**Lockheed Martin Corporation**
**6801 Rockledge Drive MP: CCT-246**
**Bethesda, MD 20817**
**Telephone (301) 548-2227**

June 1, 2017

**VIA PRIVATE CARRIER**

Mr. James R. Carroll
Program Administrator
Land Restoration Program
Land Management Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230

Subject: Transmittal of the 100% Design Sub-Slab Depressurization System
Third Phase Expansion – Building A
Lockheed Martin Corporation; Middle River Complex
2323 Eastern Boulevard, Middle River, Baltimore County, Maryland

Dear Mr. Carroll:

Please find enclosed two hard copies with a CD of the above-referenced document for your information. This document was developed to describe the proposed third-phase expansion of the sub slab depressurization (SSD) system currently operating in Building A of the Middle River Complex in Middle River, Maryland.

Please let me know if you have any questions. My office phone is (301) 548-2227.

Sincerely,

Lynnette Drake
Remediation Project Lead, Environmental Remediation

cc: (via email without enclosure)
Gary Schold, MDE
Mark Mank, MDE
Christine Kline, Lockheed Martin
Norman Varney, Lockheed Martin
Tom Blackman, Lockheed Martin
Dave Brown, MRAS
Michael Martin, Tetra Tech
Cannon Silver, CDM Smith

cc: (via mail with enclosure)
Tom Green, LMCPI
Mike Musheno, LMCPI
Doug Mettee, Lockheed Martin MST
John Morgan, LMCPI

cc: (via mail with CD enclosure)
Jann Richardson, Lockheed Martin
Justin Tetlow, MRAS
Scott Heinlein, LMCPI

# 100% Design
# Sub-Slab Depressurization System
# Third-Phase Expansion – Building A
# Lockheed Martin Middle River Complex
# 2323 Eastern Boulevard
# Middle River, Maryland

Prepared for:

Lockheed Martin Corporation

Prepared by:

Tetra Tech, Inc.

May 2017

Michael Martin, P.G.
Regional Manager

Peter A. Rich, P.E.
Principal Engineer

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## APPENDICES



## LIST OF TABLES

# ACRONYMS

| | |
|---|---|
| µg/m$^3$ | micrograms per cubic meter |
| % | Percent |
| *cis*-1,2-DCE | *cis*-1,2-dichloroethene |
| CQCP | construction quality control plan |
| COMAR | Code of Maryland Regulations |
| ºF | degrees Fahrenheit |
| FMEA | failure mode and effects analysis |
| GAC | granular-activated carbon |
| HASP | health and safety plan |
| HVAC | heating, ventilation, and air conditioning |
| lbs/day | pounds per day |
| Lockheed Martin | Lockheed Martin Corporation |
| MDE | Maryland Department of the Environment |
| OM&M | operation, maintenance, and monitoring |
| PVC | polyvinyl chloride |
| RTO | remedial technical operations |
| SCFM | standard cubic feet per minute |
| SSD | sub-slab depressurization |
| TCE | Trichloroethene |
| Tetra Tech | Tetra Tech, Inc. |
| TO-15 | Toxic Organic Method-15 |
| USEPA | United States Environmental Protection Agency |
| VMP | vapor monitoring point |
| VOC | volatile organic compound |
| WC | water column |
| WMP | waste management plan |

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## Section 1
# Introduction

Tetra Tech, Inc. (Tetra Tech) has prepared this 100% design on behalf of Lockheed Martin Corporation (Lockheed Martin) to describe the proposed third-phase expansion of the sub-slab depressurization (SSD) system currently operating in Building A of the Middle River Complex in Middle River, Maryland. The system has been operating since its installation in March 2008; it applies vacuum under the concrete floor in areas where elevated volatile organic compounds (VOCs) are found in the soil gas. The sub-slab vacuum draws volatile organic compounds from extraction points, and maintains a negative pressure below the slab (relative to the room space), thus minimizing the migration of chemicals from sub-slab soil into indoor air.

The system originally included two horizontal vapor extraction trenches (the “north” and “south” extraction laterals) in the former plating shop (i.e., the current “lay-up” room in the western side of the building). The system location is shown on Figure 1 in Appendix A. Vapor monitoring points (VMPs) were installed, as were a regenerative blower, a moisture separator, two 200-pound granular-activated carbon (GAC) drums, and an exhaust stack that extends above the roof of the building. The system’s “blowers skid” (blower, moisture separator, control panel, filters, and appurtenances), granular-activated carbon drums, and exhaust stack are on the loading dock just outside the lay-up room.

A first-phase system expansion completed in October 2010 addressed elevated sub-slab volatile organic compounds detected in the middle area of the Building A basement. During the first-phase expansion, two horizontal vapor extraction trenches (i.e., the “basement-north” and “basement-south” extraction laterals) were also installed, and the 200-pound granular-activated carbon drums were replaced with 400-pound drums. In addition, three stand-alone indoor-air filters (IQAir GC™ Series-GC VOC) were installed in January 2015 near vapor monitoring points 093-A and 138-A, and indoor air monitoring location 093-A-X in the Building A basement (south of the vapor extraction trenches; refer to Figure 1). The filters are continuously operated to address trichloroethene (TCE) concentrations possibly above its screening level in indoor air.

