April 4, 2017

Oregon Department of Environmental Quality
Northwest Region
700 NE Multnomah Street, Suite 600
Portland, OR 97232

Attention: Jim Orr

Closure Monitoring Plan
Former Mt. Hood Solutions Warehouse Site
4444 NW Yeon Avenue
Portland, Oregon
ECSI #081
GeoDesign Project: MtHoodChem-4-002

1.0 INTRODUCTION

On behalf of Mt. Hood Solutions (Respondent), GeoDesign, Inc. is pleased to submit this Closure Monitoring Plan (Plan) for the former Mt. Hood Solutions Warehouse site located at 4444 NW Yeon Avenue in Portland, Oregon (project site).

This document describes the approach and schedule for implementation and monitoring of an engineering control proposed for the project site consisting of an active SSD system. This Plan includes the basic elements discussed between representatives of DEQ, GeoDesign, and Evren Northwest during a project meeting on March 1, 2017. In addition, this Plan describes contingency measures associated with the proposed engineering control implemented at the project site.

Acronyms and abbreviations used herein are defined at the end of this document.

2.0 BACKGROUND

GeoDesign has completed several phases of subsurface investigation, remediation, and compliance monitoring at the project site since 2009. An exhaustive description of work completed to date is not provided herein; the reader is referred to prior project reports contained in the DEQ file.

Following site remedial actions that included (1) groundwater remediation using anaerobic reductive dechlorination and (2) soil remediation using SVE over several operational phases, GeoDesign collected confirmation and/or compliance samples of respective media following each remedial phase/event. The following sections summarize relevant recent activity.

2.1 GROUNDWATER

GeoDesign established a groundwater monitoring well network and completed routine groundwater monitoring at the project site from June 2009 through December 2012. Groundwater remediation via injection of HRC occurred in September 2009. Based on the series of groundwater sampling events (post-remediation) completed from February 2011 through December 2012, DEQ released the requirement for further groundwater compliance sampling in February 2012.

In light of an observed increase in sub-slab vapor concentrations of TCE between approximately August 2014 and May 2016, an additional round of groundwater monitoring from on-site and off-site monitoring wells was completed in November 2016 in accordance with DEQ's request (DEQ, 2016). As summarized in our most recent Progress Report (GeoDesign, 2017), the concentrations of TCE detected in groundwater during the November 2016 groundwater sampling event were generally the lowest detected values observed over the entirety of the groundwater sampling program conducted at the project site. All of the detected concentrations of TCE were substantially below DEQ's applicable RBCs.

Because the November 2016 groundwater sampling results did not indicate rebound in TCE at the project site, DEQ agreed that continued cessation of the groundwater monitoring program is appropriate. Upon completion of the SSD system and indoor air monitoring program described herein, all monitoring wells will be permanently decommissioned in accordance with OWRD requirements in conjunction with site closure.

2.2 SOIL AND SUB-SLAB VAPOR

Following source soil removal activities, GeoDesign implemented soil remediation using SVE in November 2009. Concurrent with the installation of the SVE system, several compliance sub-slab monitoring points were installed throughout the project site. Four sub-slab monitoring points (VP-1, VP-2, VP-3, and VP-6) were selected to represent overall site conditions and have served as compliance monitoring points since December 2008.

The SVE system operated in two phases:

1. Initially, the SVE system operated from November 16, 2009 (initial startup following system construction) through October 5, 2011. Based on system performance data, the system was temporarily re-configured for venting in passive mode in October 2011. GeoDesign completed subsequent rounds of confirmation sub-slab vapor sampling at sub-slab vapor compliance points VP-1, VP-2, VP-3, and VP-6 following system shutdown. The subsequent sub-slab vapor monitoring events indicated apparent rebound of TCE concentrations in sub-slab vapor, most notably in monitoring point VP-2.

2. Due to the apparent rebound condition, the SVE system was re-started (active extraction mode) in July 2012. The SVE system operated continuously from July 5, 2012 through July 15, 2013. During the second phase of operation, the system operational controls were modified to apply more extractive energy to the former source area (the array of extraction piping near VP-3). Through correspondence with DEQ and the property owner, the SVE system was shut down again on July 15, 2013 to re-evaluate remedial action effectiveness. In September 2013, the SVE system was deconstructed and reconfigured for passive venting aided by wind turbine vent caps attached to the SVE piping that extended up the side of the building to the rooftop.

