | RPM | Size |
| 670 | 3.4 | 56 | 51 | 50 | 46 | 41 | 32 | 120 | 55 | 1700 | 3" Round |

The performances shown are with inlet grille, backdraft damper and outlet duct. RPM shown is nominal and the performance is based on actual speed of test. The sound ratings shown are loudness values in fan sones at 5' (1.5m) in a hemispherical free field calculated per AMCA Std. 301. Values shown are for installation Type B: free inlet fan sone levels.

## SONES

| Model Number | HVI Sones @ 0.1" S.P.** | AMCA Sones @0.0" S.P.** |
|---|---|---|
| **670** | 3.5 | 3.4 |

** There is difference between sone values certified by HVI for residential use and by AMCA for commercial/industrial use. Exact comparison of these values is not possible. This difference is mainly due to procedures used to convert measured sound to perceived sound. ANSI S3.4, used by both HVI and AMCA, specifies a procedure for calculating loudness as perceived by a typical listener under specific conditions. HVI establishes values at a distance of 5 feet from the fan in a "spherical free field"; AMCA establishes values at a distance of 5 feet in a "hemispherical free field". HVI and AMCA have different rules for rounding sone values.

## AMPS

| MODEL NUMBER | AMPS* |
|---|---|
| **670** | 0.8 |

*Total Connected Load

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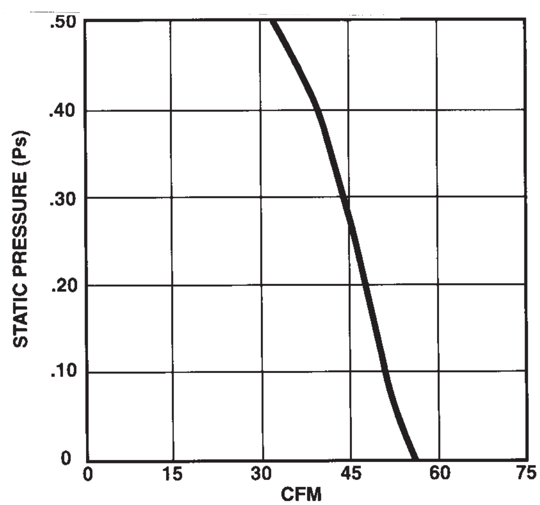
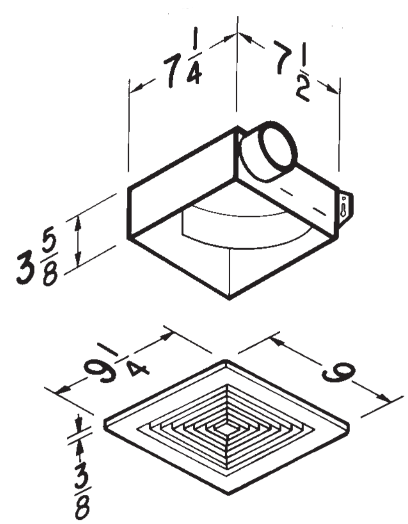



## HVI PERFORMANCE

| MODEL NUMBER | SONES | CFM @0.1" Ps |
|---|---|---|
| **670** | 3.5 | 50 |

HVI-2100 CERTIFIED RATINGS comply with new testing technologies and procedures prescribed by the Home Ventilating Institute, for off-the-shelf products, as they are available to consumers. Product performance is rated at 0.1 in. static pressure, based on tests conducted in AMCA's state-of-the-art test laboratory. Sones are a measure of humanly-perceived loudness, based on laboratory measurements.




## WEIGHT

| MODEL NUMBER | SHIPPING WT. |
|---|---|
| **670** | 4.2 LBS. |

# ***APPENDIX F***

# ***Inspection Forms***

Tomat Service Station
1815-1825 Ocean Avenue, Brooklyn NY

# SOIL VAPOR EXTRACTION SYSTEM INSPECTION FORM

**Date:**_______________

**Time:**_______________

**Weather:**____________

**Inspector:**_____________

| Extraction Point | Vacuum (iwc) | PID Reading(ppm) |
|---|---|---|
| SVE-1 | | |
| SVE-2 | | |
| Blower inlet | | |
| Carbon inlet | | |
| Between carbon | | |

| Inspection: | Yes / No | Comments |
|---|---|---|
| Blower Operating? | | |
| Spare Carbon Drums? | | |
| System Integrity? | | |

## Comments:

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

Tomat Service Station
1815-1825 Ocean Avenue, Brooklyn NY

# AIR SPARGING SYSTEM INSPECTION FORM

| Injection Point | Pressure |
|---|---|
| AS-1 | |
| AS-2 | |
| AS-3 | |
| AS-4 | |
| AS-5 | |
| AS-6 | |
| AS-7 | |
| AS-8 | |

| Inspection: | Yes / No | Comments |
|---|---|---|
| Blower Operating? | | |
| Timer, 3-way actuated valve operating? | | |
| System Integrity? | | |

## Comments:

Tomat Service Station
1815-1825 Ocean Avenue, Brooklyn NY

# CARBON MONITORING

Carbon filter installation date:__________

| Date/Time | Location | PID reading | PID units(ppm or ppb) |
|---|---|---|---|
| | **Pre-Carbon** | | |
| | **Between Carbon** | | |
| | **Post -Carbon** | | |

**Comments:**

# EQUIPMENT SHED

| Inspection: | Yes / No | Comments |
|---|---|---|
| **Vent Operating?** | | |
| | | |
| | | |

## *SVE / AIR SPARGE TEST PROCEDURES*

**PRIOR TO STARTING**

1. Take depth to water and total depth readings at all observation wells.

2. Take DO readings at all observation wells.

3. Zero out the digital manometer. Calibrate the PID.

4. Fit observation wells with cap / hose barb fitting.

5. Measure the distance from the SVE test well to each of the observations wells and then measure the distance from the sparging test well to each of the observation wells.

6. Take vacuum / pressure readings with manometer and PID readings at all observation wells.

**SVE ONLY**

1. Connect SVE blower to SVE test well. Open bypass valve on blower.

2. Turn on generator and then blower.

3. Fully close bypass valve on blower and note maximum vacuum at SVE well vacuum gauge. Reduce vacuum by adjusting bypass valve until vacuum at wellhead is $1/3^{rd}$ of maximum.

4. Record vacuum readings in the observation wells with a manometer. Record the vacuum at the blower and at the wellhead with the vacuum gauges. Do not use manometer for vacuum readings at blower as it will damage the unit.

5. Run the test at this vacuum for 15 minutes or until vacuum at the observation wells stabilize. Record air flow at discharge point and take pid readings in the influent air stream (before carbon).

6. Increase the vacuum at the well head to 2/3rds maximum and repeat steps 4 and 5.

7. Increase the vacuum at the well head to maximum and repeat steps 4 and 5.