A second-phase system expansion completed in April 2016 included replacement of the original blower skid, and installation of five new extraction and vapor monitoring points to address areas along the eastern side of Building A (near VMPs 136-A, 079-A, and 117-A), where elevated concentrations of volatile organic compounds were detected in the sub-slab in 2014-2015. More recently, a parallel train of two, 400-pound carbon units in series was added to the system in February 2017 to improve treatment efficiency, increase system flow capacity, and reduce blower outlet pressure.

The proposed third-phase expansion includes adding one vertical extraction point and one VMP, installing a second moisture separator, and extending the SSD system header to the southern area of the Building A basement.

This design document is organized as follows:

Section 1—Introduction: Briefly describes the history of the existing sub-slab-depressurization system in Building A.

Section 2—Basis of Design: Presents the technical basis for the expansion design.

Section 3—100 Percent Design: Describes the components of the system expansion.

Section 4—Performance Monitoring: Describes the planned system startup, operation, monitoring, and proposed project schedule.

Section 5—References: Lists the references used in this design document.

## Section 2
# Basis of Design

The primary design objective for the third-phase expansion of the sub-slab depressurization (SSD) system is to mitigate potential vapor migration into the eastern area of Building A by maintaining a negative pressure of at least 0.01 inches water column (WC) in the sub-slab at all times, regardless of heating, ventilation, and air conditioning (HVAC), or variation in barometric conditions. To achieve the system expansion objective, one vertical, sub-slab vapor extraction point (SSD-39-A) and one vapor monitoring point (VMP) (169-A) will be installed.

The location of the new extraction point and VMP are shown on Figure 1 in Appendix A. These locations were selected based on the elevated sub-slab vapor sampling results detected at VMP 168-A during sub-slab vapor sampling in February 2017. The locations were reviewed with the facility on April 17, 2017, and will be cleared with a geophysical utility-investigation prior to installation. The radius of influence for induced vacuum at the new extraction point is expected to extend approximately 25 feet, based on current operation of the SSD system.

Additionally, the SSD system header will be extended in the Building A basement to the southern portion for potential future use in extraction from ducts, sumps, or sidewall extraction points. The second moisture separator will be added on the outlet side of the SSD system blower to remove any remaining extracted condensate droplets in the vapor stream before being treated. GAC pipe and hose connections will be improved to minimize low points and allow improved condensate collection.

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# Section 3
# 100-Percent Design

The third-phase expansion for the sub-slab depressurization (SSD) system includes the following:

- Installing one vertical, sub-slab vapor extraction point (SSD-39-A) in the eastern target area of Building A
- Installing one vapor monitoring point (VMP) (169-A) near the new vapor extractions point
- Using four-inch-diameter Schedule 40 polyvinyl chloride (PVC) pipe to connect the new extraction point to the SSD system
- Using four-inch-diameter Schedule 40 PVC pipe the SSD system header will be extended in the Building A basement to the southern portion for potential future use in extraction from ducts, sumps, or sidewall extraction points
- Installing a second moisture separator on the outlet side of the SSD system blower to remove any remaining extracted condensate droplets in the vapor stream before being treated
- Improving GAC pipe and hose connections to minimize low points and allow improved condensate collection

Drawings showing the items listed above are in Appendix A. The design of each expansion component is discussed below.

## 3.1 VAPOR EXTRACTION POINT

The proposed vapor-extraction point location was reviewed with Bob Kuhn of Middle River Aircraft Systems (MRAS) on April 17, 2017. Tetra Tech, Inc. (Tetra Tech) will retain Enviroscan, Inc. to clear the agreed upon location via a geophysical utility-investigation. (The utility clearance report will be included in Appendix B once it is completed.) Subsequently, the extraction point will be constructed using two-inch-diameter 0.020-inch slot Schedule 40 PVC pipe (screen), and two-inch-diameter solid Schedule 40 PVC pipe (riser) in a six-inch-diameter borehole. The screen will extend from the bottom of the slab to a depth of 12 to 18 inches. The annular space was filled with clean pea gravel and a two-inch thick bentonite grout seal will be placed above the screen and gravel to prevent short-circuiting (extracting indoor air).

The extraction point will be located as close to a wall or column as possible, so that cutting the concrete slab (other than for coring at the vapor extraction point) is avoided, and the extraction point and piping are placed outside normal traffic flow in the facility. The grout around the point will be finished in a manner equal to or better than surrounding areas, as required by Lockheed Martin. The new extraction point and VMP are in areas with no floor coverings. Extraction point and VMP details are on Figure 1 in Appendix A.

The riser pipe (two-inch-diameter PVC) from the new extraction point will be supported on the column/wall shown on Figure 1 with pipe supports placed near valves, elbows, fittings, and joints. The riser pipe will have a measuring point for sampling, flow, and vacuum monitoring, and a lockable diaphragm valve for throttling or shutting off flow. The riser pipe will be connected to an elevated, four-inch-diameter Schedule 40 PVC pipe to be installed overhead. Sub-slab soil vapor from the new extraction point will be routed into the common header to the blower skid, where it will be joined with vapor from the four existing vertical points and extraction trenches before heading to the moisture separator.