Following system reconfiguration to passive venting, GeoDesign periodically collected confirmation sub-slab samples from November 2013 through November 2016 to evaluate post-remediation sub-slab concentrations and variability in vapor concentrations over the course of different seasonal periods. The compliance sampling data indicated a significant degree of variability by season; however, the most recent sampling events also suggest an overall increasing trend in TCE concentrations near VP-2 (proximate to the former source area). While concentrations of TCE throughout the overall site (i.e., VP-1, VP-3, and VP-6) have typically not exceeded applicable DEQ RBCs, the concentrations of TCE in sub-slab vapor at compliance point VP-2 have exceeded the applicable DEQ RBC of 2,900 $\mu g/m^3$ during recent sampling events.

Based on the presence of elevated TCE concentrations at sub-slab compliance point VP-2, the operation of an active SSD system appeared to be an appropriate step to mitigate TCE in sub-slab vapor, particularly in the VP-2 area. In December 2016, the initial phase of active SSD operation was implemented. Further discussion of the active SSD system is presented in Section 3.0.

2.3 INDOOR AIR

In accordance with the request by DEQ (DEQ, 2016), GeoDesign conducted indoor air sampling at the project site in December 2016. Three indoor air samples were collected within the project site building at the following general locations (see Figure 1):

- Near the VP-2 sample point area (indoor air sample IA-1)
- Near the VP-6 sample point area (indoor air sample IA-2)
- In the office area located in the southern portion of the project site building (indoor air sample IA-3)

As agreed through correspondence with DEQ, each indoor air sample was collected over the course of five days (Friday, December 2, 2016 through Wednesday, December 7, 2016). TCE was detected in indoor air samples IA-1, IA-2, and IA-3 collected from the warehouse and office spaces in December 2016 at the following concentrations:

- IA-1 (Near VP-2): TCE detected at a concentration of 1.4 $\mu g/m^3$
- IA-2 (Near VP-6): TCE detected at a concentration of 1.3 $\mu g/m^3$
- IA-3 (Office Space): TCE detected at a concentration of 0.23 $\mu g/m^3$

Each of the detected concentrations of TCE were below DEQ's generic RBC value of 2.9 μg/m^3 for occupational exposure. TCE breakdown products, including 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride, were not detected in samples collected during the December 2016 indoor air sampling event.

3.0 ACTIVE SSD SYSTEM INSTALLATION

3.1 INITIAL MEASURES

In accordance with our Work Plan dated November 15, 2016 (GeoDesign, 2016), initial measures were implemented to re-establish a negative pressure under the building slab following completion of the overall sampling activities completed in November and December 2016. Initial SSD system implementation included the installation of four in-line fans connected to the riser portions of the array of sub-slab perforated pipes comprising the former SVE system at the project site.

Each of the four in-line fans consists of an AMG Eagle® 0.2-horsepower fan. The fan system was initiated on December 7, 2016. The respective fan placements in relation to the array of sub-slab ventilation pipes included in the SVE trench piping system are summarized as follows[1]:

- Fan #1: SVE line VE-4 (former source area)
- Fan #2: SVE lines 1n, 1s, and 2s
- Fan #3: SVE lines 3s and 5s
- Fan #4: SVE lines 6s and 7s

GeoDesign collected operational parameters of the active SSD system on December 7 and 20, 2016. Operational parameters included the measurement of applied vacuum, flow rate, PID measurements within the respective SVE lines, and induced vacuum throughout the warehouse sub-slab area using previously installed sub-slab and vadose zone monitoring points associated with the former SVE system monitoring. The induced vacuum pressures measured on December 20, 2016 (with four fans operational) ranged from -0.001 to 0.048 iow in the accessible monitoring points. As agreed with DEQ, a target vacuum level of -0.02 iow will be used for the SSD system as recommended by EPA (EPA, 2008). Accordingly, the sub-slab ventilation/SSD system installed on December 1, 2016 and initiated on December 7, 2016 will be subject to augmentation through the installation of additional fans in order to impart additional vacuum pressure to the sub-slab and achieve the overall -0.02 iow vacuum response target level.