## 3.2 SSD HEADER PIPING EXTENSIONS

The four-inch-diameter header pipe that will connect the new extraction point to the SSD system header will be run along the loading dock, wall and ceiling sections in Building A (see Figure 1 in Appendix A). Specifically, the header pipe will run approximately 200 feet from the current SSD pipe elbows on the west wall of the loading dock approximately 200 feet to the north and then into the building with other utility entrances near 168-A. In the basement, a tee will be installed in the existing four-inch-diameter pipe that runs down the stairwell to the basement extraction trenches and a four-inch-diameter PVC pipe will be extended approximately 150 feet south to the area above sump, duct, and sidewall investigation that has been ongoing.

All new header extension piping will be level, or sloped back toward the vapor extraction points or toward header-pipe condensate sumps, to prevent condensate accumulation in low points in pipe runs. Condensate sumps will be installed to remove liquid accumulated in any piping low points that cannot be avoided. All piping will also be labeled with green color “vacuum” self-sticking vinyl pipe markers. Wherever the header piping is installed in high-traffic areas, exclusion zones of appropriate size will be set up to ensure that no one can enter the work zone. Alternative routes will be available for all blocked traffic areas. Header piping will be installed as quickly as possible, without jeopardizing employee and project safety, to avoid unnecessary disruption to facility operations.

Most of the planned pipe runs will be in areas where pipe runs can use existing racks and supports as coordinated with the facility. If pipe runs in the loading dock area may potentially disturb lead-based paint, the material will be contained, removed, and disposed of per all requirements. If pipe runs may potentially disturb asbestos-containing materials, the pipe will be rerouted, where possible, or work will stop and the facility will be contacted to coordinate abatement. No new wall penetrations will be needed to complete the third-phase expansion.

## 3.3 MODIFICATIONS TO EXISTING SSD SYSTEM

Required modifications to the main system are:

- Installing a second moisture separator
- Improving GAC pipe and hose connections

The new moisture separator will be installed on the outlet side of the SSD system blower (post-blower and post-heat exchanger) to remove any remaining extracted condensate droplets in the vapor stream before being treated. This will minimize pressure buildup in the GAC drums and maximize carbon life. The moisture separator will be identical to the existing unit, Gasho Model GX-100DL with a liquid storage capacity of 40 gallons (cut sheet in Appendix C) and will also be provided with heat trace, insulation, and a level switch. The level switch interlock will be connected in the SSD system's control panel and added to the autodialer alarm list.

The GAC pipe and hose connections will be improved by adding additional PVC piping to allow use of shorter hose runs for connections to minimize low points and allow improved condensate collection.

After the third-phase system expansion is completed, we anticipate a combined system vapor flow rate of 350 SCFM, with average extraction rates of 50 SCFM each from the current vapor extraction trenches, and 25 SCFM from each of the six vertical extraction points. The target vapor-flow rate of 350 SCFM will produce minimal friction losses in both the individual extraction pipes and the header pipe. Friction loss was estimated at 0.011 inches of water column per foot of pipe in the new two-inch-diameter vapor-extraction point.

## 3.4 VAPOR MONITORING POINT

VMP 169-A will be installed near SSD-39-A using Cox-Colvin and Associates, Inc.'s stainless steel Vapor Pins™. Data from the new VMP and VMP 168-A will be used to monitor the induced vacuum near the new extraction point. The radius of influence for the induced vacuum at the new extraction point is expected to be about 25 feet, based on the operating parameters of the current SSD systems at the site (in Building A and Building C). Vapor-extraction-point flow rates will be adjusted to maximize vacuum influence within the target area, and to achieve the system-expansion design criteria, where possible. The concrete floor slab will be checked for short-circuiting at joints and perforations with visual and auditory observations and smoke testing of suspect areas, if any, with non-toxic smoke candles; any pathways will be sealed.

## 3.5 ESTIMATED MASS EXTRACTION AND PERMITS

Volatile organic compound (VOC)[1] mass removal rates of approximately 0.1 pound per day are anticipated at expansion startup. Removal rates are expected to decrease to about 0.05 pounds per day or less after the first month of operation. These estimated removal rates are based on soil-vapor concentrations in existing SSD system influent and VMPs, and concentration decline rates observed during initial operation of the Building A and Building C SSD systems in 2008. The four existing 400-pound capacity GAC drums (lead and lag) will be used to adsorb VOCs in the discharge line of the system before the treated vapors are discharged to the atmosphere. GAC usage is expected to be about two units every year.

A sub–slab vapor sample will be collected for laboratory analysis of VOCs at the new SSD-39-A vapor extraction point 24 hours after start-up of the expanded system. The sample will be submitted to TestAmerica in Knoxville, Tennessee for VOC analysis by United States Environmental Protection Agency (USEPA) Toxic Organic Method 15 (TO-15).

[1] mainly trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE)

Table 3-1 lists the estimated initial mass extraction rates (in pounds per day) for the expanded system, based on current system influent concentrations and sampling results at VMP 168-A. Even without GAC treatment, the estimated mass-extraction rate (18.25 pounds of VOCs per year) is below the Title 5 emission level (25 tons VOCs per year) regulated by Maryland Department of the Environment (MDE) at Code of Maryland Regulations (COMAR) 26.11.02.01C. Telephone communication with the MDE Air Quality Permits Section in November 2007 (at system startup) indicated that no air permit would be required for the emission rates associated with the SSD system. An e-mail communication on September 22, 2015 from Mr. Nolan Penney of the MDE Air Quality Permits Section (Appendix E) reconfirmed that no permit would be needed, and that extraction rates less than one pound per day qualify for the *de minimus* exemption under COMAR 26.11.02.10X. Therefore, no air permit was required for the second-phase expansion of the SSD system (MDE, 2015) or the third-phase expansion. We will provide the Middle River facility with total annual emission volumes for their reporting requirements. Based on discussions with the facility during previous SSD system installations, no building or other permits are required for the proposed third-phase system expansion.

## 3.6 FAILURE-MODE AND EFFECTS ANALYSIS

Tetra Tech, Lockheed Martin, and its remedial technical operations (RTO) contractor conducted a failure mode and effects analysis (FMEA) on December 8, 2015, via a virtual (online) meeting as part of the second-phase expansion. It was agreed during the scoping process of the third-phase expansion that another FMEA was not required.

## 3.7 PROPOSED CONSTRUCTION SCHEDULE AND WORK PLANS

The construction work plans prepared by Tetra Tech for the second-phase expansion (available under separate cover) will be followed for the third-phase expansion. Those plans included a construction quality control plan (CQCP) (Tetra Tech, 2016a), a site and temporary facilities plan (Tetra Tech, 2016b), and a project-specific health and safety plan (HASP) (Tetra Tech, 2016c) that includes an Emergency Response Plan. A waste management plan (WMP) was not prepared for the second-phase system expansion work as the wastes can be managed in accordance with the facility's current investigation–derived WMP (Tetra Tech, 2015c). The CQCP presents the approach for confirming that the system is installed consistent with the design intent. The site and temporary facilities plan details the temporary facilities required to advance work and the best management practices that will be used to limit impact to Building A tenants and operations. The HASP includes procedures used to protect workers and the public from potential hazards during construction and system OM&M. The emergency response plan, included in the HASP, outlines emergency procedures.

The system's OM&M manual will be updated to include the new extraction point, VMP, and moisture separator. The work plans and updated OM&M manual are available under separate cover. The construction of the third-phase system expansion is expected to last three weeks.

**Table 3-1**

**Estimated Mass Extraction Rates**
**Building A SSD System Third-Phase Expansion**
**Lockheed Martin Middle River Complex, Middle River, Maryland**

| Vapor extraction point | Estimated average flow (SCFM) | Estimated VOC concentration (µg/m$^3$) | Estimated initial^ mass extraction (lbs/day) |
|---|---|---|---|
| **Existing horizontal extraction trenches/laterals/vertical points** | | | |
| Combined:<br>North (former plating shop), South (former plating shop),<br>Basement-north,<br>Basement-south,<br>SSD-34-A, SSD-35-A, SSD-36-A, SSD-37-A, SSD-38-A | 325 | 1,212 | 0.035 |
| SSD-39-A | 25 | 27,419 | 0.062 |

^VOC concentrations at proposed vapor extraction points are expected to decrease up to 90% during the first month of operation
lbs/day – pounds per day
µg/m$^3$ – micrograms per cubic meter
SCFM – standard cubic feet per minute
SSD – sub-slab depressurization
VOC – volatile organic compounds

Mass Extraction (lbs/day) = µg/L x L/min x 1,440 min/day x 1 lb/4.54 x $10^{-6}$ µg
[a] Based on total VOC influent SSD system concentrations in April 2017
[b] Based on total VOC sub-slab vapor concentrations from VMP 168-A in February 2017

## Section 4
# Performance Monitoring

## 4.1 SYSTEM STARTUP AND OPERATION

After the third-phase system expansion is installed, the system will be rebalanced by taking vacuum and flow rate measurements from each extraction point and induced vacuum monitoring point, and adjusting the diaphragm throttling valves, to pull about 200 standard cubic feet per minute (SCFM) total from the current vapor extraction trenches, and 25 SCFM from each of the vertical points.

Once the extraction points are set to pull the target flows (or as close as possible), the system vacuum and flows will be adjusted to achieve the design criterion of a vacuum of 0.01 inches water column or greater at each vapor monitoring point within the radius of influence, when possible. One sample from the new extraction point (collected 24 hours after startup) will be submitted for laboratory analysis. Moisture accumulation will also be monitored during startup.

System checks will occur every two weeks and will include applied vacuum and flow rate at each extraction point, and induced vacuum at vapor monitoring points (VMPs). System vapor samples (influent, midpoint, and effluent) will be collected monthly. Sub–slab vapor samples will be submitted to TestAmerica in Knoxville, Tennessee for analysis of currently agreed list of target compounds by United States Environmental Protection Agency (USEPA) Toxic Organic Method 15 (TO-15). The resulting data will be used to determine mass removal trends, and to verify that breakthrough of the granular activated-carbon units has not occurred.

## 4.2 SYSTEM MONITORING

System checks will be completed by following these steps:

- Measure and record the vacuum and air velocity from each extraction point using a manometer and velocity meter, respectively, and adjust as needed.
- Replace the lead granular activated-carbon units when 50% or higher breakthrough is observed in the midpoint air sample, or at Tetra Tech's discretion (with concurrence from Lockheed Martin Corporation), to minimize total volatile organic compound discharge and

minimize carbon usage. Install lag units as lead units, and install new canisters in the lag position.