3.2 PROPOSED ACTIVE SSD SYSTEM AUGMENTATION

As discussed with DEQ, the existing SSD system shall be augmented through installation of additional in-line fans. Specifically, four additional in-line fans identical to the initially installed fans (0.2 horsepower AMG Eagle in-line fans) will be installed on the existing array of subsurface

[1] Refer to earlier reports for a detailed description of the SVE system formerly in operation at the project site. With the exception of SVE leg VE-4 (which is a stand-alone, 3-inch-diameter piping system), each SVE trench includes a deep, 4-inch-diameter extraction line and a shallow (sub-slab), 3-inch-diameter extraction/ventilation line. The "s" designation on the SVE legs denotes the shallow, 3-inch-diameter extraction/ventilation line within each SVE trench. The "n" on the SVE legs designation denotes a separate ventilation line located in the former neutralization sump area. The "d" designation on the SVE legs denotes the deeper, 4-inch-diameter extraction/ventilation line within each SVE trench.

piping. A schematic depicting the proposed augmented fan layout is presented on Figure 2. Completion of the SSD system augmentation will result in active ventilation of each shallow and deep ventilation line associated with the former SVE system.

Following completion of the SSD system augmentation, subsequent monitoring activity described in Section 4.1 of this Plan will be used to evaluate the increased/expanded performance of the SSD system.

4.0 PROPOSED MONITORING AND COMPLIANCE POINTS

4.1 SUB-SLAB AND SOIL VAPOR MONITORING POINTS

The existing array of sub-slab and vadose zone observation and monitoring points associated with the former SVE system will be used to evaluate sub-slab and vadose zone vacuum pressures induced by the augmented SSD system. These proposed monitoring points represent the overall building footprint and will include the following (see Figure 1):

- VP-1
- VP-2
- VP-3
- VO-5
- VO-6
- VO-7
- VO-8
- VO-9
- VO-10
- VO-11
- VO-12
- VO-13
- VO-14

Monitoring points VP-1, VP-2, and VP-3 are "floating" points within the concrete slab section that are intended to reflect sub-slab aggregate conditions only. Monitoring points VO-5, VO-6, VO-7, VO-11, VO-12, VO-13, and VO-14 are constructed as nested observation points with three separate open intervals of 0 to 1.5 feet BGS (shallow), 2 to 3 feet BGS (intermediate), and 4 to 5 feet BGS (deep). Monitoring points VO-8, VO-9, and VO-10 are constructed as nested observation points with two separate open intervals of 0 to 1.5 feet BGS (shallow) and 2.5 to 3.5 feet BGS (deep). A depiction of the sub-slab and vadose zone monitoring points in relation to the subsurface extraction/ventilation piping features is presented on Figure 3.

4.2 INDOOR AIR MONITORING POINTS

As requested by DEQ, the three indoor air sampling locations utilized in December 2016 will continue to be used as the indoor air sampling points. These locations are described as follows (see Figure 1):

- IA-1: Near VP-2, in proximity to the former source location area
- IA-2: Near the northwest corner of the building, proximate to the former VP-6 sub-slab sampling location
- IA-3: In the office area located in the southern portion of the project site building (IA-3)

5.0 MONITORING SCOPE AND METHODS

Routine monitoring of sub-slab vacuum conditions and indoor air chemical analytical sampling are proposed to verify that conditions remain protective during future SSD system operation. The following sections present detailed methods to be employed for the various monitoring activities proposed for this purpose.