- Record effluent blower temperature and pressure.
- Check induced vacuum at vapor monitoring points.
- Empty condensate in moisture separators and sumps into properly labeled transportable drums, as needed.
- Check vacuum gauges, pressure gages, piping, and fittings for leaks and signs of heat stress.

The system checklist used to document system monitoring is provided under separate cover in the updated operation, maintenance, and monitoring (OM&M) manual.

## 4.3 INDUCED VACUUM MONITORING

During startup of the new extraction point, induced vacuum will be monitored at the two nearby vapor monitoring points (SSD-168-A and SSD-169-A) by collecting single, instantaneous readings with a manometer every two weeks.

# Section 5
# References


1. Maryland Department of the Environment (MDE), 2007. Telephone communication between Mr. Dave Mummert (MDE Air Quality Permits Section) and Ms. B. Chang Lee (Tetra Tech) regarding anticipated volume of emissions at site not requiring an air permit. November 16.

2. Maryland Department of the Environment (MDE), 2015. Email communication between Mr. Nolan Penney (MDE Air Quality Permits Section) and Ms. B. Chang Lee (Tetra Tech) regarding permit exemption based on anticipated mass extraction rates. September 22, 2015.

3. Pace Analytical Services (Pace), 2014. *Report of Laboratory Analysis*, *Pace Project No. 10259332*. April 17.

4. Tetra Tech, Inc. (Tetra Tech), 2015a. *Basis-of-Design Report Sub-slab Depressurization-System Second-Phase Expansion—Building A, Lockheed Martin Middle River Complex, 2323 Eastern Boulevard Middle River*, *Maryland*. October 21.

5. Tetra Tech, Inc. (Tetra Tech), 2015b. *Operation and Maintenance Manual: Sub-slab Depressurization-System—Building A, Lockheed Martin Middle River Complex, 2323 Eastern Boulevard Middle River, Maryland*. June.

6. Tetra Tech, Inc. (Tetra Tech), 2015c. *Investigation-Derived Waste Management Plan, Lockheed Martin Middle River Complex, 2323 Eastern Boulevard Middle River, Maryland*. May.

7. Tetra Tech, Inc. (Tetra Tech), 2016a. *Construction Quality Control Plan, Sub-slab Depressurization-System Second-Phase Expansion—Building A, Lockheed Martin Middle River Complex, 2323 Eastern Boulevard Middle River, Maryland*. January.

8. Tetra Tech, Inc. (Tetra Tech), 2016b. *Site and Temporary Facilities Layout Plan, Sub-slab Depressurization-System Second-Phase Expansion—Building A, Lockheed Martin Middle River Complex, 2323 Eastern Boulevard Middle River, Maryland*. January.

9. Tetra Tech, Inc. (Tetra Tech), 2016c. *Site-Specific Health and Safety Plan For Second-Phase Expansion Construction, Operation, Maintenance And Monitoring of the Sub-Slab Depressurization System, Lockheed Martin Middle River Complex, 2323 Eastern Boulevard Middle River, Maryland*. January.