5.1 ACTIVE SSD SYSTEM AND SUB-SLAB MONITORING

Baseline monitoring will include the following activities at the fan locations and each of the sub-slab monitoring points:

- Complete a visual inspection of the vent risers, in-line fans, and monitoring point components for overall condition.
- Document atmospheric barometric and weather conditions during the monitoring period.
- Record (active fan) system operating vacuums, VOC vapor readings, temperatures, and flow rates at the upstream side of each in-line fan (for each individual ventilation pipe serviced by the fans). These measurements will be obtained using a differential micro-manometer pressure meter, a PID, a field temperature meter, and a hot-wire anemometer, respectively.
- At each monitoring point, record sub-slab and vadose zone differential pressures and VOC vapor readings using a differential micro-manometer pressure meter and a PID, respectively.
- Evaluate the SSD system performance, and review the observed levels of induced vacuum throughout the warehouse areas relative to the target vacuum level of -0.02 iow.

5.2 INDOOR AIR MONITORING

Indoor air monitoring will be completed at each of the three aforementioned indoor air monitoring points (IA-1, IA-2, and IA-3) and will include the following activities:

- Document atmospheric barometric and weather conditions during the sampling period. In addition, document the general nature of building ventilation over the sampling period.
- Deploy indoor air sampling equipment at the designated locations. Prior to sampling, perform shut-in tests to assess sampling system integrity and tightness.
- Collect each indoor air sample over the course of five days (approximately 120 hours) to include a weekend period. Sampling equipment will include a 6-liter summa canister equipped with a five-day flow controller. At the end of the sampling interval, record residual canister vacuum.
- Submit each indoor air sample to an accredited analytical laboratory for analysis of TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride by EPA Method TO-15.

6.0 MONITORING SCHEDULE

6.1 BASELINE MONITORING

We intend to utilize the December 2016 sampling data (indoor air samples and sub-slab vacuum levels using the original array of four SSD fans) as a baseline condition for this proposed monitoring program. The rationale for this follows:

- The indoor air samples collected in December 2016 represent a site condition preceded by approximately three years of passive venting of the subsurface ventilation pipes. Therefore, this sampling event characterizes the site condition prior to activation of the SSD system as summarized in this Plan.
- The initial measurements of sub-slab and vadose zone vacuum levels collected in December 2016 reflect initial operation of the original four in-line fans described in Section 3.1. The original operational condition will provide a baseline to assess the increased effectiveness of the augmented SSD system, in attaining the overall goal of establishing an induced vacuum level of -0.02 iow throughout the array of monitoring points.

6.2 PERFORMANCE MONITORING

As requested by DEQ, performance monitoring (to include the scope of activity described in Sections 5.1 and 5.2) will occur quarterly for one year following SSD system augmentation.

Tentatively, the SSD system augmentation is scheduled for early April 2017. Subsequent monitoring events would, therefore, occur tentatively as follows:

- April 2017
- July 2017
- October 2017
- January 2018

7.0 CONTINGENCY PLAN

Based on current conditions and the anticipated effectiveness of the proposed active SSD system, the presence of TCE and related breakdown products in sub-slab vapor and indoor air at concentrations exceeding DEQ RBCs is considered unlikely in the future. The purpose of implementing this Plan is to provide verification and continued assessment of conditions over time, verify that conditions remain protective, and support potential contingency responses as detailed in this section.

7.1 ACTIVE SSD SYSTEM

The induced levels of sub-slab vacuum pressure generated by the active SSD system will be compared to the target value of -0.02 iow throughout the monitoring point network. If the target level of induced vacuum cannot be achieved by the augmented SSD system described herein, the Respondent, Owner, and DEQ will be notified. As indicated by the prior (baseline) results of indoor air sampling, induced sub-slab vacuum levels less than the target -0.02 iow would not necessarily correlate to indoor air risks and would, therefore, not constitute an urgent condition. However, if this condition is encountered, appropriate parties will be notified and measures will be taken to (1) modify the active SSD system to achieve the induced vacuum goal (i.e., install higher capacity in-line fans) and/or (2) modify the monitoring program. Any future modifications to the monitoring scope and schedule will be documented through an addendum to this Plan.

If indoor air sampling indicates the presence of TCE or associated breakdown products at concentrations exceeding DEQ RBCs, the Respondent, Owner, and DEQ will be notified. An evaluation of sub-slab conditions will be made, and sub-slab vapor sampling will commence immediately. In addition, an evaluation of short-term exposures, background conditions, and/or potential separate sources may be made. Such actions would be subject to discussion and planning through correspondence with the Respondent, Owner, DEQ, and GeoDesign.

8.0 REPORTING AND COMMUNICATION

8.1 PERFORMANCE MONITORING REPORTS

Each performance monitoring event will be described in a brief technical memorandum submitted to DEQ. Each technical memorandum will include the following:

- A brief summary of the work performed, methods employed during the monitoring event, and a discussion of the results relative to operational benchmarks and DEQ RBCs.
- A site plan depicting the location of relevant features associated with the monitoring event.
- A tabulated summary of induced vacuum levels measured in the sub-slab and vadose zone monitoring points.
- A summary of indoor air sample chemical analytical data collected during the monitoring events and appended laboratory reports. The reports will also include a data quality review and associated QA/QC elements of the analytical program.
- Conclusions and recommendations within the context of the monitoring program

8.2 REQUEST FOR CONDITIONAL SITE CLOSURE

If the results of performance monitoring described in this Plan exhibit acceptable sub-slab vacuum levels and TCE concentrations in indoor air below applicable RBC values over the course of four consecutive quarters, the Respondent will request regulatory closure of the project site through continuous operation of the active SSD system as an engineering control. A formal written request will be made to DEQ for the conditional closure.

♦ ♦ ♦

If you have any questions regarding the information contained in this Plan, please do not hesitate to call.

Sincerely,

GeoDesign, Inc.

Erik A. Hedberg, P.E.
Senior Project Engineer

Jason O'Donnell, R.G.
Principal Geologist

cc: Tom Mulflur, Mt. Hood Solutions (via email only)
Carson Bowler, Schwabe, Williamson & Wyatt (via email only)
Lynn Green, Evren Northwest, Inc. (via email only)

EAH:JSO:kt
Attachments
One copy submitted (via email only)
Document ID: MtHoodChem-4-002-040417-envl-CMP.docx

REFERENCES

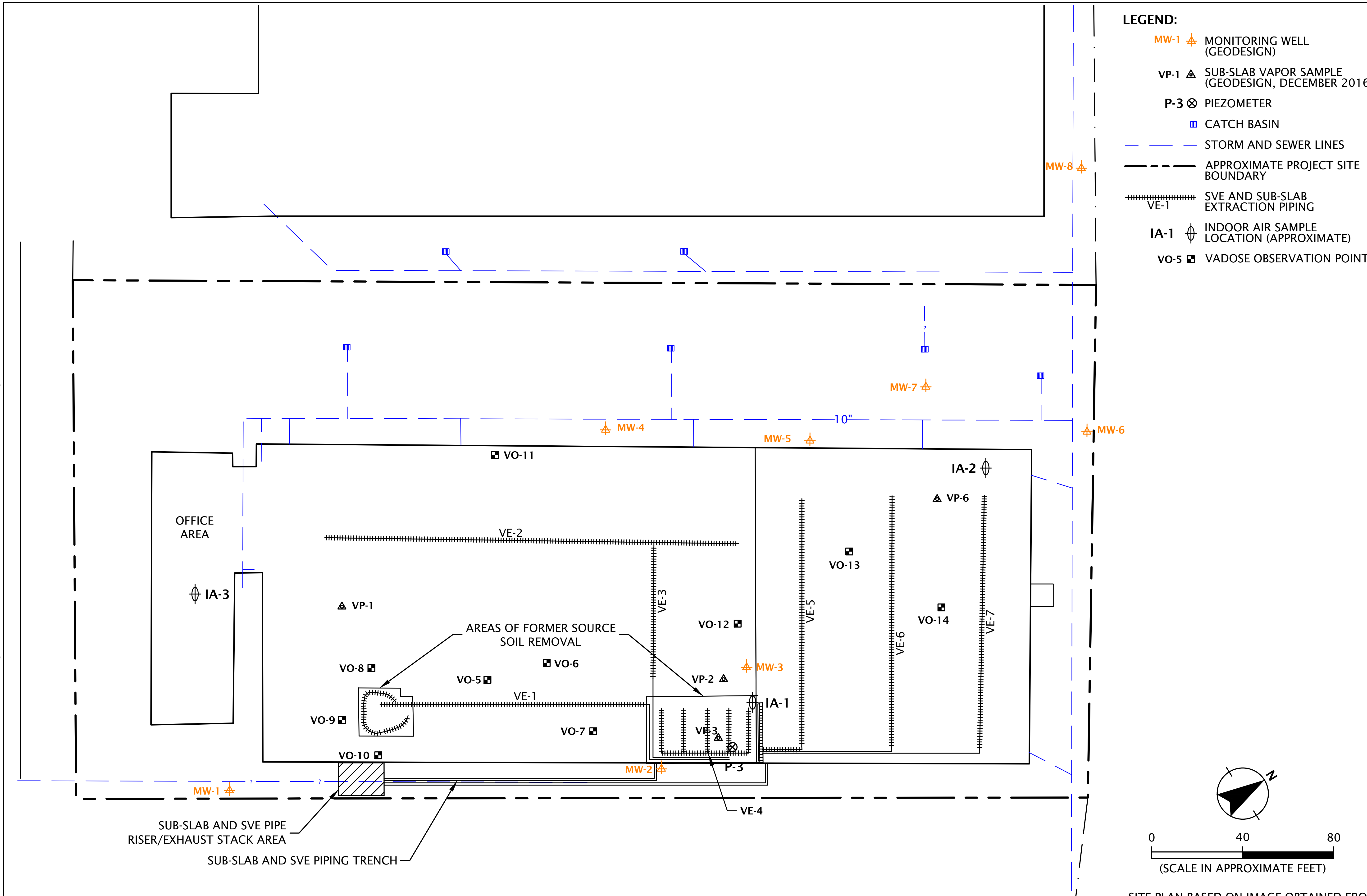
DEQ, 2016. *Re: DEQ Request for Additional Monitoring, Mt. Hood Chemical, ECSI #81,* dated October 4, 2016.