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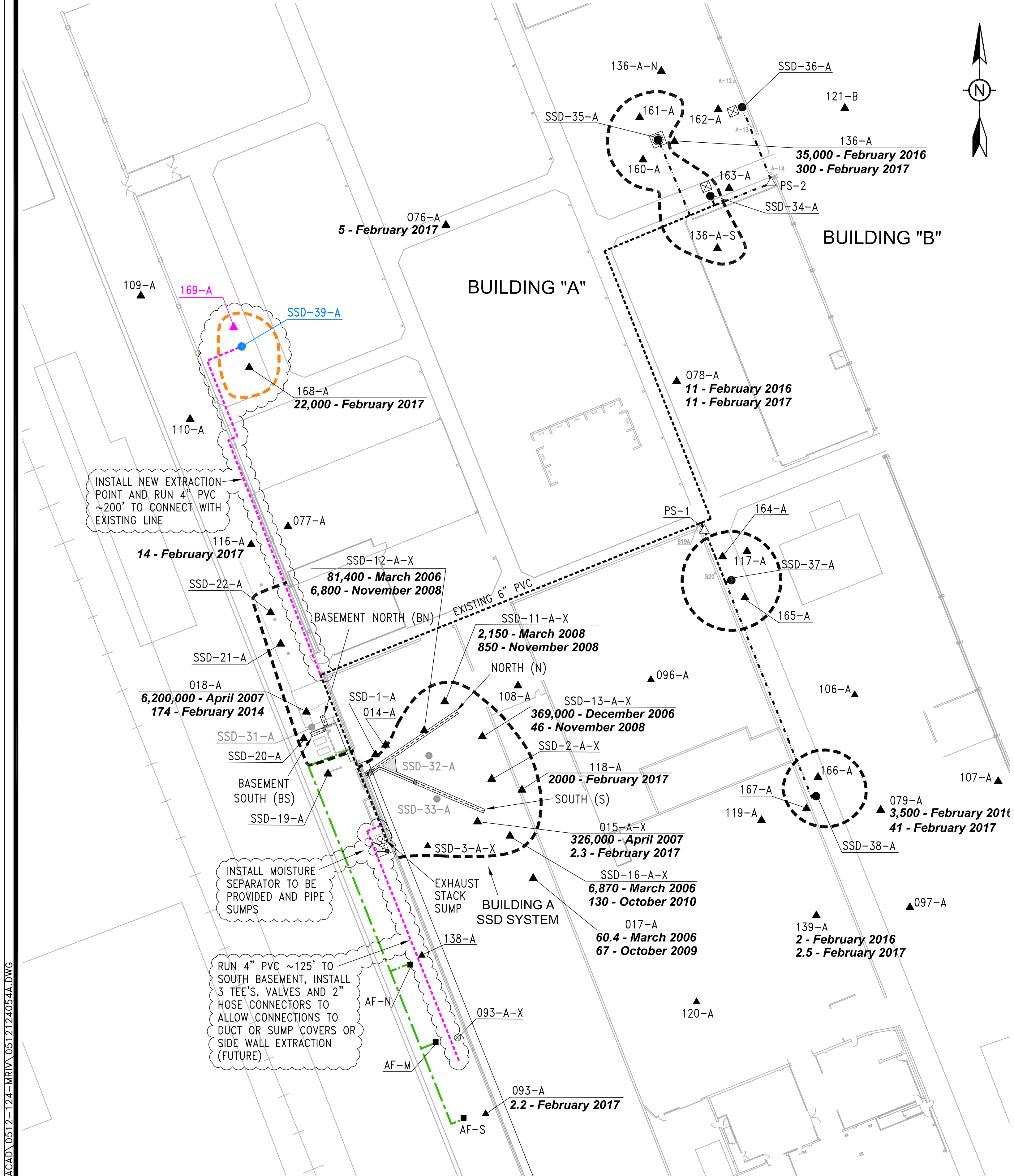
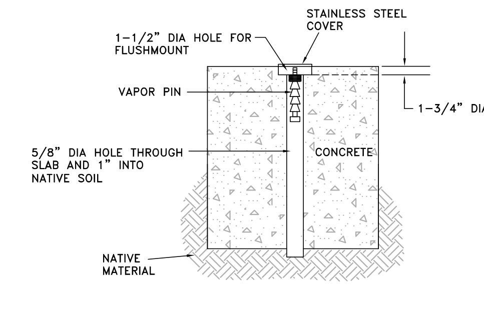
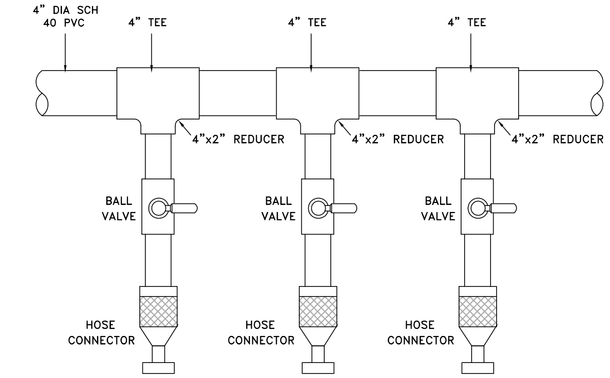
# APPENDIX A—DESIGN DRAWINGS




VAPOR MONITORING POINT DETAIL (169-A)
NOT TO SCALE



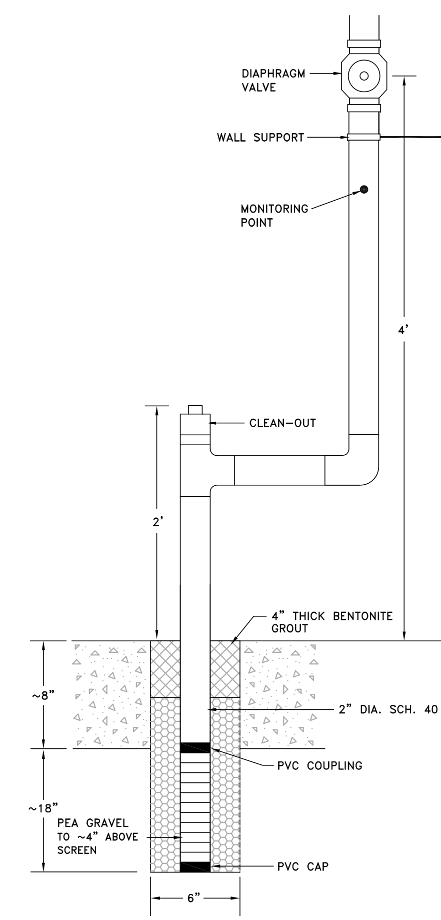

END OF SOUTH BASEMENT PIPE EXTENSION
NOT TO SCALE

| WASHED PEA GRAVEL GRADATION | |
|---|---|
| SIEVE SIZE | PERCENT PASSING |
| 1/2" | 100% |
| 3/8" | 85 TO 100% |
| #4 (4.75MM) | 10 TO 30% |
| #8 (2.36MM) | < 5% |
| #20 (0.85MM) | < 2% |

NOTES:

A. GRAVEL MATERIAL SHALL CONFORM TO ASTM C-33 SPECIFICATIONS FOR 3/8"AGGREGATE.

B. GRAVEL SHALL BE SEMI-ROUND AND FREE OF ORGANIC MATERIAL.




SSD-39-A DETAIL
NOT TO SCALE

LEGEND

- SUB-SLAB VAPOR MONITORING POINT
- VERTICAL SOIL VAPOR EXTRACTION POINT
- NEW SUB-SLAB VAPOR EXTRACTION POINT
- SUB-SLAB VAPOR EXTRACTION POINT (USED IN PREVIOUS PILOT TEST)
- INDOOR AIR SAMPLING POINT
- NEW SUB-SLAB VAPOR MONITORING POINT
- SSD — SUB-SLAB DEPRESSURIZATION
- NEW 4" DIA. PVC HEADER
- INDOOR AIR FILTER CONNECTION TO EMERGENCY POWER SUPPLY (FIELD RUN)
- TARGET INFLUENCE AREA FOR SSD SYSTEM EXPANSION
- APPROXIMATE EXISTING INFLUENCE AREA
- INDOOR AIR FILTER
- SSD SYSTEM BLOWER SKID
- EXISTING SUB-SLAB VAPOR EXTRACTION LATERAL
- PIPE SUMP
- STEEL PIPE SLEEVE (4" DIA.)
- PIPE BOLLARD (2" DIA.)
- **3,500** — HIGHEST SUB-SLAB TCE CONCENTRATION ($\mu g/m^3$) PRE-SSD SYSTEM AND MOST RECENT CONCENTRATION POST-SSD SYSTEM OPERATION

NOTE:
PIPE HANGERS PLACED NEXT TO EXISTING SUPPORT BRACKETS FOR STEEL PIPING IN CEILING APPROX. 6-12 FT APART.

0 60 120
SCALE IN FEET

TITLE: **PIPING LAYOUT AND DETAILS**
**SSD SYSTEM THIRD PHASE EXPANSION - BUILDING A**

LOCATION: **LMC Middle River Complex**
**Middle River, Maryland**

TETRA TECH

| | | | |
|---|---|---|---|
| APPROVED | DM | FIGURE | 1 |
| DRAFTED | CP | | |
| PROJECT# | 117-0512124 | | |
| DATE | 5-22-17 | | |

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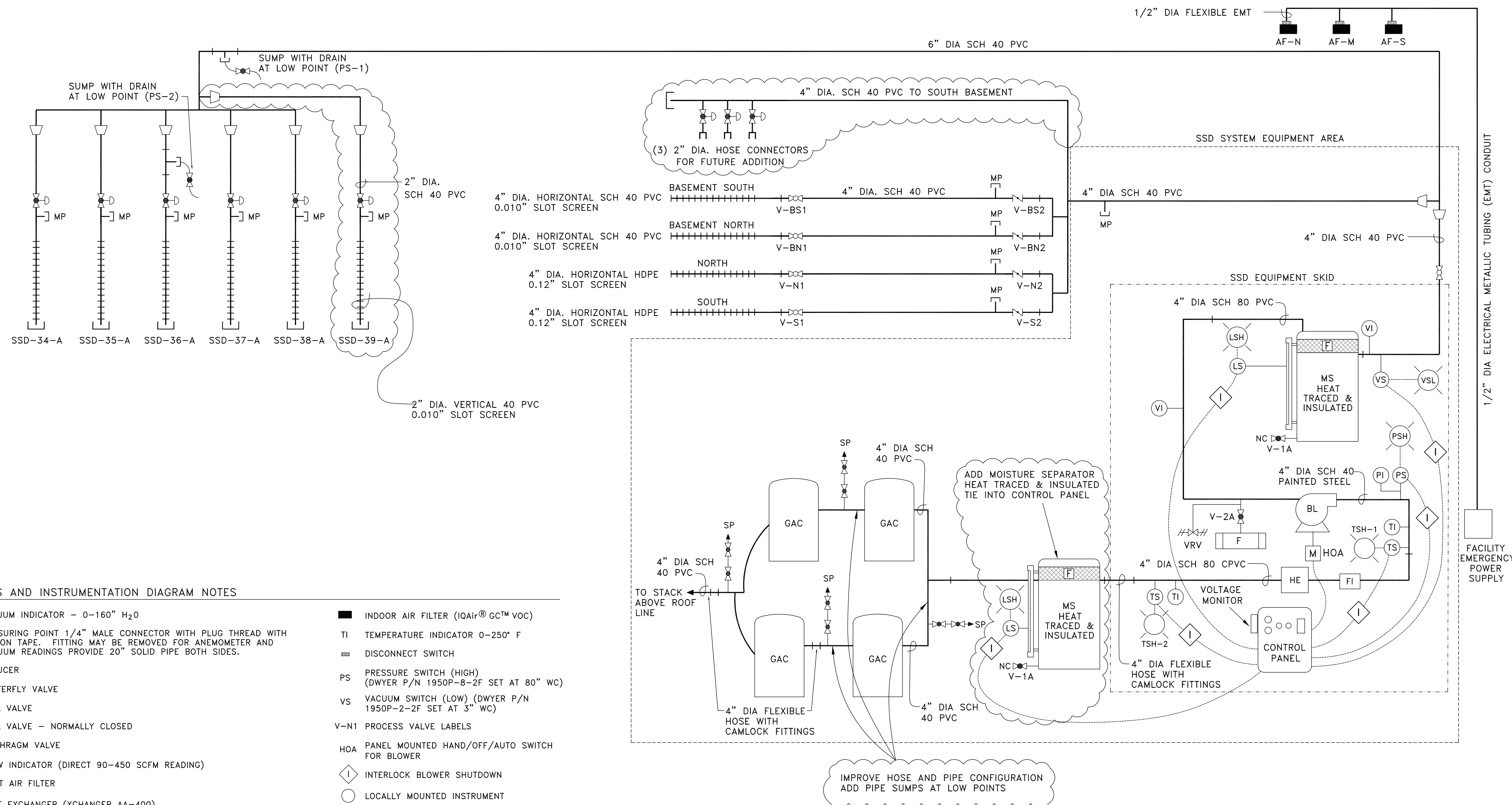