EPA, 2008. Engineering Issue: Indoor Air Vapor Intrusion Mitigation Approaches; Office of Research and Development, National Risk Management Research Laboratory, EPA.600/R-08-115, 49 p. October.

GeoDesign, Inc., 2016. *Revised Work Plan; Sub-Slab Vapor, Indoor Air, and Groundwater Sampling; Former Mt. Hood Solutions Warehouse Site; 4444 NW Yeon Avenue; Portland, Oregon; ECSI File: 081,* dated November 15, 2016

GeoDesign, Inc., 2017. *Memorandum Re: Progress Report, Former Mt. Hood Solutions Warehouse Site, ECSI File #081,* dated January 31, 2017

FIGURES



SITE PLAN BASED ON IMAGE OBTAINED FROM EVREN NORTHWEST INC., SITE PLAN DATED MARCH 28, 2007

FIGURE 1

SITE PLAN

FORMER MT. HOOD SOLUTIONS WAREHOUSE SITE
PORTLAND, OR

MTHOODCHEM-4-002

APRIL 2017

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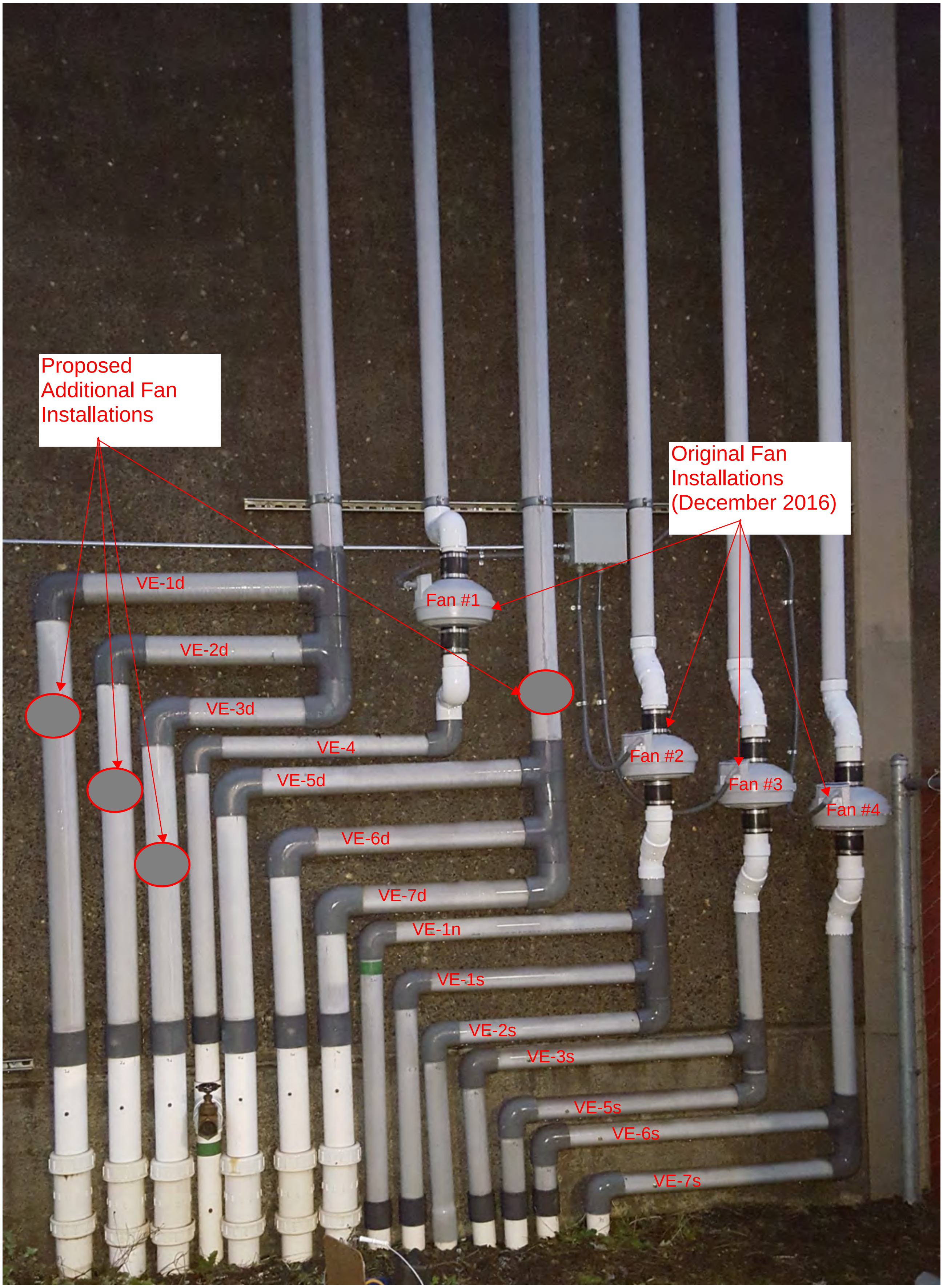
Printed By: mmiller | Print Date: 4/4/2017 7:45:00 AM
File Name: J:\M-R\MtHoodChem\MtHoodChem-4\MtHoodChem-4-002\Figures\CAD\CLOSURE MONITORING PLAN\MtHoodChem-4-002-SP01.dwg | Layout: FIGURE 1



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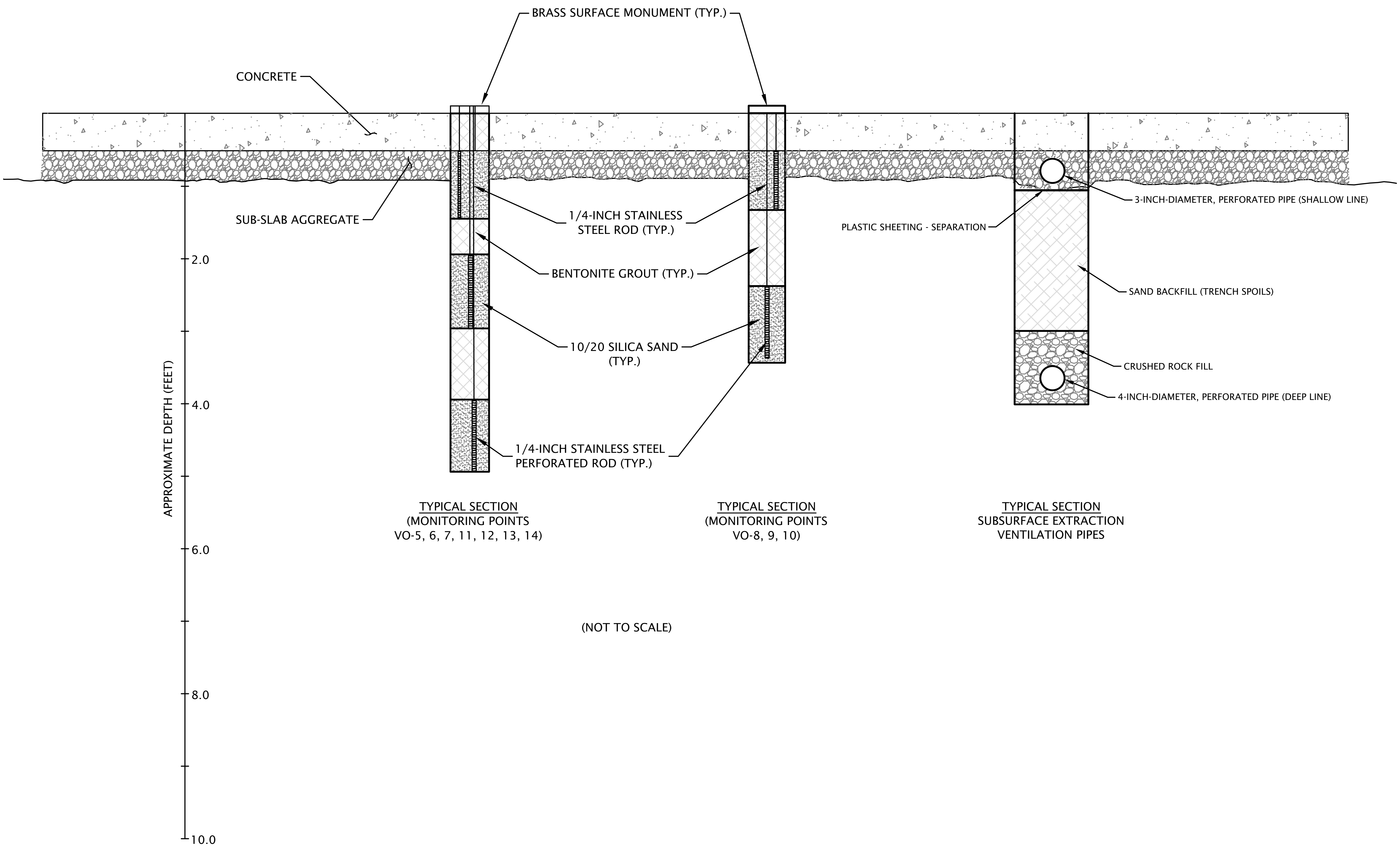
MTHOODCHEM-4-002	SSD FAN SCHEMATIC		
APRIL 2017	FORMER MT. HOOD SOLUTIONS WAREHOUSE SITE PORTLAND, OR		FIGURE 2



MONITORING POINT AND PIPING TRENCH DETAILS

FORMER MT. HOOD SOLUTIONS WAREHOUSE SITE
PORTLAND, OR

FIGURE 3

MTHOODCHEM-4-002

APRIL 2017

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ACRONYMS AND ABBREVIATIONS

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DCE	dichloroethene
DEQ	Oregon Department of Environmental Quality
ECSI	Environmental Cleanup Site Information
EPA	U.S. Environmental Protection Agency
HRC	Hydrogen Release Compound
iow	inches of water
OWRD	Oregon Water Resources Department
PID	photoionization detector
QA/QC	quality assurance/quality control
RBC	risk-based concentration
SSD	sub-slab depressurization
SVE	soil vapor extraction
TCE	trichloroethylene
$\mu g/m^3$	micrograms per cubic meter
VOC	volatile organic compound