## PROCESS AND INSTRUMENTATION DIAGRAM NOTES

| | |
|---|---|
| VI | VACUUM INDICATOR – 0–160" $H_2O$ |
| MP | MEASURING POINT 1/4" MALE CONNECTOR WITH PLUG THREAD WITH TEFLON TAPE. FITTING MAY BE REMOVED FOR ANEMOMETER AND VACUUM READINGS PROVIDE 20" SOLID PIPE BOTH SIDES. |
| | REDUCER |
| | BUTTERFLY VALVE |
| | BALL VALVE |
| | BALL VALVE – NORMALLY CLOSED |
| | DIAPHRAGM VALVE |
| FI | FLOW INDICATOR (DIRECT 90–450 SCFM READING) |
| F | INLET AIR FILTER |
| HE | HEAT EXCHANGER (XCHANGER AA–400) |
| MS | MOISTURE SEPARATOR (GASHO GX–100DL) WITH 40 GALLON CAPACITY, SLIGHT TUBE, REMOVABLE TOP, DRAIN VALVE |
| LS | LEVEL SWITCH |
| VRV | VACUUM RELIEF VALVE – 2" (SET AT 81.6" WC) |
| SP | SAMPLE PORT 1/4" DIAMETER |
| BL | AMETEK®, ROTRON® 909BB72W 10 HP MOTOR, 300 SCFM @ 75" $H_2O$ |
| PI | PRESSURE INDICATOR 0–160" $H_2O$ |
| TS | TEMPERATURE SWITCH (ASHCROFT P/N T424–T05–030–XFS–150–260; TSH–1 SET AT 220° F AND TSH–2 SET AT 115° F) |
| GAC | GRANULAR ACTIVATED CARBON VAPOR TREATMENT (SIEMENS VENT SCRUB® VSC400, VOCARB® 48C) |
| | INDOOR AIR FILTER (IQAir® GC™ VOC) |
| TI | TEMPERATURE INDICATOR 0–250° F |
| | DISCONNECT SWITCH |
| PS | PRESSURE SWITCH (HIGH) (DWYER P/N 1950P–8–2F SET AT 80" WC) |
| VS | VACUUM SWITCH (LOW) (DWYER P/N 1950P–2–2F SET AT 3" WC) |
| V–N1 | PROCESS VALVE LABELS |
| HOA | PANEL MOUNTED HAND/OFF/AUTO SWITCH FOR BLOWER |
| | INTERLOCK BLOWER SHUTDOWN |
| | LOCALLY MOUNTED INSTRUMENT |
| | PANEL ALARM LIGHT |
| H | HIGH |
| L | LOW |
| SSD | SUB–SLAB DEPRESSUIZATION |
| M | MOTOR |
| EMT | ELECTRICAL METALLIC TUBING |

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TITLE: **PROCESS AND INSTRUMENTATION DIAGRAM SSD SYSTEM THIRD PHASE EXPANSION - BUILDING A**

LOCATION: **LMC Middle River Complex Middle River, Maryland**

TETRA TECH

| | | |
|---|---|---|
| APPROVED | DM | FIGURE |
| DRAFTED | CP | |
| PROJECT# | 117–0512124 | 2 |
| DATE | 5–22–17 | |

# APPENDIX B— GEOPHYSICAL UTILITY-INVESTIGATION REPORT (PENDING)

# APPENDIX C— EQUIPMENT LIST AND CUT SHEET

# EQUIPMENT LIST AND CUT SHEET

1. Cox-Colvin and Associates, Inc.'s stainless steel Vapor Pins™ (one)

2. Moisture separator: Gasho, Inc. model GX-100DL with level switch

3. PVC piping:
    a. 100 feet, Schedule 40, 2-inch-diameter
    b. 350 feet, Schedule 40, 4-inch-diameter
    c. Couplings, elbows, tees, caps, reducers

4. Diaphragm valves: 2-inch-diameter construction PVC, 150 pounds per square inch (PSI) rating (4)
5. Primer: PVC primer
6. Cement: heavy bodied universal cement
7. Hose quick-connect fittings, 2-inch-diameter (3)

The Leader in Blower & Vacuum Solutions
460 West Gay Street
West Chester, PA 19380

# GX100-DL Moisture Separator, 400 CFM Specification

100 gallon vessel with approx. 40 gallons of storage
Flow Rate- 400 ICFM, Vacuum rating 28” Hg
Integral SS demister / filter media, 99.5% entrained water removal
Pressure drop through clean media = .25 IWC
Welded steel construction, reinforced for high vacuum
External Site Gauge
Level Switch Ports- (3) 1” NPT ports, 6” 150 Lb. Flange Cleanout port with clear cover
4” NPT inlet, and outlet
Standard External finish is alkyd paint, inside is left uncoated
Optional coatings available